Yakima Fisheries Project

Revised Draft Environmental Impact Statement

DOE/EIS-0169
May 1995

In cooperation with:
Washington Department of Fish & Wildlife and Yakama Indian Nation

BONNEVILLE
POWER ADMINISTRATION

YAKIMA FISHERIES PROJECT
REVISED DRAFT ENVIRONMENTAL IMPACT STATEMENT
(DOE/EIS-0169)

Responsible Agency: U.S. Department of Energy, Bonneville Power Administration (BPA).

Title of Proposed Action: Yakima Fisheries Project

Cooperating Agencies: Washington Department of Fish and Wildlife, Yakama Indian Nation

States Involved: Washington

Abstract: BPA proposes to fund several fishery-related activities in the Yakima River Basin. These activities, known as the Yakima Fisheries Project (YFP), would be jointly managed by the State of Washington and the Yakama Indian Nation. The YFP is included in the Northwest Power Planning Council's (Council's) fish and wildlife program. The Council selected the Yakima River system for attention because fisheries resources are severely reduced from historical levels and because there is a significant potential for enhancement of these resources.

BPA's proposed action is to fund (1) information gathering on the implementation of supplementation techniques and on feasibility of reintroducing coho salmon in an environment where native populations have become extinct; (2) research activities based on continuous assessment, feedback and improvement of research design and activities ("adaptive management"); and (3) the construction, operation, and maintenance of facilities for supplementing populations of upper Yakima spring chinook salmon. Supplementation is a strategy for rebuilding fish spawning runs by releasing artificially propagated fish into natural streams to increase natural production.

The project has been considerably revised from the original proposal described in the first draft EIS. Examined in addition to No Action (which would leave present anadromous fisheries resources unchanged in the Basin) are two alternatives for action: (1) supplementation of depressed natural populations of upper Yakima spring chinook and (2) that same supplementation plus a study to determine the feasibility of re-establishing (via stock imported from another basin) naturally spawning population and a significant fall fishery for coho in the Yakima Basin. Alternative 2 has been identified as the preferred action. A central hatchery would be built for either alternative, as well as three sites with six raceways each for acclimation and release of spring chinook smolts.

Major issues examined in the Revised Draft EIS include potential impacts of the project on genetic and ecological resources of existing fish populations, on water quality and quantity, on threatened and endangered species listed under the Endangered Species Act, and on the recreational fishery. Only minor differences in environmental consequences were found between Alternatives 1 and 2. Potentially high impacts on wild, native, and non-target fish populations under both alternatives would be mitigated through careful adherence to the adaptive management process outlined in the EIS.

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DISCLAIMER

YAKIMA FISHERIES PROJECT
ENVIRONMENTAL IMPACT STATEMENT

TABLE OF CONTENTS

Page

Page

Page

Page

Page

List of Tables

Page

List of Figures

APPENDICES

1. PURPOSE OF AND NEED FOR ACTION

1.1 Proposed Action

The Bonneville Power Administration (BPA) proposes to fund the Yakima Fisheries Project (YFP) to undertake fishery research and enhancement activities in the Yakima River Basin. The State of Washington and the Yakama Indian Nation (YIN) would jointly direct the project.

In cooperation with BPA, the project managers propose to construct, operate and maintain anadromous[1] fish production facilities in order to conduct research activities designed to increase knowledge of supplementation techniques. These techniques would be applied to rebuild naturally spawning anadromous fish stocks historically present in the Yakima River Basin and, ultimately, to rebuild those throughout the Columbia River Basin.

The protection, mitigation, and enhancement of fish and wildlife resources of the Columbia River and its tributaries is one of the goals of the Pacific Northwest Electric Power Planning and Conservation Act of 1980 (Northwest Power Act). That Act requires that the Northwest Power Planning Council (Council) develop both a **program** to protect and rebuild Columbia Basin fish and wildlife resources (the Columbia River Basin Fish and Wildlife Program; NPPC, 1994) and a 20-year **plan** for meeting the region's electrical energy needs (the Northwest Conservation and Electric Power Plan). The Act also requires that BPA fund protection, mitigation, and enhancement activities consistent with the Council's Fish and Wildlife Program, the Power Plan, and other purposes of the Northwest Power Act. The Yakima-Klickitat Fisheries Project (YKFP) is one of the projects included in the Fish and Wildlife Program; the YFP is the first phase of the YKFP.

Although the YFP may eventually involve the supplementation of all stocks of anadromous fish known to have occurred in the Yakima Basin, at this time only two alternatives have been proposed:

- **Alternative 1** would supplement depressed naturally spawning populations of upper Yakima spring chinook;
- **Alternative 2** would include all actions under Alternative 1; in addition, it would add a study to determine the feasibility of re-establishing a naturally spawning population and a significant fall fishery for coho in the Yakima Basin.

Coho are now virtually eliminated from the basin. Under Alternative 2, a feasibility study would be conducted using smolts currently being imported from another basin under the

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1 Words underscored at their first appearance in the text are defined in the **Glossary**.

Columbia River Fish Management Plan (CRFMP).[2] **The Policy Group for the Yakima Fisheries Project has identified Alternative 2 as the preferred alternative.** (See Section 1.5 for background on defining the scope of the project.)

1.2 Need and Purposes

The project responds directly to a **need for knowledge of viable means to rebuild and support naturally spawning anadromous fish stocks.** In proposing the YFP, BPA and the project managers seek knowledge about how resource managers can use the strategy of supplementation in their efforts to protect, mitigate, and enhance stocks of anadromous fish in the Yakima River Basin. As described below, traditional methods may be less viable than originally thought.

Conventional fish hatcheries traditionally have produced large numbers of artificially propagated fish to increase harvest opportunities and, in some cases, to bolster natural production. However, important questions regarding hatchery production have arisen in three areas:

- the survival of hatchery fish after release from the hatchery,
- the impacts of hatchery fish as they compete with wild populations, and
- the effects of hatchery propagation on the long-term genetic fitness of fish stocks.

The YFP is being designed (1) to provide resource managers with knowledge regarding these issues and (2) to identify and apply improved methods for carrying out hatchery production and supplementation of natural production.

Supplementation aims to rebuild natural anadromous fish spawning runs by raising and releasing artificially propagated fish into natural streams and by enhancing natural production of both naturally and artificially produced fish. Its goal (as distinct from conventional hatchery practices; see Table 1.1) is to increase the numbers of naturally spawning fish, while maintaining the long-term genetic fitness of the fish population being supplemented and keeping adverse genetic and ecological interactions with non-target species or stocks within acceptable limits. Its ultimate goal is to produce enough naturally spawning fish with a high enough survival rate to be able to phase out artificial propagation.

2 Coho are currently being acclimated and released below Wapato Dam as part of the *U.S. v. Oregon* Columbia River Fish Management Plan; see Section 1.4. This coho program is intended to provide harvest opportunities for the Yakama Indian Nation and other fishers.

Table 1.1 A Comparison of Current Hatchery Programs and Proposed Supplementation Facilities

	SUPPLEMENTATION	CONVENTIONAL HATCHERY
GOALS	• Increase natural runs while preserving genetic diversity of fish stocks • Gather information on supplementation techniques • Develop and carry out research activities	• Increase fish numbers • Mitigate fish losses • Increase harvest opportunities
BROODSTOCK	• Use only naturally spawning fish trapped near spawning areas	• Use adult fish returning to hatchery
EARLY REARING	• Structure more closely resembles natural environment	• Standard ponds consisting of a constant or fixed environment
FEED	• Use of some standard feed plus live feed to encourage natural feeding instincts	• Use of standard hatchery feed and methods
RACEWAYS	• More raceways with fewer fish (continual monitoring)	• Established numbers and density of fish in each
REARING PONDS	• Few, to support acclimation	• Common, as needed for production
FISH RELEASE	• Acclimate in ponds and allowed to leave on their own	• Dropped directly into streams
ADULT FISH	• Return to natural spawning areas	• Return to hatchery via fish ladder

Supplementation is supported by numerous knowledgeable interests and by results to-date:

- Fishery agencies and Tribes throughout the Pacific Northwest consider supplementation a potentially important viable alternative to conventional hatchery methods for rebuilding salmonid runs.
- The Regional Assessment of Supplementation Project (RASP, 1992) states that over 50 percent of the increases in salmon and steelhead run sizes projected for the Columbia River Basin might be achievable through supplementation.
- The Council recognizes the value of scientifically supported supplementation programs for the rehabilitation of weak wild and naturally spawning populations (NPPC, 1994).
- The National Marine Fisheries Service, in its Proposed Recovery Plan for Snake River Salmon (NMFS, 1995), proposes development of management programs involving artificial propagation and supplementation to support recovery of listed Snake River salmon. These programs would include specific numerical goals and strategies for genetic management, disease management, monitoring and evaluation, reintroduction and supplementation, and facilities management.

Despite this support, no adequately detailed understanding of optimal techniques exists for all situations where supplementation may be applied. Furthermore, none of the existing supplementation projects in the Columbia River Basin have adequate facilities for testing the various rearing strategies being proposed for the YFP. (See Section 2.5.) **The uncertainties about the technique, as well as the importance of supplementation to existing and potential future enhancement plans, make it imperative that supplementation be thoroughly evaluated using a systematic, experimental program. The YFP would be designed to meet both the need for rigorous research and that for responsiveness to changes as the project proceeds.**

A significant feature of the YFP is the effort to maintain the long-term genetic fitness of the salmonid populations. Some of the strategies that project managers would employ would be aimed at minimizing the potential for adverse genetic impacts. These would include, but not be limited to, the following:

- identifying and separately culturing distinct stocks of fish and returning them to their ancestral drainages;
- assuring that returning first-generation supplementation fish are not used for broodstock;
- adopting broodstock collection and natural escapement protocols to assure that both components are representative of the population and contain adequate numbers to assure conservation of stock characteristics and long-term fitness;
- assuring that at least 50% of naturally spawned adults are allowed to spawn naturally and by managing the proportion of hatchery-spawned and naturally spawned adults allowed to spawn naturally;
- conserving the genetic diversity of the hatchery fish by using carefully planned and monitored mating strategies, and;
- creating rearing conditions that more closely resemble natural conditions.

The project would include an extensive monitoring and evaluation program to measure Yakima River Basin salmonid responses to supplementation activities. Project managers and researchers would follow an **adaptive management policy** (see Section 2.2), which would allow goals and strategies to evolve as new information becomes available. At the same time, the YFP would proceed with the Council's long-term goal of enhancing the anadromous fishery in the Yakima River Basin to increase the abundance of naturally reproducing salmonid stocks to increase harvest opportunities for Yakama tribal members and other fishers.

These objectives shape the purposes of the YFP, as they are listed below:

1) To test the assumption that new supplementation techniques can be used in the Yakima River Basin to increase natural production and to improve harvest opportunities, while maintaining the long-term genetic fitness of the wild and native salmonid populations and keeping adverse ecological interactions within acceptable limits;

2) To provide knowledge about the use of supplementation, so that it may be used to enhance anadromous fisheries throughout the Columbia River Basin;

3) To implement and be consistent with the Council's Fish and Wildlife Program; and

4) To implement the project in a prudent and environmentally sound manner.

1.3 Background

The enhancement of Yakima River Basin fisheries resources is an important feature of the Columbia Basin Fish and Wildlife Program. The Council selected the Yakima River system for supplementation for two reasons:

- fisheries resources are severely reduced from historic levels, and
- there is a significant potential for enhancement of these resources.

Historically, numbers of anadromous fish in the Yakima River were estimated to have ranged from 600,000 to as many as 960,000 (BPA, 1990b). Current salmonid runs in the Yakima River have been reduced to fewer than 7,000 adults (about 1 percent of the historical run size). Declines in anadromous fish runs in the Yakima River have been attributed to activities related to irrigation, mining, harvest, forestry, and hydroelectric power generation. A comparison of historical and present returns to the basin is shown in Table 1.2.

Table 1.2. Estimates of Historical Anadromous Fish Runs in the Yakima River as Compared to Recent Run Size (5-year average, 1989-1994). (Fast, per. comm., 1994)

Species/Race	Pre-1900 Run	Recent Average
Fall Chinook	132,000	1,200
Spring Chinook	200,000	3,800
Summer Chinook	68,000	0
Coho	110,000	240
Summer Steelhead	80,500	1,100
Sockeye	200,000	0

Similar declines in anadromous fish runs have occurred throughout the Columbia River Basin. The Council considers the Yakima River system a promising location for mitigation and enhancement to compensate for losses from development and operation of hydroelectric projects elsewhere in the Columbia Basin. The YFP would help determine the role that supplementation might play in increasing natural production of anadromous salmonids throughout the Columbia Basin.

In 1982, the Council first encouraged BPA to "fund the design, construction, operation, and maintenance of a hatchery to enhance the fishery for the Yakima[3] Indian Nation as well as all other harvesters." (NPPC, 1982). In 1984, the Council provided further direction by recommending development of a master plan for the YKFP. Supplementation research was added to its stated fish production objectives. The proposed YKFP master plan, reviewed by the Council in 1987, provided the conceptual framework for the project, including types of fish and numbers to be produced, facility descriptions, management structure, schedule, and steps for evaluating the success of planned activities (Fish Management Consultants, 1987).

Following Council review, preliminary design work studies were begun to collect additional information needed for project planning. In 1990, the Preliminary Design Report (BPA, 1990b) was completed. Study results indicated that production facilities could be built in the Yakima River Basin to supplement natural production, provide harvest benefits, and gain knowledge about supplementation techniques of benefit to the entire region (BPA, 1990b).

1.4 Relationship to Other Yakima River Basin Fishery Enhancement Efforts

The YFP is part of a more comprehensive effort by the U.S. Bureau of Reclamation (USBR), U.S. Forest Service (USFS), BPA, the YIN, and the State of Washington to enhance fishery and water resources in the Yakima River Basin. The YFP would test the assumption that supplementation could be used to increase natural production of anadromous fish in the Yakima River Basin and improve harvest opportunities while maintaining long-term genetic fitness of anadromous fish. The benefits of supplementation include increased natural production (greater abundance) and increased productivity (more surviving offspring per spawner). These benefits may become self-sustaining after a period of supplementation.

However, supplementation would not eliminate the need to pursue other conservation and enhancement measures planned for the Yakima River Basin. Sustained supplementation may eventually become unnecessary, but only if substantial improvements in habitat and in-river migration conditions were to reduce significantly the mortality of all salmonid stocks. While these improvements are not proposed as part of the project addressed in

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3 Previously accepted spelling for the Yakama Indian Nation.

this EIS, there are other ongoing projects, described below, and additional improvements may be proposed in the future.

Earlier fishery and habitat enhancement efforts in the Yakima River Basin include Congressional legislation to authorize passage improvements (fish screening and adult ladders) at numerous irrigation facilities. The USBR and BPA have prepared Environmental Assessments (EAs) for these facilities (BPA, 1991) and have completed construction for the first phase of these facilities. Phase II fish screening activities are ongoing at this time. Other efforts, which include measures to enhance Yakima River Basin water resources, also are expected to benefit anadromous fish production. In October 1994, Congress passed legislation (the Yakima River Basin Water and Conservation Act, Public Law 103-434) to authorize water conservation activities, including improvements to irrigation water delivery systems and a basin-wide water conservation program. The USFS, as well as State and private entities, have also conducted habitat improvement activities in the Basin.

Some fishery enhancement activities are currently taking place in the Yakima River Basin under the auspices of the CRFMP. This fish conservation and management plan describes production and harvest management actions that have been agreed to by all the parties to the *United States v Oregon* treaty fishing rights case. The parties to the original lawsuit and the CRFMP are the states of Oregon, Washington, and Idaho; the United States through representation by the National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS); the four Columbia River Treaty Tribes (YIN, Confederated Tribes of the Warm Springs Indian Reservation, Umatilla, and Nez Perce tribes); and, to a limited extent, the Colville and Shoshone-Bannock tribes. Commercial, recreational, and traditional tribal fisheries in the mainstem Columbia River are managed under CRFMP provisions. The fish production and harvest provisions of CRFMP are intended to assist in the rebuilding of upper Columbia River chinook, sockeye, coho, and steelhead runs, while assuring an equitable sharing of harvestable fish between treaty and non-treaty fisheries.

Current CRFMP-sponsored activities in the Yakima River basin include programs for both fall chinook and coho salmon. The fall chinook program includes the production and release into the Yakima of 1.7 million smolts from the Little White Salmon National Hatchery. Between 1983 and 1994 the smolts were transported and released directly into the Yakima River. The YIN, with funds provided under the Mitchell Act program, has developed acclimation facilities in the vicinity of Prosser Dam for final rearing and release of these fall chinook smolts.

Since 1987, the CRFMP-mandated coho program has provided 700,000 early-run coho yearly for release from the Oregon Department of Fish and Wildlife's (ODFW) Cascade Hatchery (near Bonneville Dam) to the Yakima River. This program is part of a larger effort to redistribute coho for release in upper Columbia tributaries rather than in the lower Columbia. In 1994, these coho were also acclimated in ponds near Wapato Dam as part of the YIN program to improve their post-release survival.

1.5 Relationship to Other Documents, Including the Draft EIS

In conjunction with the Preliminary Design Report on the YFP, an EA was prepared on the siting and construction of central, satellite and trapping facilities for supplementing anadromous fish populations in the Yakima and Klickitat River Basins (BPA, 1990a). The EA found that no significant environmental impacts would result from this portion of the proposed action, and the U.S. Department of Energy (USDOE) issued a **Finding of No Significant Impact (FONSI)** in April 1990.

However, BPA identified the need for additional environmental documentation to cover other aspects of the project, including operation of the planned production facilities and potential impacts from the siting and construction of acclimation facilities. Because various entities have subsequently expressed concern over management practices planned for the YFP, BPA concluded that an **Environmental Impact Statement** (EIS) was necessary to consider issues relating to project management, genetic impacts, and species interactions.

Accordingly, BPA prepared and then issued a Draft EIS (DEIS) for the YFP in October 1992. The public comment period for the DEIS closed in December 1992. Comments were extensive. Many valid concerns were raised about the project, and several omissions were identified in the analysis. After reviewing these comments, BPA concluded that additional work and a revision in the scope of the project was needed to respond fully.

This Revised Draft EIS (RDEIS) presents, for public review and comment, a description of the revised YFP alternatives and additional information that was not included in the YFP DEIS. The RDEIS follows the same general format and, except where modified, includes the text of the earlier document. (Consequently, a reader of the RDEIS need not refer to the DEIS to integrate the two documents.)

Below are listed the more significant changes to the document.

- Changed descriptions of the alternatives in Chapter 2;
- Expansion of a cumulative impacts analysis for fisheries (see Section 4.1.2.2);
- A revised natural production modeling effort, resulting in a more sophisticated description of species interactions, genetics and harvest impacts, and experimental design and monitoring; and
- Additional discussion on project management and water rights impacts.

The alternatives addressed in this EIS are summarized as follows:

- **Under Alternative 1**, the project managers propose to conduct supplementation activities on upper Yakima spring chinook.
- **Under Alternative 2**, project managers would conduct supplementation activities on upper Yakima spring chinook *and* a study to determine the

feasibility of re-establishing a naturally spawning population and a significant fall fishery for coho in the Yakima River Basin. This is the preferred alternative.

- **Under the No Action Alternative,** no supplementation or study activities would be funded by BPA in the Yakima River Basin under these auspices, and no facilities would be constructed.

The RDEIS addresses in detail those issues relevant to these three alternatives.

Note that if Alternative 1 or 2 were selected, the project managers and BPA would continue to evaluate the possibility of supplementing additional stocks in the Yakima River Basin. Any proposals to initiate supplementation on any of the other stocks considered in the original DEIS would be addressed in subsequent supplementation plans and environmental documents. Development of detailed supplementation plans for additional stocks would rely heavily on the adaptive management process and other project management decision mechanisms described in Section 2.2.

Supplemental environmental analyses might also be required for other future activities, such as changes in the program which may occur as a result of feedback from the adaptive management process. (See Sections 2.2.2 and 2.2.3.) Uncertainties clearly exist as to the impacts of certain supplementation activities planned for the project. In fact, the adaptive management philosophy for the project anticipates resolution of uncertainties unforeseen at the inception. During an annual YFP planning process, a Science/Technical Advisory Committee (STAC) would identify possible unforeseen changes to the currently proposed project activities. Actions that would trigger impacts *not* addressed in the YFP EIS would be deferred pending additional National Environmental Policy Act (NEPA) compliance activities, such as supplemental analyses, supplemental documents, or emergency consultations with the President's Council on Environmental Quality, if necessary.

Several commentors on the DEIS suggested that a comprehensive EIS should be prepared on *all* of the salmonid production and mitigation efforts in the Columbia River Basin. In fact, the USFWS, NMFS, and BPA are currently preparing a programmatic EIS, called the Comprehensive Environmental Analysis of Anadromous Fish Production (CEA) that will address the cumulative effects of the interaction between anadromous fish produced under current fish hatchery programs and naturally spawning salmon and steelhead in the Columbia River Basin. The YFP will be evaluated along with all other existing and proposed artificial propagation and supplementation facilities being addressed in the CEA. The CEA EIS and the YFP EIS are at present on similar schedules, with drafts of both documents anticipated in Spring 1995. The CEA EIS will concentrate on cumulative impacts resulting from the mixing of the wild and hatchery fish stocks in the migration corridor, while the YFP EIS addresses the sub-basin impacts of the YFP. However, the YFP RDEIS also includes a cumulative impact analysis that considers the impacts of this project on the overall Columbia River Basin fishery (see Section 4.1.2.2).

The NMFS *Proposed Recovery Plan for Snake River Salmon* and the recently issued NMFS Biological Opinion on operation of the Federal Columbia River Power System in 1995 and future years are now available. These documents address protection and recovery measures for the Snake River salmon stocks listed under the Endangered Species Act. However, their publication is too recent to determine with any certainty what their effects might be on the YFP. This will be addressed further in the Final EIS.

1.6 Decisions to be Made

Preparation of this document is intended to fulfill the NEPA requirements for BPA. The document also has been prepared for purposes of compliance by the Washington Department of Fish and Wildlife (WDFW) with the Washington State Environmental Policy Act (SEPA). Although neither law applies to YIN activities, the YIN have chosen to participate as a cooperating entity. The requirements of NEPA and SEPA are nearly identical. The WDFW will be the lead agency for SEPA compliance for the project.

Bonneville Power Administration must decide:

- whether to fund the project as described and, if so,
- whether to fund Alternative 1, which calls for supplementation of a single chinook stock, or whether to fund Alternative 2, which calls for supplementation of that single stock and additionally for a feasibility study for reintroduction of coho.

If BPA were to decide *not* to fund the project (the No Action Alternative), the portion of the Council's Program that addresses the YFP would not be fulfilled. If BPA were to choose not to fund the project, it would likely not be implemented by any of the other entities, due to lack of funding.

The factors that will be considered in making these decisions are based on the purposes defined for the project in Section 1.2. They are listed below.

- The ability of the alternative to:
  - evaluate the effectiveness of supplementation techniques for implementation throughout the Columbia River Basin;
  - increase natural production of anadromous fish in the Yakima River Basin while improving harvest opportunities and maintaining the long-term genetic fitness of anadromous fish in the Yakima River Basin;
- The alternative's consistency with the Council's Fish and Wildlife Program;
- The economic factors relative to the alternative; and
- The environmental impacts of the alternative.

1.7 Scoping

A Notice of Intent (NOI) to prepare an EIS for the YFP was issued in January 1991. Scoping meetings were held in February 1991 in Yakima, Goldendale, Richland, Ellensburg, and Bellevue, Washington, and Portland, Oregon. Over 200 people attended these meetings, and 95 comment letters were received from the general public. Public comments were considered and used to determine the scope of the EIS.

The following issues were identified during the scoping process:

- Genetic risks to existing wild fish populations both in and outside the Yakima River Basin (discussed in Sections 4.1.2.1 and 4.1.2.2).
- Potential negative impacts on the resident trout fishery above Roza Dam--competition for food and space, genetic risk, disease transfer, increase in number of salmon and steelhead anglers (Sections 4.1.9.1, 4.1.2.1, and 4.1.2.2).
- EIS Scope--preparation first of a programmatic EIS for entire Columbia River Basin, with tiered, Basin-specific and even sub-Basin-specific project environmental analyses; to include cumulative analysis of all supplementation and hatchery releases throughout the Columbia River Basin (Section 1.5).
- Economic issues--total project costs, benefit-cost analysis, cost-effectiveness analysis in relation to other fishery projects in the Columbia system, and local economic impacts (Section 4.1.8).
- Project decisionmaking--what is the process, what factors will influence the final decision on the project, who will make the decision, why NEPA wasn't done before the project went to the Council (Section 1.6).
- Supplementation--definition of supplementation and how it differs from conventional hatchery programs, review and evaluation of previous supplementation work, how proposed supplementation efforts would differ from or complement existing efforts (Sections 1.2 and 2.6).
- Water rights and claims--concern about effects of project, need for specific assurances that the project would not affect private landowners' rights in any way (Section 4.1.1.1).
- Straying fish--how they could affect endangered or petitioned stocks in other basins, concern that they might stray and ultimately affect water rights (Section 4.1.2.1).
- Other ecological resources--long-term effects on the ecosystem, particularly the aquatic food base, impacts on wildlife and resident fish (Sections 4.1.3, 4.1.5, and 4.1.6).
- Suggested alternatives--No Action, hatchery outplantings for extinct runs and habitat improvement for other runs, additional steelhead production above

Roza Dam, smaller-scale supplementation alternative, non-hatchery alternatives, full production (Chapter 2).

The DEIS for the YFP was released in October 1992. Six public meetings were held throughout the region (Richland, Yakima, Portland (two meetings), Bellevue, and Ellensburg). Written remarks and comments were also accepted through December 28, 1992. BPA received a total of 107 letters and telephone calls from individuals, groups, and agencies during the comment period. In addition, more than 300 people attended the public meetings, with many individuals providing oral comments about the project.

A detailed listing of the comments and responses to them may be found in Appendix A. Issues raised were similar to those raised in earlier project forums. In particular, four issues received the most extensive comment:

- project purpose and need;
- potential impacts on water rights and claims;
- the genetic risks to the existing wild fish populations; and
- potential impacts on the resident trout fishery above Roza Dam.

Other comments received focused on the EIS process, the project alternatives selected for EIS analysis, and the potential impacts on other ecological resources, including threatened and endangered species.

2. ALTERNATIVES

2.1 Introduction

The goal of this YFP is to obtain knowledge about how resource managers can use the strategy of supplementation in their efforts to protect, mitigate, and enhance stocks of anadromous fish in the Yakima River Basin. The YFP would include several artificial production facilities designed to test and apply supplementation techniques. Results of these experiments might apply throughout the Yakima Basin and Columbia River system. The ultimate result would increase the productivity and abundance of natural runs of anadromous salmonids in the Yakima River Basin.

This chapter describes several central features of the project:

- The adaptive management process (Section 2.2) to be used under either of the two alternatives that have been proposed to satisfy the need for the project (see Chapter 1);
- The two action alternatives (Sections 2.3 and 2.4);
- the No Action Alternative (Section 2.5);
- Alternatives eliminated from detailed consideration (Section 2.6); and
- A summary and comparison of the potential environmental consequences of the alternatives (Section 2.7).

Adaptive Management. The proposed adaptive management policy specifies an ongoing, iterative approach to planning for the project. Full detailed plans for supplementing the stocks would be continuously developed and revised, using information gained from the previous year's activities. Section 2.2 below provides details.

The most detailed planning has been completed for the upper Yakima spring chinook and coho stocks, the focus of the two alternatives mentioned below. Those stocks for which detailed supplementation planning has *not* been completed (e.g., summer steelhead, fall chinook) are not addressed in this RDEIS. If the project managers and BPA should decide in the future to propose to undertake supplementation for any of those stocks, such plans would be addressed in additional environmental documents.

Alternatives. The DEIS's several project alternatives were distinguished from each other primarily by the number of stocks proposed for supplementation. In some alternatives, the number of smolts to be stocked also varied. The alternatives ranged from supplementation of seven stocks to supplementation of three stocks only. However, after considering public comments on the DEIS, BPA and the project managers concluded that these multi-stock options are no longer appropriate at this time (see Section 2.6.2). Consequently, Alternative 1 discussed below focuses on supplementation of a single stock (upper

Yakima spring chinook). Alternative 2 also focuses on supplementation of that stock, but adds a feasibility study for the reintroduction of coho. The No Action alternative is addressed in Section 2.5.

2.2 Adaptive Management

The project managers would use an **adaptive management policy** in order to achieve project goals and protect the basin's fishery resources from unforeseen, adverse project impacts. Adaptive management emphasizes experimental intervention into an ecosystem to provide insights into how it works and changes. The effects of management actions are monitored and evaluated, and programs, procedures, and facilities may all be modified in response to these findings.

Using adaptive management, the scientific method is incorporated into project planning and decision-making. It is particularly appropriate when attempting to enhance otherwise declining natural resources in a complicated, large-scale ecosystem where complexities of the system are not fully understood. Such uncertainty may make scientists hesitant to act and experiment. **Adaptive management is the conscious decision in favor of *action* designed to increase understanding as opposed to *inaction* in the face of uncertainty.**

There are risks inherent in such action. Such risk is best managed by collecting baseline data, monitoring and evaluating, and being prepared to respond to new information, *even if it means drastic changes to a program.* The success of the proposed YFP monitoring program would depend on the ability of project personnel to obtain valid information about how the project is working, using available theory and technology. Likewise, the success of the proposed evaluation program depends on the commitment of project managers to institute a management and decision-making process that can respond effectively to new information calling for change. **This process must be able to overcome resistance to change and the apparent security afforded by stability.**

Under adaptive management, project managers propose actions in response to a set of agreed-upon objectives. These actions are designed as experiments to test hypotheses regarding their outcome: to see whether the predicted result occurs or whether some other result occurs. The experiment must be carefully designed to obtain valid (i.e., statistically reliable) results in a specified period of time. The experiment is conducted, and the results carefully monitored to allow statistical evaluation of the results.

Implementing an adaptive management policy requires the following:

- a project management plan;
- a commitment to defining and expressing policy;
- a management framework for carrying out the plan.

These elements are described below to demonstrate how the YIN and the WDFW will use an adaptive management design to implement the YFP.

2.2.1 Project Management Plan

The proposed YFP Project Management Plan uses Walters' (1986) adaptive management cycle: it involves adaptive learning through management experiments rather than conservative natural resource management or basic research. The design of the experimental program for upper Yakima spring chinook involved the following basic actions (Figure 2.1):

1. identify objectives;
2. identify strategies to achieve the objectives;
3. identify operating assumptions needed to accept the strategies;
4. identify uncertainties associated with these assumptions;
5. identify the risk of not meeting the stated objectives if the assumptions are incorrect or the strategy is not feasible; and
6. develop a monitoring plan and process for continual review of results and adaptation to manage the uncertainty and risk associated with supplementation.

The Project Management Plan uses experiments designed to resolve uncertainties as it accomplishes YFP goals and objectives. The risk analysis and monitoring steps include feedback loops, which may cause the objectives to be modified, which in turn would restart the process.

2.2.1.1 Planning Status Report

The YFP planning cycle is shown in Figure 2.2. Each year, the YFP STAC prepares a *Planning Status Report* (completed in 1992, 1993, 1994, and 1995) documenting the objectives, strategies and operational assumptions for the YFP (developed through the actions above) consistent with the state of knowledge and information available and analyzed before the first of each year. A Planning Status Report is completed early in each year and includes ongoing and new proposals to implement the objectives and strategies for supplementation in the upcoming year.

Under adaptive management, BPA and the cooperating agencies would examine the Planning Status Report to determine whether new or revised strategy options contained in it are included in the scope of this RDEIS. If not, BPA and the cooperating agencies would identify potential environmental impacts resulting from newly proposed project activities and would determine whether additional NEPA and/or SEPA work would be necessary to address these impacts. This RDEIS is based on the 1995 Planning Status Report (presently in revision; revised upper Yakima spring chinook chapter is attached as Appendix B to this EIS, and coho chapter will be included in Final EIS).

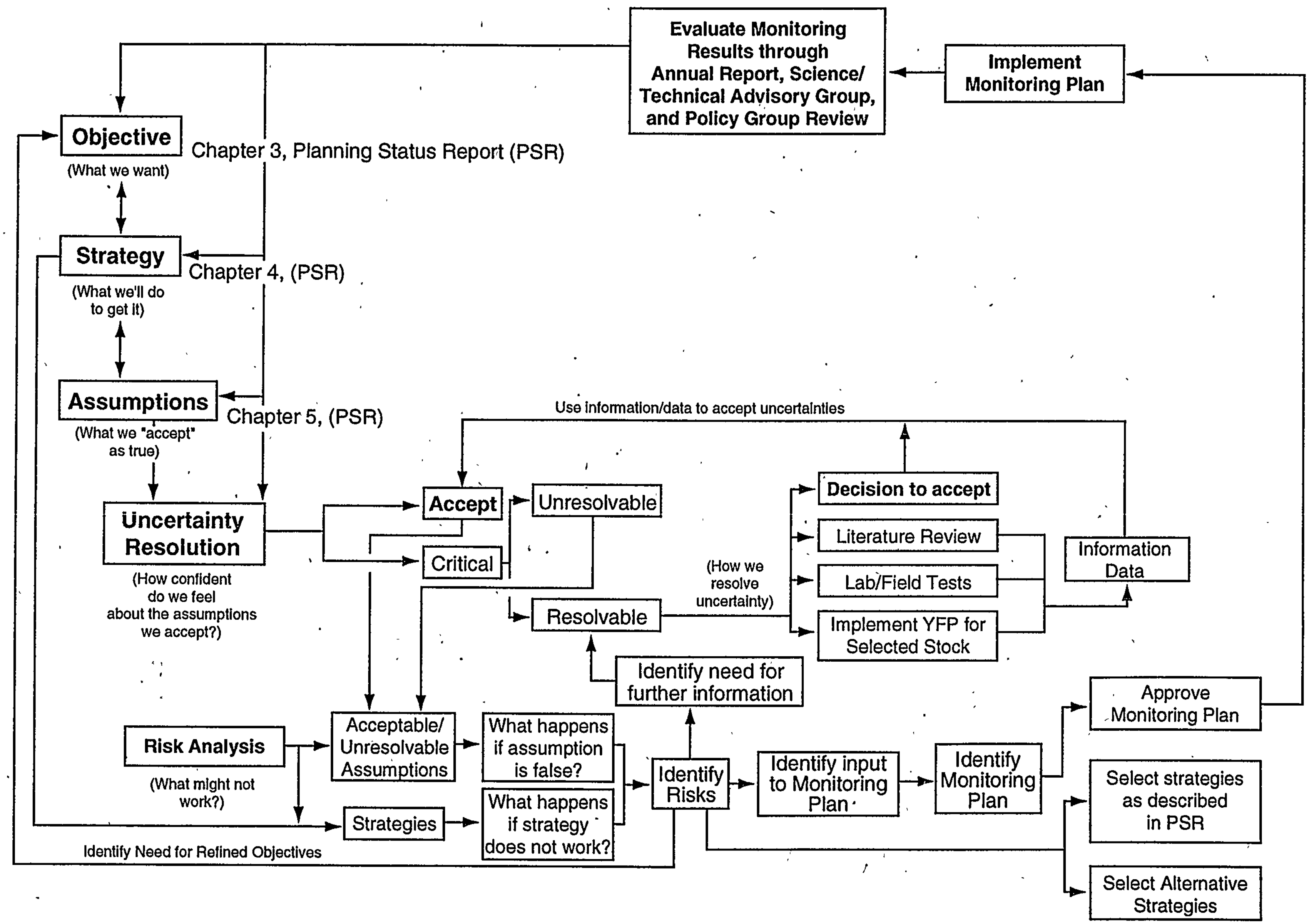


Figure 2.1 Adaptive Management Process for the Yakima Fisheries Project

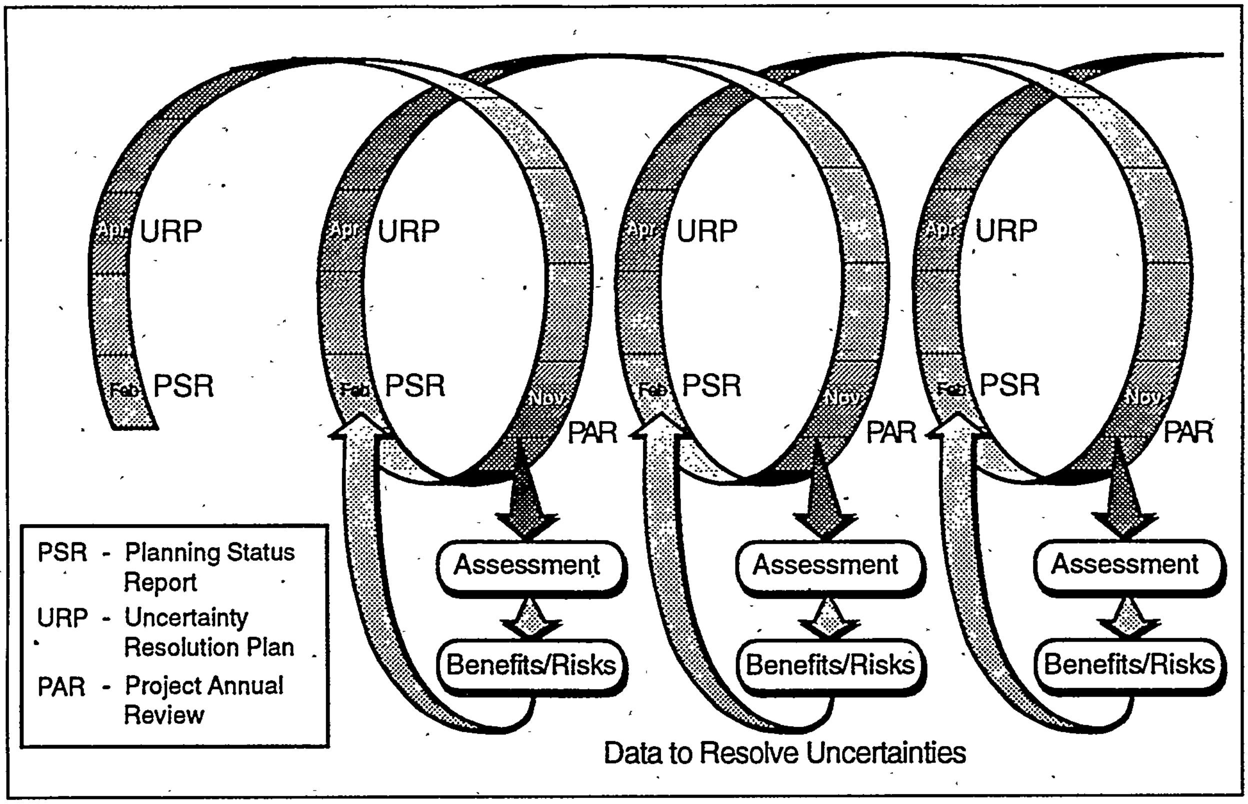


Figure 2.2 Planning Cycle for the Yakima Fisheries Project

2.2.1.2 Uncertainty Resolution Plan

By late spring of each year, the STAC prepares an *Uncertainty Resolution Plan* which identifies strategies to resolve uncertainties (identified in action 4 above) about project operational assumptions. These strategies can include scientific literature searches, small-scale short-term field and laboratory experiments, large-scale long-term studies, and learning from other ongoing studies. Uncertainties must be prioritized for attention so that work can be carried out promptly. *Resolvable* uncertainties are a near-term high priority: they affect strategy implementation, and the benefits of immediate resolution are high. The Uncertainty Resolution Plan therefore would also be used to prepare an annual work plan for the project. The draft Uncertainty Resolution Plans used for this RDEIS were prepared in 1994 and address upper Yakima spring chinook and coho. The Uncertainty Resolution Plans for spring chinook and coho will be revised before the Final EIS.

2.2.1.3 Project Annual Review

Toward the end of each year, the project managers undertake a *Project Annual Review*, (completed in 1992, 1993, and 1994). In this Review, project staff and consultants present the results of their uncertainty-resolution work (including progress reports) to the project managers for process and policy decisionmaking. The Review is an opportunity for project scientists to present and discuss with others the new knowledge gained during the year (1) relative to project objectives and assumptions stated in the Planning Status Report and (2) resulting from resolution work described and scheduled in the Uncertainty Resolution Plan. These results are compiled; analyzed for relevance, task completion, and percent of uncertainty resolution; and formally documented.

However, reviewing/analyzing the data is only the first step. The Project Annual Review and its ensuing analyses are the processes that provide the feedback loop from the current year's cumulative learning into the following year's plans. The Project Annual Review reclassifies the resolution status of specific critical assumptions and identifies spin-off resolution tasks for the coming year. Changes in uncertainty levels of specific assumptions are based on scientific evidence. Scientific documents that form the basis for management decisions will undergo peer review. Thus, the Project Annual Review and any associated peer review steps form the basis of proposed amendments submitted early the following year to project managers for consideration and possible incorporation in the upcoming Planning Status Report.

Consistent with the adaptive management process, YFP managers will review the benefits and risks of continuing the preferred strategies to meet the project's objectives. Strategies will be retained or adopted only if potential benefits exceed foreseeable risks, and if the risks of failure fall within acceptable limits. Thus, risk is managed and reduced over time through implementation of (1) the Uncertainty Resolution Plan (i.e., prior mitigation of uncertainties) and (2) the monitoring and evaluation plan. In this way, the risk of strategy failure (objectives not met and/or strategies incorrectly implemented) can be reduced through pre-implementation research *and* through risk monitoring and a willingness to change during implementation.

2.2.2 Policy Definition and Expression

The adaptive management policy described above would guide project planning and operations. Within its context, specific strategies would be selected and new information identified and applied. Project objectives would then normally be reviewed and perhaps revised, and appropriate strategies devised to achieve them. YFP policy would be created as strategies are selected to meet the stated objectives. As objectives and strategies are revised and adjusted (consistent with YFP experimentation goals), management would be adaptive and consistent underlying policy would evolve.

YFP adaptive management would identify alternatives, clarify associated benefits and risks, and make full public disclosure of project findings and changes in policy direction. Section 2.2.3 shows the corresponding project management structure within which the YFP Policy Group would serve as the main body for resolving YFP policy issues. Information on YFP implementation and policy would be available through minutes of policy meetings, newsletters, technical and planning reports. The Planning Status Report, Uncertainty Resolution Plan, Project Annual Review, and any other related materials would be published annually. The YFP Policy Group would submit an annual summary of project progress and adaptive responses to the NPPC. The managers would be committed to public involvement through ongoing implementation under NEPA and other statewide and regional planning and management forums related to fisheries resources. As needed, the Policy Group might convene special meetings to obtain public input on specific issues.

2.2.3 Project Management

Project management would be coordinated among several groups:

- The YIN would manage the project as Lead Agency.
- The Policy Group, with members from the YIN and the WDFW, would provide policy guidance to the Lead Agency, and review and approve annual planning documents.
- The STAC, consisting of State and Tribal biologists and others as determined or needed, would advise the Policy Group.
- A Project Manager, appointed by the Policy Group, would report to the YIN.
- Department managers for each functional area of project operations would report to the Project Manager.
- Several Federal Agencies, including BPA, USBR, NMFS, USFWS, USFS, and the Bureau of Indian Affairs (BIA) would provide funding, technical assistance, NEPA review, and other participation as arranged.

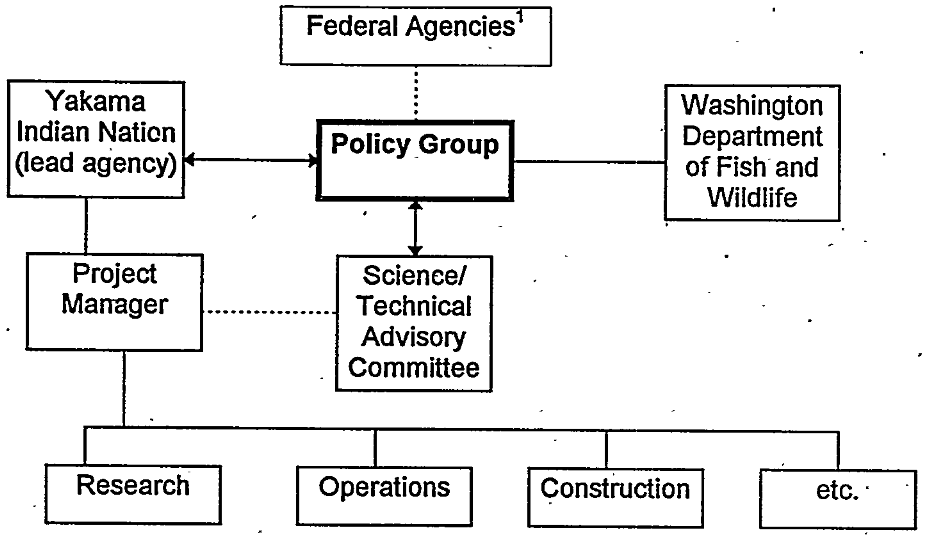
The relationship between each level of project management is illustrated in Figure 2.3.

2.2.3.1 Policy Group

The Policy Group, which includes appointed YIN and State of Washington representatives, works with BPA. The Yakama Tribal Council has appointed the Chairperson of its Fish and Wildlife Committee, acting through the YKFP Coordinator, as its representative on the Policy Group. Because the Washington Department of Fisheries and the Washington Department of Wildlife merged in March 1994, the State is now represented by the YKFP Senior Policy Representative, as appointed by the Director of the newly formed Washington Department of Fish and Wildlife (WDFW). BPA's liaison with the Policy Group is a representative from the Anadromous Fish Implementation Branch of the Division of Fish and Wildlife.

The Policy Group's purpose and primary responsibility is to provide policy direction to the Lead Agency with regard to YFP planning, construction, operation, and maintenance. The Group will also review and approve the project planning documents and other related project activities.

Figure 2.3 Yakima Fisheries Project Management Structure



[1]Bonneville Power Administration, U.S. Bureau of Reclamation, National Marine Fisheries Administration, U.S. Fish and Wildlife Service, Bureau of Indian Affairs, and U.S. Forest Service.

2.2.3.2 Project Managers

In 1987, the State of Washington and the YIN agreed to designate the YIN as Lead Agency for managing the project. In 1994, the State and the YIN executed a Memorandum of Understanding (MOU) that delineates and apportions each agency's responsibilities for project management.

Generally, project management functions include research and project development, planning, operations, and contract administration. The Project Manager would receive directions for project operations from the Lead Agency. It is anticipated that the YIN and BPA would enter into an agreement similar to the MOU mentioned above; it would also include a mechanism for BPA to fund project activities. BPA is and would remain the lead agency for purposes of NEPA review and compliance (due to Federal NEPA compliance requirements for projects that are Federally funded).

2.2.3.3 Science/Technical Advisory Committee

The STAC would, upon the direction of the Policy Group, review and make recommendations on project planning, construction, and operations, including objectives and strategies. In this capacity, STAC would provide general scientific oversight of project planning and related matters.

2.2.3.4 Bonneville Power Administration

BPA would remain an integral part of the YKFP during all phases of the project, as part of its requirement to fund protection, mitigation, and enhancement activities consistent with the Council's Fish and Wildlife Program and the Northwest Power Act. A representative from the Anadromous Fish Branch would serve as a liaison with the Policy Group. Technical assistance would also be provided as needed with the STAC. As previously stated (see Section 2.2.3.1), BPA would remain the lead agency for facilitating the NEPA process. BPA and the YIN are presently developing an MOU that will more fully detail their respective roles and responsibilities.

2.3 Alternative 1: Upper Yakima Spring Chinook Supplementation

Alternative 1 would test supplementation on one Yakima River stock: upper Yakima spring chinook. One central facility would be built for several functions: holding upper Yakima spring chinook adults, spawning, incubating eggs, and early and extended rearing of the young fish. In addition, three sites would be constructed for acclimation and release of the smolts. The discussion below focuses first on the adaptive management framework of supplementation objectives, strategies, assumptions, uncertainties, risk analysis, and monitoring plans; then on the facilities and their operations.

2.3.1 Supplementation Objectives and Strategies

The project managers have agreed on a set of objectives and strategies for supplementing each of the Yakima River Basin stocks. These objectives and strategies are reviewed, revised, and published annually in the Planning Status Report (see Section 2.2.1).

- The objectives are statements of planned accomplishments for the basin,
- The strategies are statements of actions that the project managers believe will enable them to achieve these objectives.

The objectives and strategies are intended to be precise and increasingly specific statements about the YFP in four categories: genetics, natural production, experimentation, and harvest. The strategies are representative of those available to project managers to achieve production objectives and to contain unacceptable genetic and ecological risks. Table 2.1 presents the latest version of the objectives and strategies for spring chinook (Planning Status Report 1995, Volume 3, Summary, attached as Appendix B).

Under the YFP, no objective is static and absolute. This is because, under adaptive management, the annual planning cycle of the project regularly and repeatedly examines the capacity and constraints of the stock and stream system, as well as the performance of hatchery fish, testing and revising a theory of supplementation. The rearing and release of each new group of smolts always represents an experimental test of the latest theory.

New experimental insights are used to modify or discard ineffective strategies, to improve underlying theory and, when necessary, to revise objectives to conform with perceived possibilities. Quantitative production objectives (for most of the stocks originally identified to be supplemented as part of the YFP) were formulated in 1990 in the Refined Goals section of the Preliminary Design Report (BPA, 1990b). The "Refined Goals" objectives were based on computer simulations generated by the NPPC's System Planning Model.

However, those objectives are continually re-assessed in the light of the latest demographic data, suspected ecological relationships, and modeling tools. Quantitative production objectives for upper Yakima spring chinook have been refined, based on computer simulations using the Ecosystem Diagnostic and Treatment Planning Model (EDTPM) (Lestelle et al, 1994) developed under the RASP (RASP, 1992). For a number of reasons, BPA and the project managers have used the EDTPM for YFP planning rather than the System Planning Model, because it tracks juvenile production capacity more closely and allows for variable (density-dependent) predation on outmigrating smolts.

As noted below, the supplementation program provides a multifaceted, but indirect means of addressing the broadest questions related to supplementation. The YFP approach is designed to resolve specific uncertainties related to the effectiveness of supplementation and to the selection of treatments for fish in the artificial environment. The YFP supplementation project would incorporate two repeated tests or treatments: a New Innovative Treatment using incubation, rearing, and release techniques that attempt to produce smolts with attributes and, consequently, survival, similar to those of wild or native fish, and an Optional Conventional Treatment.

- **Treatment A** is an Optimal Conventional Treatment (OCT) to incubate, rear, and acclimate salmonids using the currently accepted "Best Technology" used at state, tribal and Federal hatcheries.
- **Treatment B** is a New Innovative Treatment (NIT) that creates a more natural environment (e.g., natural cover, substrate, and structures) to incubate, rear, and acclimate fish. The intent of this treatment is to raise and release fish with characteristics and behavior similar to those of naturally produced fish in order to achieve improved survival and productivity.

The fish from these two treatments would be compared (e.g., in terms of physical characteristics and survival to returning adults) with each other as well as to the native fish. These comparisons would be used to determine the success of the YFP. As much as possible, information on variation in ocean conditions, instream flows, harvest, and other activities and factors would be utilized to provide a context for interpretation of YFP findings.

Table 2.1. Upper Yakima Spring Chinook Objectives and Associated Strategies

Objectives	Strategies
Genetic	
Manage genetic risks (extinction, loss of within- and between-population variability, and domestication selection) to all stocks from management of the fishery.	Segregate identified stocks by selecting broodstock for which the origin can be reasonably well determined, and release hatchery-reared progeny only in ancestral drainages. Use for broodstock only those fish that are not first-generation hatchery fish. Operate the supplementation facilities using appropriate mating procedures, naturalized environments, and experimental numbers to reduce the possibility of extinction, loss of within- and between-population variability, and domestication selection. Use less than 50% of the natural-origin returning adult escapement from each stock for broodstock purposes. Manage the proportion of natural- to hatchery-origin adults allowed to spawn naturally.
Conserve upper Yakima and Naches stocks of spring chinook salmon.	Segregate identified stocks by selecting broodstock for which the origin can be reasonably well determined, and release hatchery-reared progeny only in ancestral drainages. Collect, identify and segregate spring chinook by stock through spawning, rearing and release.
Conserve the American River stock of spring chinook salmon.	Collect, identify and segregate spring chinook by stock, through spawning, rearing and release. Develop and apply methods to maximize the likelihood that only American River-origin fish enter and spawn in the American River.
Natural Production	
Optimize natural production of spring chinook with respect to abundance and distribution.	Improve the physical, biological, and chemical environment on a priority basis. Use harvest controls and supplementation to optimize natural spawning distribution (temporal and spatial). Release 810,000 acclimated smolts into the upper Yakima basin.
Optimize natural production of spring chinook salmon while managing adverse impacts from interactions between and within species and stocks.	Improve the physical, biological, and chemical environment on a priority basis. Use harvest controls and supplementation to optimize natural spawning distribution (temporal and spatial). Release 810,000 acclimated smolts into the upper Yakima basin.

Natural Production (con't)	
Maintain upper Yakima spring chinook natural production at a level that would contribute an annual average of 3000 fish to the Yakima Basin adult return.	Improve the physical, biological, and chemical environment on a priority basis. Use harvest controls and supplementation to optimize natural spawning distribution (temporal and spatial). Release 810,000 acclimated smolts into the upper Yakima Basin.
Maintain natural escapement of upper Yakima spring chinook (hatchery and wild) at an average of 2000 adult returns and consistently greater than 1700 spawners per year.	Improve the physical, biological, and chemical environment on a priority basis. Use harvest controls and supplementation to optimize natural spawning distribution (temporal and spatial). Release 810,000 acclimated smolts into the upper Yakima Basin.
Experimentation	
Learn to use supplementation as defined by the Regional Assessment of Supplementation Project (RASP, 1992) to increase natural production of upper Yakima spring chinook and increase harvest opportunities.	Conduct experiments using upper Yakima stocks to evaluate the risks and benefits of supplementation as defined by the RASP (1992). Design and conduct experiments using upper Yakima stocks to compare risks and benefits of an NIT against an OCT for supplementation. The NIT would use methods that result in fish which mimic natural fish. The OCT would use methods that result in fish raised according to the state-of-the-art hatchery definition of quality. Collect upper Yakima broodstock at Roza Dam. Release 18 groups of 45,000 fish each of the upper Yakima stock into the upper Yakima River. Release experimental groups of fish from separate acclimation sites connected to target streams. Design experiments to detect a 50% or greater difference (with 90% certainty) between test treatments for all response variables.
Harvest	
Increase harvest opportunities for all fishers consistent with requirements of genetic, natural production and experimentation objectives.	Use selective and/or "status-index harvest" policies to increase harvest opportunities for all fishers.

There are three stocks of spring chinook in the Yakima River: an upper Yakima stock that spawns upstream of Roza Dam, a stock that spawns in the Naches River, and one in the American River (see Figure 2.4). Of these, only the upper Yakima spring chinook stock is proposed for supplementation at this time. This program would include construction of facilities to release up to 810,000 such smolts each year.

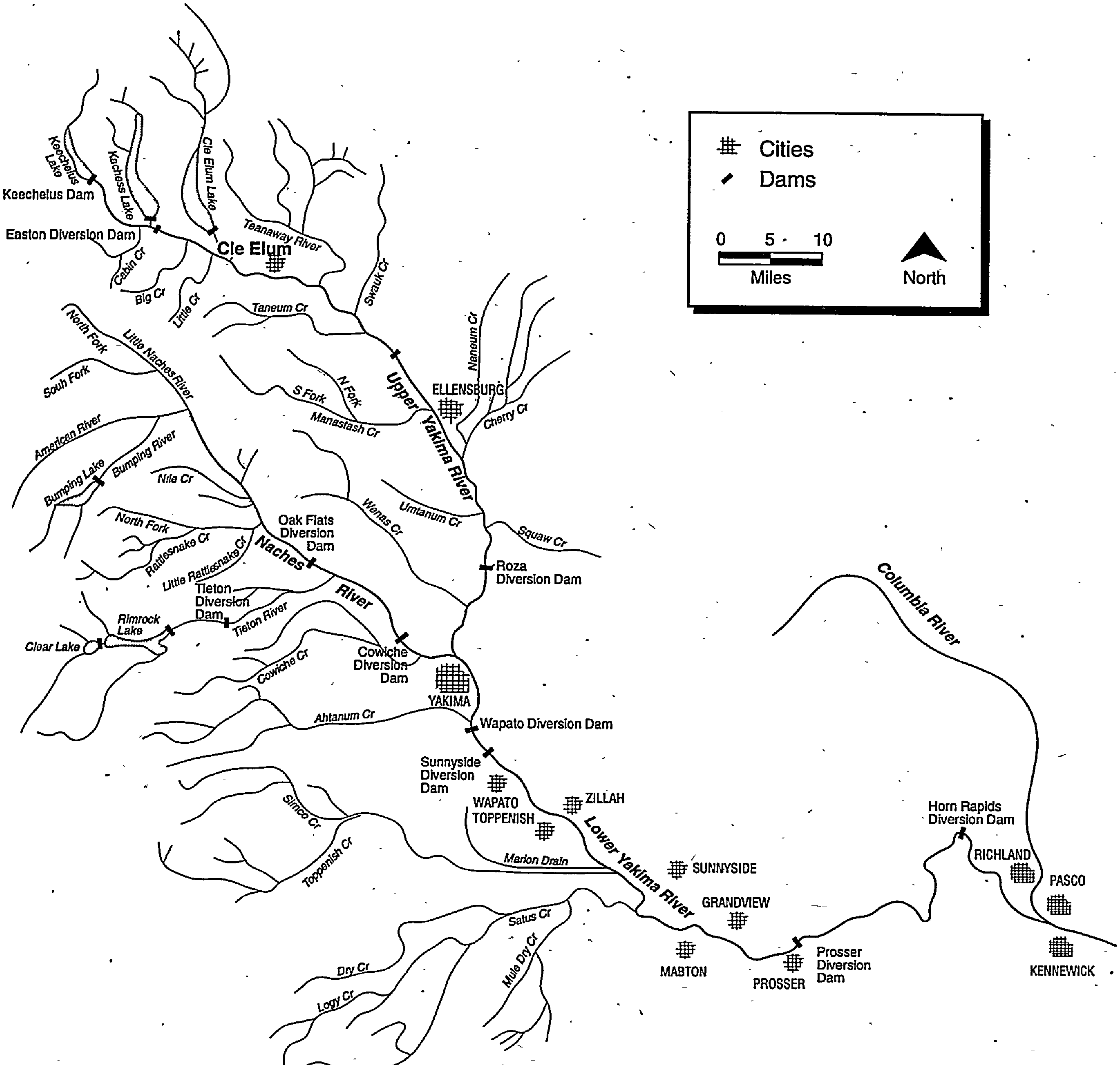


Figure 2.4
Yakima River Basin

Natural production objectives for all Yakima River spring chinook stocks were modeled assuming that all upper Yakima supplementation facilities were operational and were producing a range of 600,000 to 1,150,000 smolts. As modeled, the proposed production level (810,000 smolts) would be expected to produce adult returns, spawning, and harvest objectives in the middle of the range of estimates that follow. Simulations indicated that production levels would produce a total return to the Yakima basin that would range from 8,200 to 11,590 adults: 6,600 to 9,800 upper Yakima spring chinook, 1,000 to 1,100 Naches spring chinook, and 600 to 690 American River spring chinook. Objectives for natural spawning would include 3,100 spring chinook in the upper Yakima (combined wild and hatchery fish at all production rates); 570 to 630 spring chinook in the Naches (all wild); and 340 to 390 spring chinook in the American River (also all wild). Spawning escapement (how many adult fish return to spawn) for all stocks would be above the level (approximately 200-250 spawners per year) at which loss of within-population variability becomes a concern. Harvest objectives would include a Yakima River catch between 2,480 and 6,440 fish over all spring chinook stocks (2,000 to 5,900 from the upper Yakima, 300 to 340 from the Naches and 180 to 200 from the American River stocks), and a total harvest to all fisheries (Yakima River, Columbia River and ocean) of between 4,580 and 9,620 fish. These numbers are based on a *range of smolts released.*

The quantitative production objectives described above for upper Yakima spring chinook are based on the EDTPM computer simulations. These natural production and harvest objectives make the following assumptions:

(1) that hatchery fish survive at half the rate of wild fish in an environment in which natural production is winter-limited;

(2) that carrying capacity is about 900,000 smolts naturally produced in the upper Yakima River under current habitat conditions and operation of the river for irrigation; and

(3) that up to 240,000 smolts (27 percent of carrying capacity) can be lost to density-dependent mortality inside the subbasin (Watson et al., 1993).

Under these conditions, the EDTPM indicates that natural production and harvest objectives are attainable with a terminal harvest rate of 30 percent, applied uniformly over all stocks. The EDTPM assumptions included selective removal of between 100 and 3,000 upper Yakima hatchery fish to limit the maximum proportion of hatchery fish in the natural spawning escapement to 50 percent or less. The impact analyses included in Chapter 4 are based on these assumptions.

Note that these preliminary supplementation strategies and production objectives are based on *modeled assumptions*, not on *empirical data*. The assumptions underlying the computer analyses represent a reasonable synthesisof what is known at present about the natural production and post-release survival of spring chinook in the Yakima River (Watson, et. al., 1993). Future and ongoing risk analysis and ecological research would be expected, through the normal operation of the annual planning and implementation cycle, to result in refinements to supplementation strategies and perhaps to objectives as well.

2.3.2 Assumptions, Uncertainties, and Risk Analysis

A set of assumptions relating to the strategies discussed above has been developed for the YFP. They are significant suppositions or statements of conditions or perceptions that affect the choice of strategies and how these strategies are to achieve specified objectives. Assumptions for the upper Yakima spring chinook program are listed in the Planning Status Report (Appendix B, Tables 5.1-4).

Each assumption is evaluated to determine its level of certainty (how certain the project scientists are that it is true). Assumptions with a high level of certainty are classified as "accepted," and monitoring is used to corroborate them. Other assumptions are further divided into "resolvable" and "unresolvable" categories. Unresolvable assumptions are those which cannot be corroborated. The project managers must decide whether or not the amount of risk associated with the unresolvable assumptions is acceptable. Again, monitoring is used to manage the uncertainty for unresolvable assumptions. Finally, the resolvable uncertainties are addressed for resolution through literature review, studies, and experiments. The Planning Status Report (Appendix B) describes in more detail this uncertainty and its relationship to the benefit/risk evaluation process.

The benefit/risk evaluation process includes a set of questions to be asked about the project's most recent objectives, strategies, and assumptions. The evaluation weighs the changing balance of opposing benefits and risks, as well as levels of uncertainty. The goal is to inform, encourage, and/or caution project managers as they proceed to the next stage. The analysis is time-bound: it is applied to, and emerges from, the project's base of knowledge and recognized uncertainty at a given point in time along the project path. This knowledge base is reflected in the current Planning Status Report and the uncertainty-resolution matrix laid out in the Uncertainty Resolution Plan. However, adaptations to assumptions and strategies are the result of updating this benefit/risk evaluation process each year, along with its companion uncertainty-resolution process, to assist the project managers in deciding the direction for the project in the following year.

The risk assessment for the supplementation of upper Yakima spring chinook is presented in Chapter 7 of Volume 3 of the Planning Status Report (Appendix B). It is summarized in Section 4.1.2 of this RDEIS.

2.3.3 Monitoring

Effective monitoring is the key to a successful adaptive management program. Monitoring enables project managers to determine whether an action achieved its objective, or whether the objective was properly developed. Monitoring should also provide insight into the actual result of an action as well as explain the success (or lack) in achieving the predicted result. In this way, new information can be gained that will facilitate better-informed decisions in the future.

The Planning Status Report (Appendix B; Volume 3, Chapter 9) lays out an integrated multi-level monitoring program for supplementing upper Yakima spring chinook. This structure ensures that strategies are implemented as intended, that experimental studies produce reliable results, and that risks associated with unresolved uncertainties are contained. It also ensures efficiency, prevents duplication of effort, and tracks progress toward meeting objectives.

The monitoring plan for the supplementation of upper Yakima spring chinook under the YFP addresses the following five monitoring categories:

- quality-control monitoring of both research efforts and project operations (to confirm that supplementation is being conducted as intended and record keeping is accurate and complete),
- product specification monitoring (to indicate how fish behave and survive),
- research monitoring (to determine whether the hypotheses regarding supplementation being tested are proven or not),
- risk containment monitoring (to evaluate whether supplementation is progressing toward the objective of increasing harvest and enhancing natural production while maintaining genetic resources), and
- stock status monitoring (to estimate annual spawning escapement and measure other biological or quantitative changes in the populations over time).

Since monitoring activities for these categories overlap, they will be developed into an integrated monitoring plan. Table 2.2 summarizes the proposed monitoring activities for upper Yakima spring chinook for all categories except quality control monitoring. The monitoring plan would be revised and expanded as part of the adaptive management process.

Quality control monitors the performance of the facilities and their operators. Quality standards would be developed for all fish culture and data collection activities as part of the certification process required for the facilities. Quality control monitoring procedures would be included in the operations manuals for all facilities and field activities. This includes the broodstock collection facility at the Roza Dam; the broodstock holding, incubation and rearing at the central production facility; the acclimation ponds; and the juvenile and adult monitoring stations at Chandler and Roza dams.

The following **product specification** attributes would be monitored at the Cle Elum facility, the acclimation ponds, and the juvenile monitoring facilities to determine whether the fish produced by the project meet certain goals:

- fish health;
- morphology (size and shape);
- behavior; and
- survival.

Research monitoring activities would be designed to test the performance of two treatments of artificially reared fish (OCT vs. NIT) and to compare their performance with naturally reared fish. These monitoring activities would be performed at the Roza and Chandler juvenile facilities for outmigrating smolts, at the Prosser and Roza fish ladders and collection facilities for returning adults, and on the spawning grounds for straying rates and reproductive success monitoring. Research monitoring would include measurements of performance in four main areas:

- post-release survival (survival from time of release until the fish return to spawn);
- reproductive success (number of offspring produced per spawner);
- long-term fitness (genetic diversity and long-term stock productivity); and
- ecological interactions (population abundance and distribution, growth rates, carrying capacity, survival rates, transfer of disease, and gene flow).

The **risk containment** portion of the monitoring plan was developed based on the findings of the risk analysis for Yakima spring chinook, discussed above. There were four categories of interest identified in the risk analysis to monitor risk containment:

- experimental;
- genetic;
- harvest; and
- natural production/ecological interactions.

These four areas relate back to the objectives and strategies. The risk analysis defines risk in terms of the probability of failure to meet the objectives of the project for these four categories.

Monitoring of stock status includes measurements of run size and escapement and to determine if harvest objectives can be met without impacting natural production. It would provide information essential to track the long-term performance and fitness of the fish populations. This monitoring would be coordinated with ongoing monitoring currently being conducted by the USBR.

Implementation of the monitoring plan, annual review of the findings, and subsequent adjustment, as necessary, of the supplementation program objectives, strategies, assumptions, uncertainties, and risk analysis would complete the feedback loop that is essential to the success of the adaptive management process, and ultimately, the entire project.

Table 2.2 Summary of Upper Yakima Spring Chinook Monitoring Plan

MONITORING LOCATIONS	MEASUREMENT TO BE MADE[b]	MONITORING PURPOSE[a]: Product Specifications 1) Fish health 2) Morphology 3) Behavior 4) Survival	Research/ Hypothesis testing 1) NIT vs. OCT 2) Natural vs. NIT 3) PTA	Risk Containment 1) Genetics 2) Ecological 3) Experimental 4) Harvest	Stock Status 1) Run size 2) Escapement
Cle Elum hatchery	Adult count Juvenile marking Attribute/survival histories	- 1,2,3,4 1,2,3,4	- 1,2,3 -	1,2,4 - -	1,2 1,2 -
Acclimation sites	Number (time/size) Random biosample Individually mark subsamples	2,3,4 1 4	- - -	- - -	- - -
Roza juvenile trap	Attributes of hatchery fish Read marks Attributes of naturally-spawned fish	1,2,3 4 1,2,3	3 1,2 3	- - -	- - -
Chandler juvenile trap	Attributes of hatchery fish Attributes of naturally-spawned fish Read marks	1,2,3 1,2,3 4	3 3 1,2	- - -	- - -
Test fishery	Adult mark	-	1,2	4	1
Prosser adult trap	Adult mark Adult count	- -	1,2 -	1,3,4 1,4	1 1
Fishery	Adult mark Adult count	- -	1 -	1,3,4 -	1 1
Roza adult trap	Adult mark Adult count Adult tagging	- - -	1 2 2	1,3,4 3 -	1 1 -
Upper Yakima spawning grounds	Adult mark Adult count	- -	1,2 -	1,4 -	2 2
Naches River spawning grounds	Adult mark Adult count	- -	1,2 -	1,4 -	2 2
American River spawning grounds	Adult mark Adult count	- -	1,2 -	1,4 -	2 2

[a] Quality control monitoring is not included

[b] Adult mark - sampling of adult fish: identifying whether or not they are marked; if they are marked, the mark is decoded and the experimental treatment and replicate group of the fish are determined; a set of observations is recorded for each sampled fish including time, location, size, sex, and other benign measurements; subsamples may also be subjected to tissue sampling as needed.

Adult count - count of fish by externally observable categories (e.g. marked vs. unmarked)

Adult tagging - application of individually unique marks to adults that are passed upstream at Roza for natural spawning. Representative subsamples of each of the two treatments (NIT and OCT) and unmarked fish are selected and marked. These fish are subsequently tracked and observed on the spawning grounds, where time and location of spawning are recorded; redds and carcasses may also be examined.

Juvenile marking - application of unique marks to juveniles of each replicate group that can be decoded on returning adults (without harming the fish).

PTA - Patient-Template Analysis

2.3.4 Facilities

Alternative 1 would include the construction of a central hatchery facility at Cle Elum for holding upper Yakima spring chinook adults, spawning, incubating eggs, and early and extended rearing of young fish, as well as construction of three sites with six raceways each for acclimation and release of spring chinook smolts. (See Figure 2.5 for the location of the proposed facilities.) Table 2.3, below, lists the facilities required for the supplementation activities included in Alternative 1. Alternative locations for the upper Yakima spring chinook hatchery facilities were addressed in the EA (BPA, 1990a). These included hatchery sites at Thorp and Newman, about 8 kilometers (km) or 5 miles (mi.) upstream from the city of Ellensburg. Cle Elum was identified as the preferred site as it had more abundant groundwater supplies.

The candidate acclimation sites were selected based on biological criteria specified by the managers. These criteria specify that the location should be adjacent to appropriate spawning habitat, that there must be adequate flow for fish migration, and that the water supply must encourage imprinting and homing to the desired spawning location. Several alternative acclimation sites have been considered in the upper Yakima basin, including (as identified in the original Draft EIS) five "clusters" or groups of three sites each near Thorp (Clark Flat, Town Diversion Dam, and New Cascade Canal); Keechelus (Keechelus Dam, Stampede Pass Bridge, and Mile 210); Easton (Easton Dam, Easton Gravel Ponds, and Big Creek); Teanaway (Jack Creek, Jungle Creek, and Stafford Creek); and Cle Elum (Cle Elum Upper (hatchery site), Younger, and Mile 178).

A refinement in the experimental design in combination with a reduction in the number of smolts proposed to be produced, given the additional information on water constraints at Cle Elum (see Section 2.3.1), have reduced the number of acclimation sites needed. The sites in Table 2.3 have been identified as the preferred sites due to experimental design, water availability, and fish access considerations (Dauble et. al., 1994). Information on two *siting options* for the Easton acclimation site (Easton Dam and Easton gravel pond sites) and on two additional *alternative* acclimation sites (the Cle Elum Hatchery site and the Keechelus Dam site) has been included in the EIS. A final decision on the exact acclimation sites to be used will be made in the Record of Decision on the project.

Table 2.3. Facilities Requirements for Alternative 1

	Raceways
Central Hatchery Facility	
Cle Elum	20
Acclimation Sites	
Clark Flat site	6
Easton site (2 siting options)	6
Jack Creek site	6

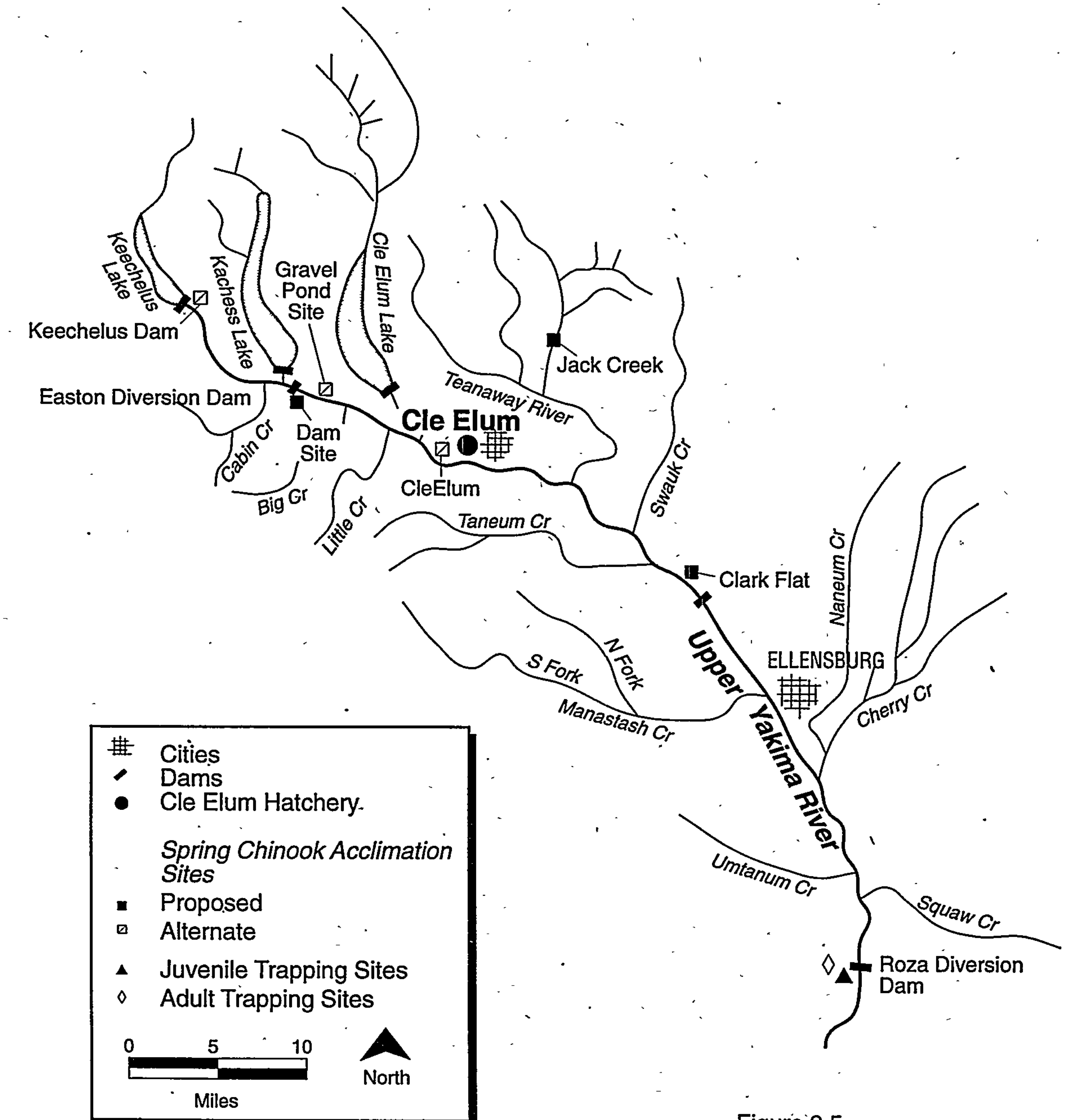


Figure 2.5

Upper Yakima River and Tributaries Project Facilities

I33.HPO.12 / Yakima R and Tributaries/Abbr / 5-5-95 / CJS / JG

2.3.4.1 Central Hatchery Facility

Cle Elum would be the central facility for supplementation of the upper Yakima spring chinook stock. About 6 hectares (ha) or 15 acres (ac.) of land would be developed at the 200-ha (500-ac.) site.. The facilities would consist of adult holding ponds, egg incubation facilities, raceways, groundwater wells, a pump station on the river, a settling pond for waste treatment, access roads, a storage building, offices, research facilities, interpretive facilities, parking, and residences. Figures 2.6 and 2.7 show the proposed layout of the facility. Construction would include 20 raceways and 2 adult holding ponds. There is room for expansion up to a total of 45 raceways on the site if additional facilities were identified as needed in the future. The proposed facility has been sited to minimize wetlands impacts. The original plan described in the EA to use the onsite oxbow lakes for water supply has been changed to include a new pump station on the Yakima River. A combination of surface water from the Yakima River and groundwater from nearby wells is now proposed to supply water for the facility.

Potential interpretive facilities might be constructed in phases. The full complement of facilities might include a visitor center, parking lot, overlook, informational kiosks, and interpretive trails. Initial construction might include the parking lot, informational kiosks, walking paths, and possibly the visitor center. Additional facilities have been discussed and might be added in the future, depending upon funding availability and public use. These could include an outdoor amphitheater, observation blinds, aquarium, and expanded day use and visitor center facilities.

The undeveloped land surrounding the hatchery would be enhanced and protected for wildlife habitat. BPA and the project managers would develop a management plan for the site to mitigate impacts on wildlife for the YFP and for possible inclusion under the Columbia River Basin Fish and Wildlife Program.

2.3.4.2 Trapping Facilities

A major activity for the YFP is monitoring and evaluation of outmigrating smolts and returning adults. Monitoring and evaluation of *outmigrating smolts* would occur at juvenile facilities at Roza and Chandler. Monitoring and evaluation of *returning upper Yakima spring chinook adults* would occur at fish trapping facilities already present at Prosser and Roza Dams. Selective broodstock collection would occur at Roza Dam. Small-scale temporary traps and/or weirs might also be used to meet a variety of monitoring and evaluation needs.

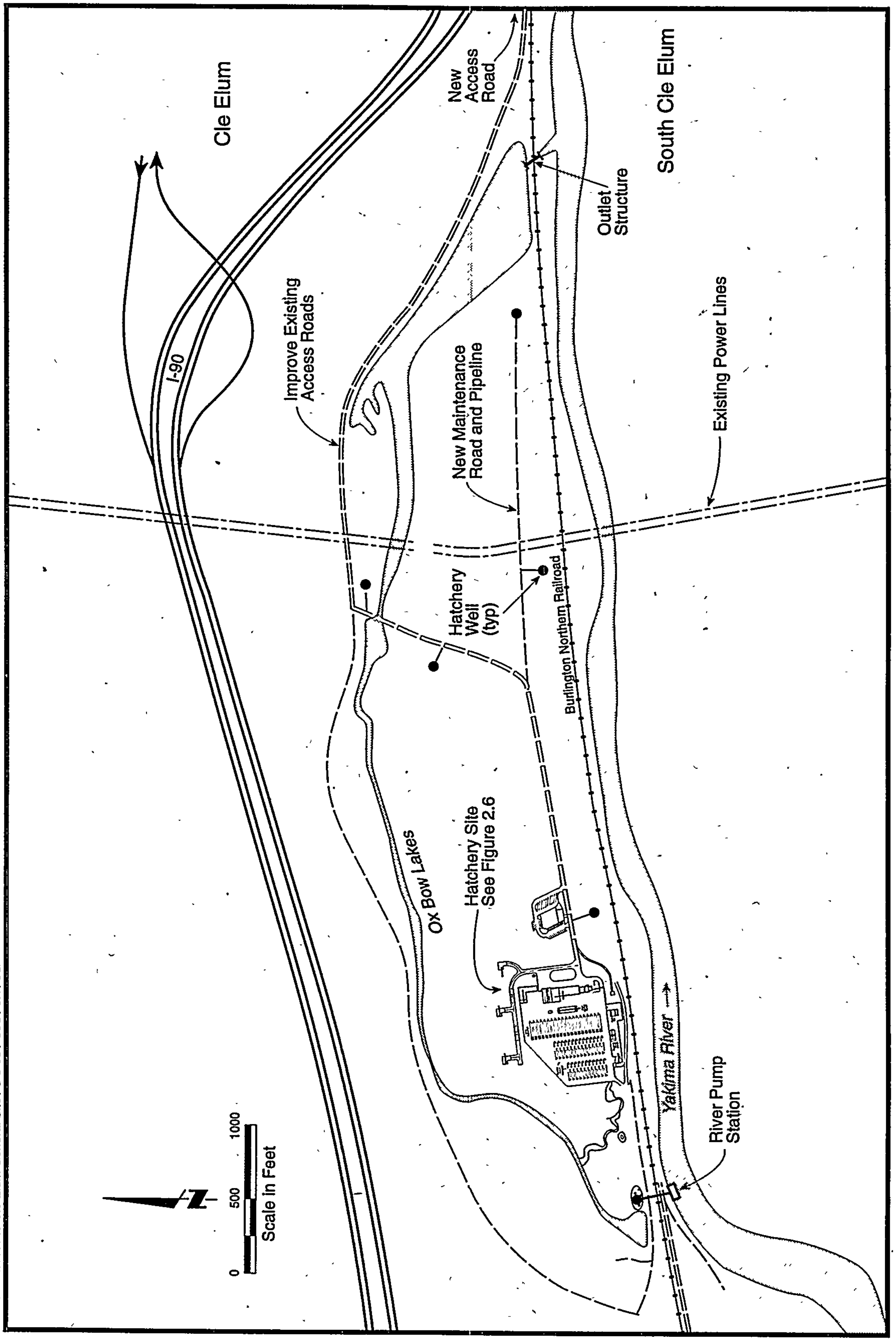
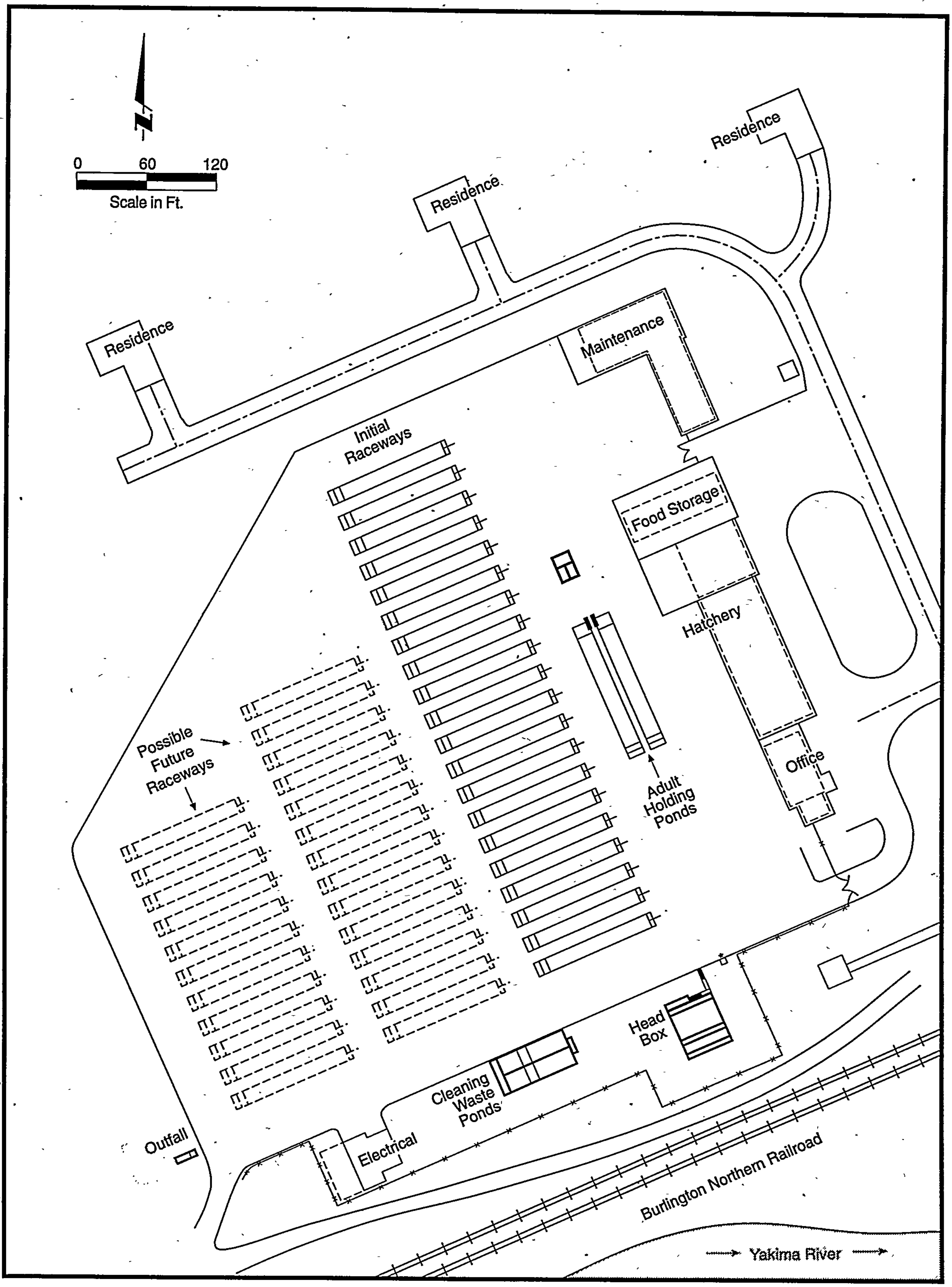


Figure 2.6
Cle Elum Hatchery General Site Plan



NPT27133.HO.12 / Cle Elum Hatchery Site / 5-5-95 / JH / JG

Figure 2.7
Cle Elum Hatchery Site Plan

2.3.4.3 Acclimation Sites

Acclimation raceways provide an environment for final rearing and acclimation of juvenile fish. The use of such sites is intended to reduce stress associated with transportation, and allow fish to acclimate and imprint on the water in which they would be released. Substantial numbers of acclimated smolts are expected to return as adult spawners to the general vicinity of the acclimation sites.

Three sites are proposed for acclimating upper Yakima spring chinook: Clark Flat, Easton (two siting options), and Jack Creek. (See Figures 2.8-11.) Of the 15 originally investigated acclimation sites, these 3 were determined to best meet project goals and have the least effect on the environment. Six raceways would be constructed at each of the sites: three for each of the two experimental treatments (NIT and OCT). Two alternate sites at the Keechelus Dam and Cle Elum site, have also been identified (Figures 2.12-13) and are discussed in this EIS.

Each six-raceway acclimation site would require development of less than 0.8 ha (2 ac.) of land. The acclimation facilities would allow incorporation of innovative features needed to study experimental variables such as feeding techniques, stream cover design, and predator conditioning. Raceways at each acclimation site would be constructed according to a standardized design. During operation, the raceways would be protected by security fencing, alarm systems, and devices (such as overhead wires or netting) that would protect the fish from predators.

The raceways would be supplied by a combination of surface water from adjacent tributaries and rivers and groundwater from nearby wells. The preferred mode of supplying water to the sites is by gravity flow, an alternative to be used on the higher-gradient tributaries. Where gradient is inadequate, water would be pumped to the raceways. Currently, the project managers are considering a plan to deliver fish to the acclimation sites during winter months, which would most likely result in water being pumped to the sites for purposes of reliable operation. Water would be diverted from streams during the winter and spring, when flows in the affected creeks or rivers are usually greatest. Groundwater would be used to supplement surface water supplies as necessary. All water used would be returned to the nearby river or tributary.

NPT27133.HO.12 / Clark Flat / 4-26-95 / CJS / JH / JG

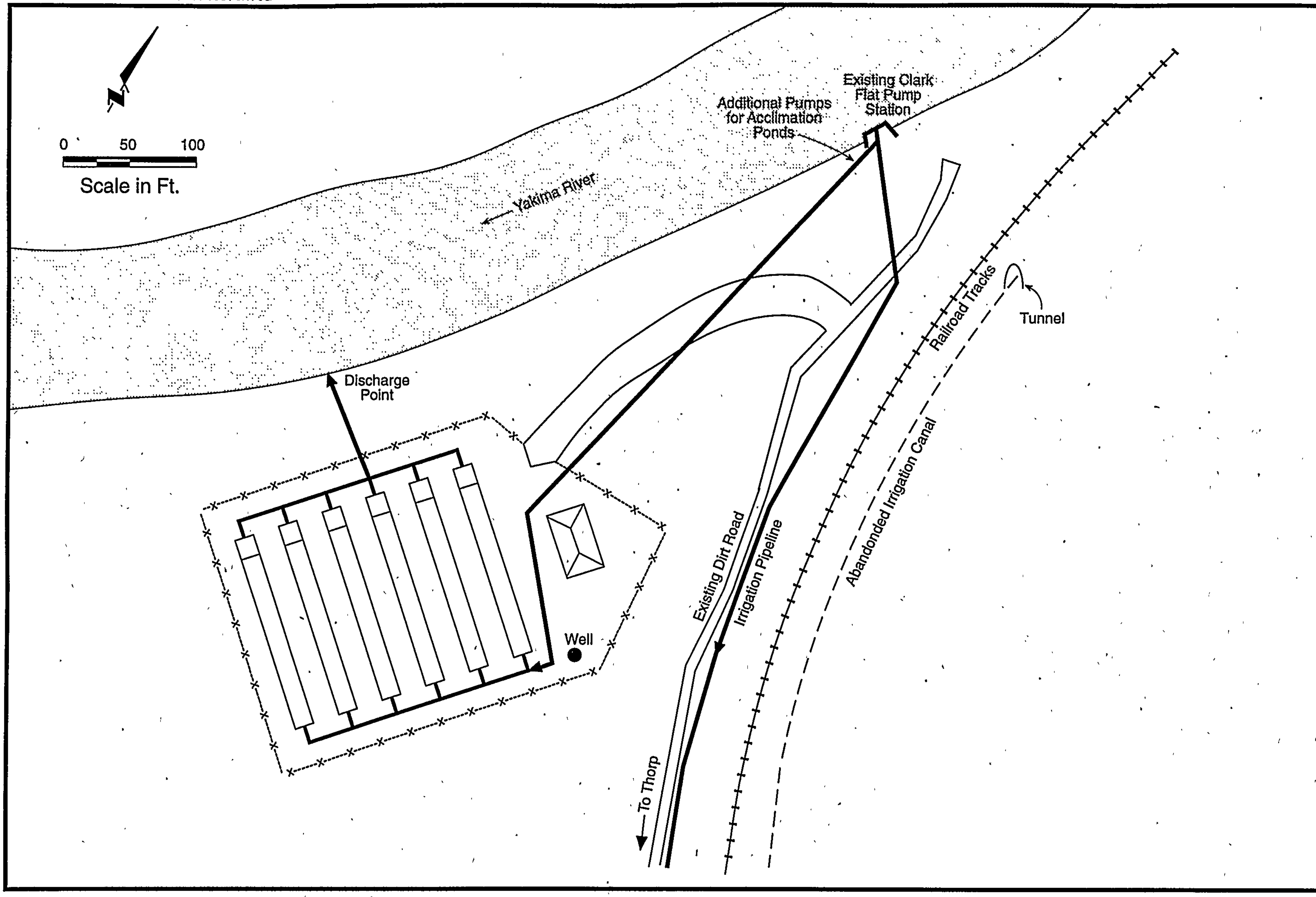


Figure 2.8
Clark Flat Acclimation Site

NPT27133.HO.12 / Canal Fish Facility / 5-5-95 / JG

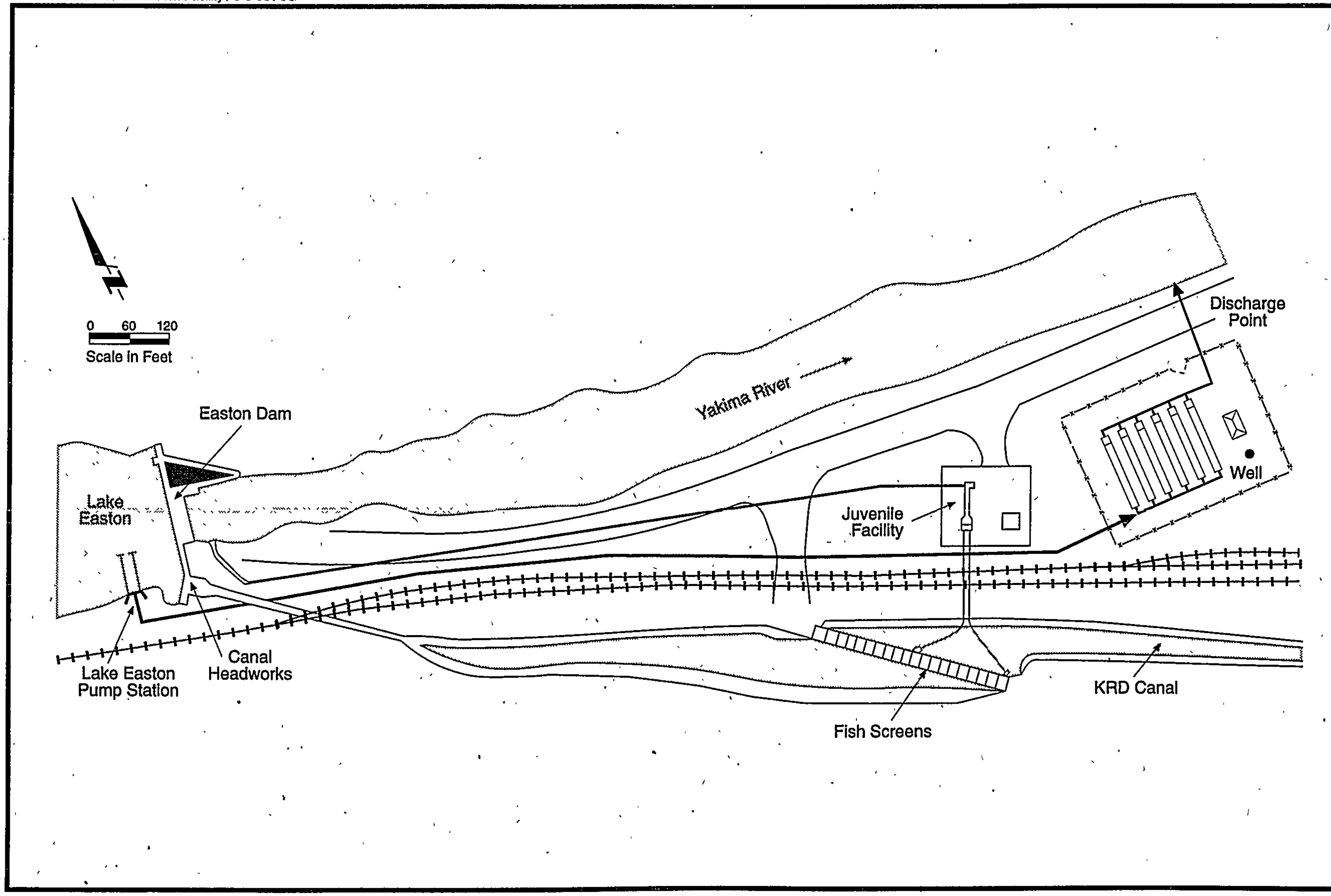


Figure 2.9
Easton Dam Siting Option
Easton Acclimation Site

VPT27133.HO.12 / Easton Acclimation Site / 5-5-95 / JH / JG

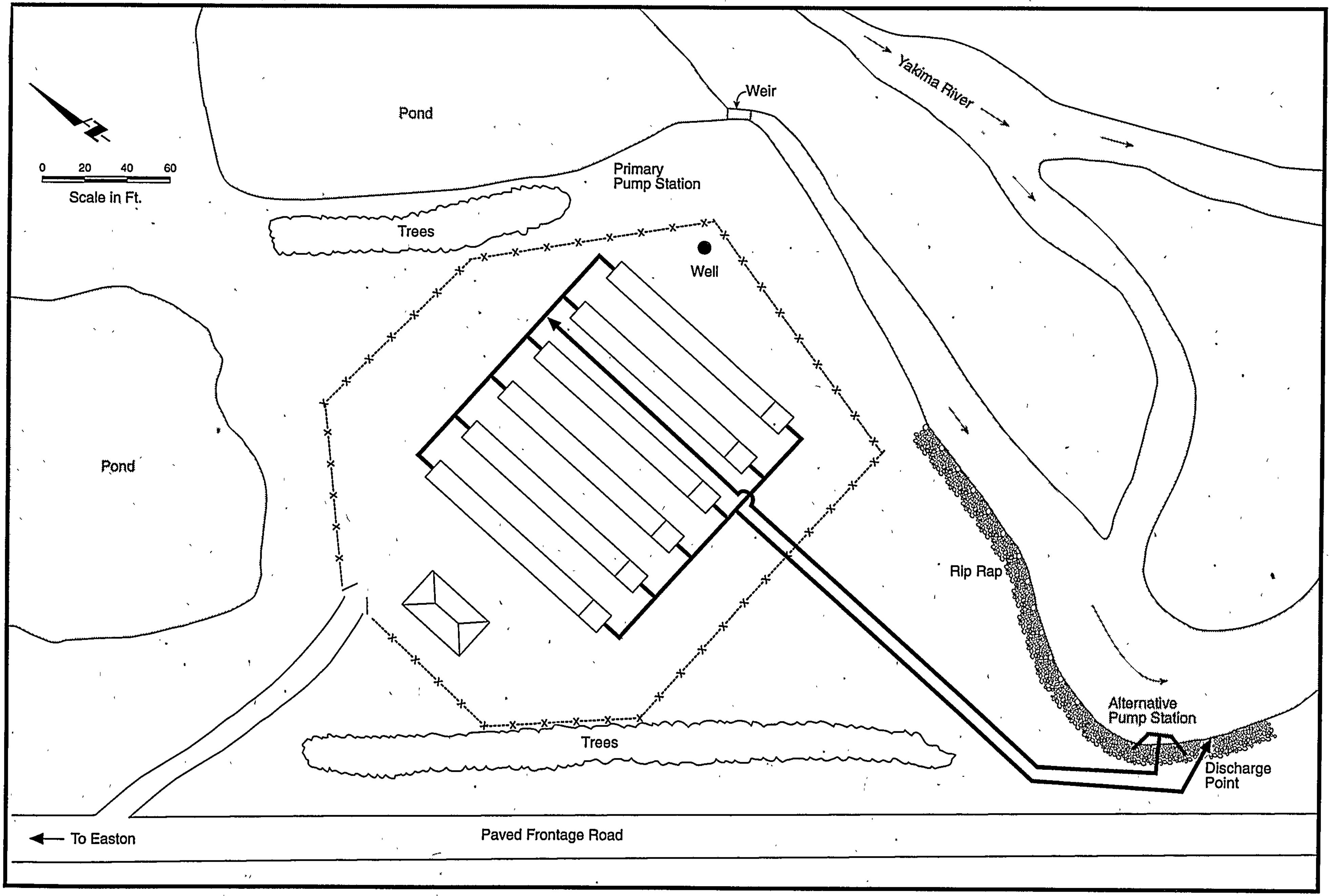


Figure 2.10
Easton Gravel Pond Siting Option
Easton Acclimation Site

NPT27133.HO.12 / Jack Creek / 5-5-95 / CJS / JH / JG

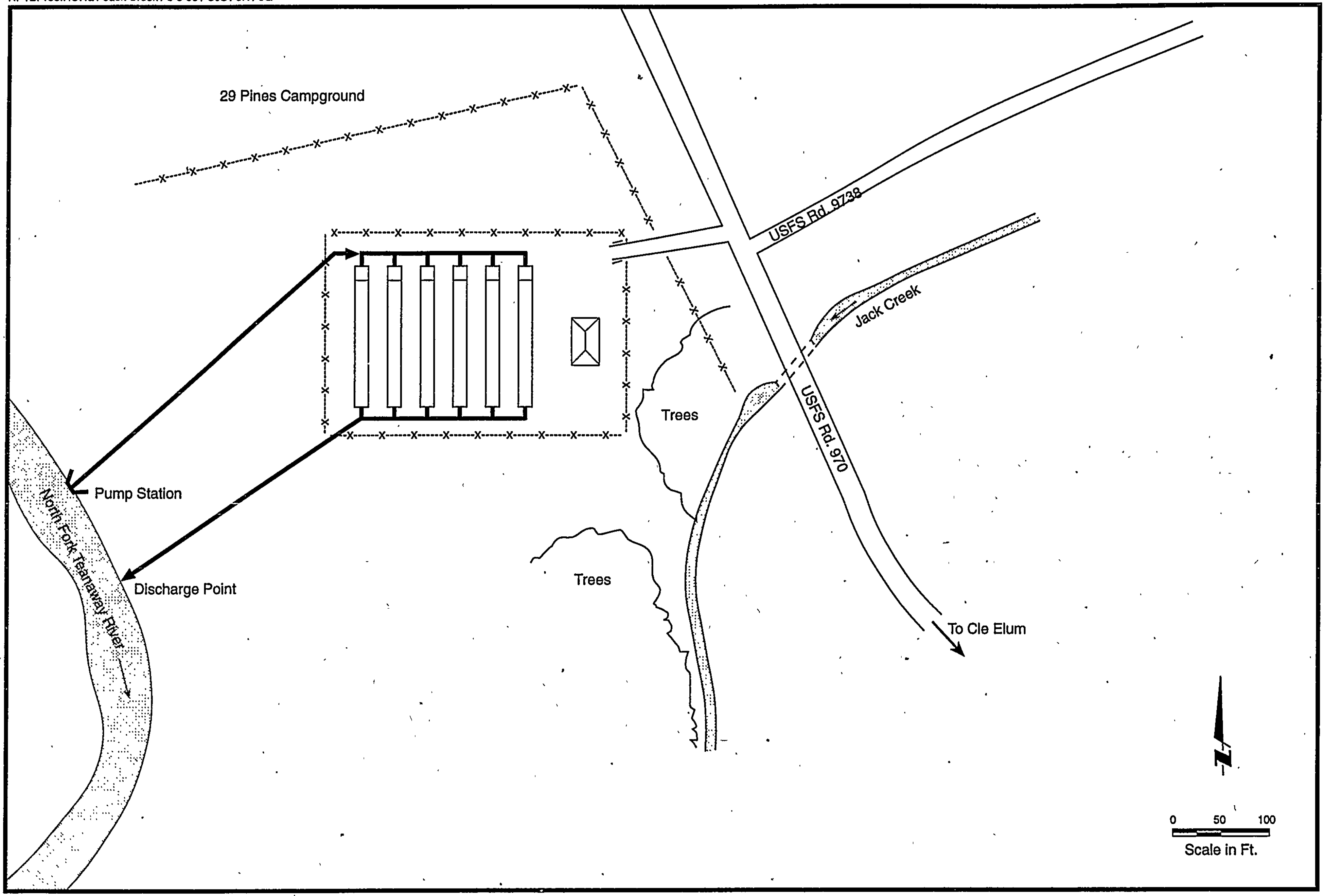


Figure 2.11
Jack Creek Acclimation Site

NPT27133.HO.12 / Cle Elum Acclimation Site / 5-5-95 / JG

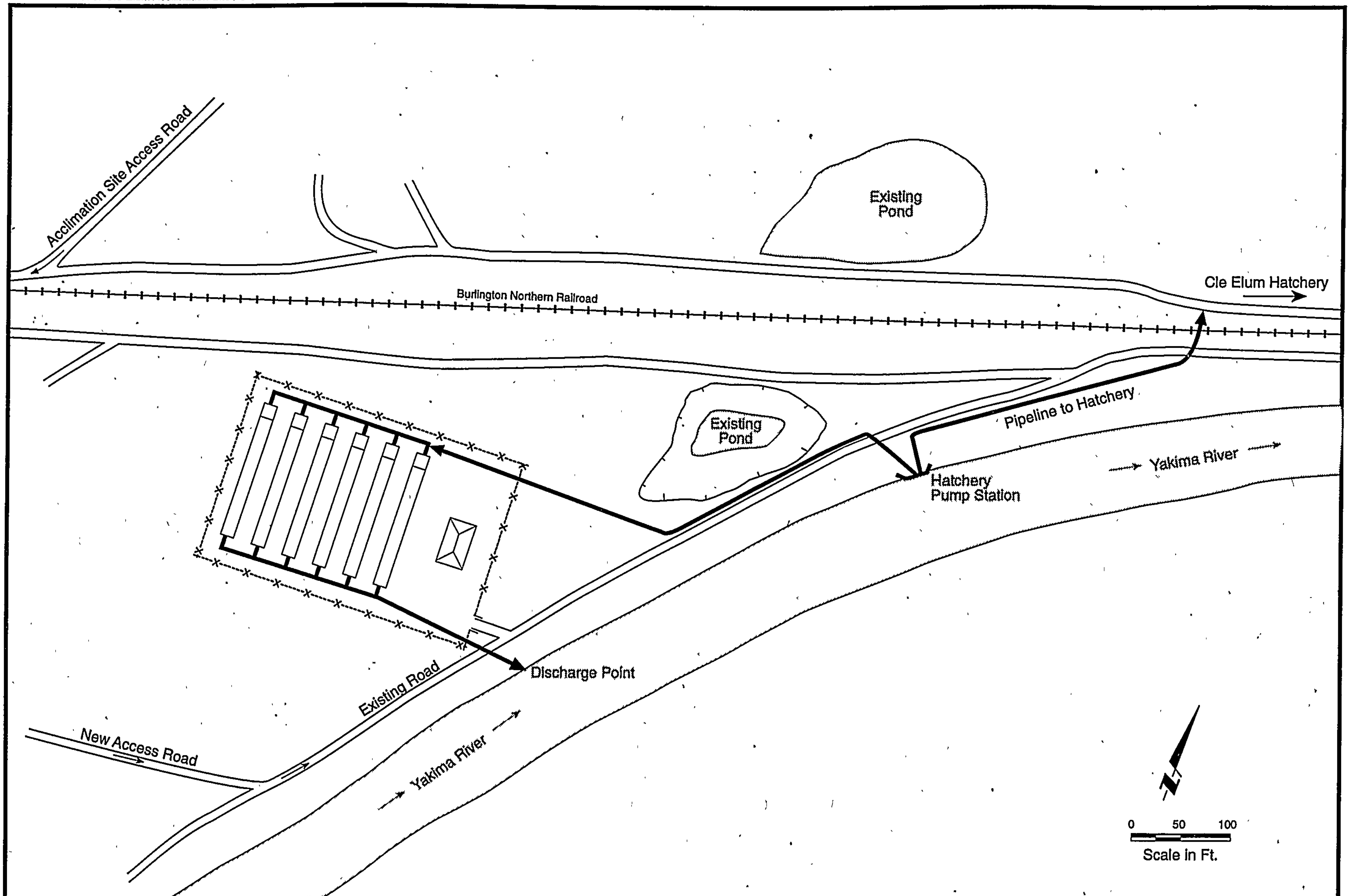


Figure 2.12
Cle Elum Acclimation Site (Alternate)

NPT27133HO.12 / Keechelus / 5-5-95 / CJS / JH / JG

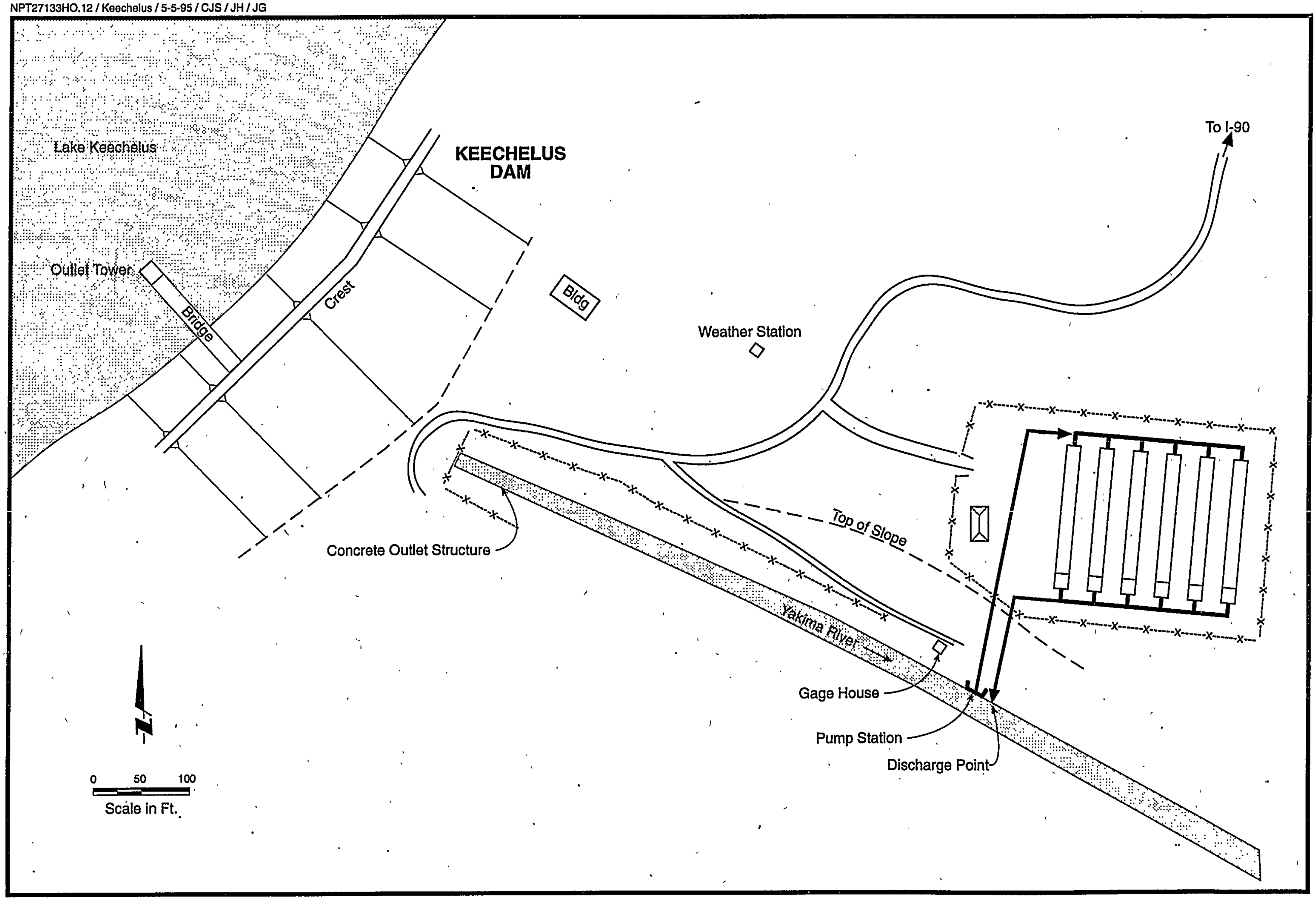


Figure 2.13
Keechelus Acclimation Site (Alternate)

2.3.5 Project Operations

Broodstock would be collected at Roza Dam, transported to the central facility, and held there for spawning. The number of natural adults used for broodstock would be large enough to be representative of the donor stock, but not so large that broodstock collection would impair the natural reproductive capacity of the stock. Incubation of eggs and rearing of fry would also take place at the central facility.

Rearing would include methods to encourage adaptation of released fish to the natural environment, such as teaching juvenile salmonids to avoid predators and to forage for food. Specific details regarding rearing protocols for both the optimal conventional treatment and new innovative treatment would be finalized based on experiments being conducted before the facilities are built.

When ready, juvenile upper Yakima spring chinook would be transferred to the acclimation sites next to the spawning grounds to which they would be expected to return as adults. When sufficiently mature, the young smolts would leave the acclimation facilities for outmigration to the ocean. Adult fish would be expected to return 2 to 4 years later to spawn.

Smolts and returning adults would be monitored for each experimental treatment (see Section 2.3.3) to determine success. Throughout the process, fish culture practices would follow guidelines established to minimize genetic change caused by hatchery rearing and to encourage adaptation of released fish to the natural environment. Genetic hatchery guidelines for the YFP have been drafted and are documented (Kapuscinski and Miller, 1993).

2.4 Alternative 2: Upper Yakima Spring Chinook Supplementation and Coho Study

Alternative 2 would involve the testing of supplementation of upper Yakima spring chinook and a study to determine the feasibility of re-establishing a naturally spawning population of coho to the Yakima River Basin. All actions relating to upper Yakima spring chinook would be identical to those described for Alternative 1. Discussion of the coho study under this alternative proceeds in the same order as for Alternative 1. **Alternative 2 has been identified by the Policy Group as the preferred alternative for the YFP.**

All approaches (adaptive management strategy, Project Management Plan, yearly Planning Status Report, environmental review as necessary, Uncertainty Resolution Plan, and a Project Annual Review) would be the same as described under Section 2.2. Monitoring and evaluation would be carried out to provide feedback for a successful adaptive management program. Policy development and expression and Project Management would also be the same as described earlier.

2.4.1 Objectives and Strategies

2.4.1.1 Upper Yakima Spring Chinook Supplementation

The program for upper Yakima spring chinook would be the same as that described in Section 2.3.1.

2.4.1.2 Coho Feasibility Study

Under Alternative 2, project managers would seek to determine the feasibility of re-establishing a naturally spawning coho population and a significant fall fishery for coho within the Yakima River Basin, while keeping adverse ecological impacts within acceptable limits.

The few naturally spawning coho salmon presently in the Yakima River Basin are considered the result of hatchery outplantings. As described in Section 1.4, the YIN is now managing a program of acclimating and releasing coho pre-smolts transferred into the Basin under CRFMP. CRFMP mandates the release of 700,000 coho annually, to supply a terminal fishery for tribal and other fishers. The program uses early-run fish from lower Columbia River hatcheries (mainly Cascade Hatchery), and has, to date, produced very few adults returning to the Yakima River. However, a program of acclimating the smolts before release was begun in 1994; it should improve the returns of adult coho to the basin. While the acclimation and release program is *not* being funded by BPA under the YFP, and its impacts are *not* addressed in this EIS, the fish being acclimated and released under this program would be used by the YFP in the proposed studies. Tribal personnel conducting both the CRFMP and YFP programs are coordinating them and working toward the common goal of establishing naturally reproducing populations of coho in the Yakima River Basin.

Under this alternative, the 700,000 smolts from the ongoing YIN coho program would be used in a feasibility study to determine the benefits and risks of re-establishing coho in the Yakima River Basin. The smolts would continue to be acclimated at low-tech facilities already developed for the Tribal coho program (Granger pond, Roza Wasteway #3 near Wapato, and the Wapato Canal net pens). Approximately 10% of the smolts are marked by clipping and coded wire tags. The smolts leave the acclimation sites voluntarily; automatic fish counters at the exit of each acclimation facility would monitor the number of fish outmigrating each day. Smolt survival would be monitored at the Chandler Juvenile Evaluation Facility.

Monitoring of the smolts released under the coho program would be conducted to study the interactions of the coho with other fish species in the Yakima River. Stomach contents of the outmigrating smolts would be sampled at the Chandler Juvenile Evaluation

Facility and at selected sites in the river, to determine the food habits of the smolts. This study would be designed to evaluate the potential risk of coho smolt predation on juvenile fall chinook salmon and juvenile rainbow/steelhead trout. Returning adults would be monitored at Prosser Dam fish ladders to determine the smolt-to-adult survival rates. Other monitoring activities may be pursued as necessary to clarify other ecological interactions. Under this alternative, juvenile coho would continue to be released in the Yakima River Basin only downstream from Wapato Dam.

The project managers have agreed on a set of objectives and strategies for the coho feasibility studies. Unlike the objectives and strategies for spring chinook, which were described in four categories, objectives for the coho feasibility studies are limited to one category, experimentation. There would be no change from the current releases of coho in the basin and the planned research effort is necessary before natural production, genetic, or harvest objectives are developed. These objectives and strategies (which are reviewed, revised, and published annually in the Planning Status Report) are more qualitative than those for upper Yakima spring chinook, since planning for coho has undergone fewer iterations and thus not as much work has been done to refine them. They will be modified and refined through the adaptive management process. Table 2.4 presents the latest version of the objectives and strategies for coho.

Table 2.4. Yakima Coho Objectives and Associated Strategies

Objectives	Strategies
Experimentation	
Determine the feasibility of returning natural production of coho salmon to the Yakima River Basin.	Evaluate the survival, escapement, and natural reproduction of introduced coho salmon in the Yakima River Basin.
Determine the potential harvest benefits from reintroduction of coho salmon in the Yakima River Basin.	Evaluate the survival, escapement, and natural reproduction of introduced coho salmon in the Yakima River Basin; calculate the potential harvest benefits.
Determine the predation impacts of releasing 700,000 acclimated coho smolts on fall chinook populations in the Yakima River Basin.	Conduct food habit analyses of coho salmon released into the Yakima River Basin to determine the impact on fall chinook populations.

2.4.2 Assumptions, Uncertainties, and Risk Analysis

2.4.2.1 Upper Yakima Spring Chinook Supplementation

The program for upper Yakima spring chinook would be as described in Section 2.3.2.

2.4.2.2 Coho Feasibility Study

The process for documenting assumptions and uncertainty resolution for the coho feasibility study would be similar to that described in Section 2.3.2 for upper Yakima spring chinook. A risk analysis for the coho study is presented in Section 4.1.2 of this EIS. The assumptions and analyses will be documented in the coho chapter of the Planning Status Report, which will be finalized prior to the final EIS and attached to it.

2.4.3 Monitoring

2.4.3.1 Upper Yakima Spring Chinook Supplementation

The monitoring program for upper Yakima spring chinook would be as described in Section 2.3.3.

2.4.3.2 Coho Feasibility Study

The monitoring plan for YFP coho emphasizes two major areas of interest to address the objectives and risks identified. These are:

- their survival through various life stages, and
- the rates of predation of released coho smolts on other species of concern.

The survival of smolts from the time of their release to the time they pass Prosser (smolt-to-smolt survival) would be evaluated by counting smolts at the Chandler juvenile evaluation facility below Prosser Dam. Adults returning to the Yakima basin would also be video-monitored at Prosser Dam. Approximately 10% of the released coho smolts would be tagged with coded-wire markers to facilitate their identification. The information obtained through this monitoring would be tracked through the STAC and reports prepared for the Tribal coho program.

A monitoring plan has been drafted to address the predation issue. It would involve studying the stomach contents of coho smolts sampled at the Chandler juvenile evaluation facility and by electroshocking as they move downstream from the release points. The STAC would evaluate the results of this study and consult with the Policy Group to determine whether and how a coho reintroduction program would be developed using the adaptive management process.

2.4.4 Facilities

In addition to those facilities described under Alternative 1 for upper Yakima spring chinook (Section 2.3.4), the low-tech acclimation facilities being used for the existing Tribal coho program, and existing trapping and monitoring facilities at Prosser Dam, no major new facilities would be needed for the coho feasibility study. It is possible that small-scale, portable traps and/or weirs may be needed to meet a variety of monitoring and evaluation needs.

2.4.5 Project Operations

2.4.5.1 Upper Yakima Spring Chinook Supplementation

The project operations for upper Yakima spring chinook would be as described in Section 2.3.5.

2.4.5.2 Coho Feasibility Study

Coho smolts would continue to be imported into the Yakima River Basin under the Tribal Program. These 700,000 smolts would be acclimated at the three low-tech facilities discussed earlier (section 2.4.1.2). When ready, the juvenile coho would leave the acclimation facilities for outmigration to the ocean. Adult fish would be expected to return to the basin the next year to spawn.

Smolts and returning adults would be monitored for survival rates; smolts would be monitored for food habits. Throughout the process, fish culture practices would follow guidelines established to minimize genetic change caused by hatchery rearing and to encourage adaptation of released fish to the natural environment. Genetic hatchery guidelines for the YFP have been drafted and are documented (Kapuscinski and Miller, 1993).

2.5 No Action Alternative

Under the No Action Alternative, BPA would not fund testing of supplementation in the Yakima River Basin. The activities described in Section 1.4 would continue, including passage improvements, water enhancements, and the coho program under CRFMP. Funding budgeted for the construction of the facilities and implementation of the project might be redirected toward some of these ongoing activities in the basin or additional habitat and water quality/quantity improvements. Further environmental review would be needed to address any alternative proposals.

Some salmon and steelhead populations might increase because of the ongoing passage improvement activities and potential habitat enhancement activities, but most likely at a slower rate than with supplementation. Harvest opportunities within the Yakima River Basin would remain low or depressed, and might be eliminated if runs continued to decline. They most likely would not increase as rapidly in the short term as they would under the action alternatives. The No Action Alternative would indefinitely delay implementation of measure 7.4K.1 of the Council's December 1994 Fish and Wildlife Program, which instructs BPA to fund construction of an anadromous fish hatchery in the Yakima River Basin.

2.6 Alternatives Eliminated from Detailed Study

A number of alternatives to the YFP have been proposed by the public and agencies, both during scoping and as comments on the Draft EIS. Most of these alternatives were eliminated from further analysis in this EIS for one or more of the following four reasons:

1) they would not meet the need for knowledge about how the strategy of supplementation can be applied to the protection and enhancement of stocks of anadromous fish in the Yakima River Basin;
2) they were addressed in other environmental documents;
3) they could result in an unacceptably high impact on the environment; or
4) they were not considered feasible.

2.6.1 Passage Improvements and Other Activities

Passage improvements, habitat improvement, improvement of instream flows, water quality improvement, and controlling predation are all valid alternatives for increasing the numbers of fish in the Yakima River Basin. These activities have been proposed for the Basin as part of the Yakima Subbasin Plan (YIN, 1990), which was developed as part of the Council's planning effort. However, these proposed nonsupplementation activities would *not* meet supplementation research objectives or help reintroduce stocks that no longer inhabit the basin. Because they would not meet the need for the project, these proposed alternatives were eliminated from detailed study as alternatives to the proposed action. Many of these activities are, however, ongoing as part of the Columbia River Basin Fish and Wildlife Program and other programs discussed in Section 1.4.

2.6.2 More Supplemented Stocks

As previously indicated, the DEIS included several project alternatives distinguished primarily by the number of stocks proposed for supplementation. The seven-stock, five-stock and three-stock alternatives discussed in the DEIS were eliminated from detailed study in this RDEIS because BPA and the project managers have concentrated detailed planning on only upper Yakima spring chinook and coho at this time. Alternatives 1 and 2 were developed to address this shift in priorities.

The *upper Yakima spring chinook* stock was identified in the original Draft EIS as the preferred spring chinook stock for testing supplementation, given the objective of conserving the American River populations and concerns regarding the ability to distinguish between the Naches and American River populations. The *coho* feasibility study is proposed under Alternative 2 because of the desire of the managers to establish a fall fishery and because it would be consistent with the Tribes' ongoing coho acclimation and release program under the CRFMP. Implementation of supplementation or reintroduction for the remaining stocks in the basin (e.g., spring chinook, fall chinook, coho, and summer steelhead) might be proposed as time and funds permit; supplemental environmental documentation would be prepared before decisions are made to add supplementation of additional stocks to the project.

2.6.3 Alternative Sites

Alternative sites and configurations for the central and satellite facilities were addressed in the EA on the siting and construction of central, satellite, and trapping facilities for supplementing anadromous fish populations in the Yakima and Klickitat River Basins (BPA, 1990a). Central hatchery facilities were proposed at Cle Elum in the upper Yakima watershed, and at Oak Flats and Nelson Springs in the Naches watershed. The Cle Elum site has been proposed in this RDEIS as the preferred central facility site for upper Yakima spring chinook, as it would best meet the water needs and is located closer to the acclimation sites. The Oak Flats site might not have sufficient groundwater available for holding of adults through the summer months, and the Nelson Springs site was proposed as (and is better suited for) a fall chinook and/or steelhead facility. Several acclimation sites were investigated and rejected, either because they did not meet the experimental needs of the project (and were therefore not feasible alternatives), or because they would have resulted in unacceptably high impacts on cultural resources or wetlands.

2.6.4 Research at Existing Non-Yakima River Basin Sites

After reviewing public comments on the original DEIS, BPA and the project managers considered an alternative involving supplementation research to be conducted at existing Columbia River Basin facilities outside the Yakima River Basin. Supplementation programs at three existing hatcheries were examined to determine whether they could meet YFP research goals--the Lyons Ferry Salmon Hatchery-Tucannon River Satellite (located northeast of Walla Walla, Washington, on the Tucannon River); the Methow Salmon Hatchery (located near Winthrop, Washington); and the Rock Island Hatchery Complex (located on five rivers in north central Washington). These three programs were selected as a representative sample from the list of regional supplementation programs. They are operationally similar to the proposed YFP, they are located in the State of Washington, and information on them was readily available from WDFW.

However, none of the three hatcheries could meet both of the two distinct levels of experimentation within the YFP experimental design. The first level tests supplementation success in the context of four major biological response variables (post-release survival, reproductive success, long-term fitness, and ecological interactions). The second experimental level tests the value of various hatchery rearing strategies. Both the Methow and Rock Island hatcheries could provide equivalent or greater potential than offered by the YFP to monitor and evaluate biological response variables. However, none of the three hatcheries has sufficient facilities to meet the statistical criteria for testing alternative hatchery rearing treatments set by the design of the YFP. In addition, the ability of the Lyons Ferry Hatchery to meet the supplementation success research goals has been diminished with to the declaration of the Snake River sockeye stocks and the spring and fall chinook stocks as endangered under the Endangered Species Act (ESA).

2.6.5 Other Research Outside the Yakima River Basin

While it appears that there is some opportunity to conduct supplementation research comparable to the research planned for the YFP outside the Yakima River Basin, this alternative would not meet two of the purposes of the proposed action. The purpose of testing the assumption that new supplementation techniques can be used in the Yakima River Basin to increase natural production and to improve harvest opportunities while maintaining genetic resources can be met *only* by supplementing *Yakima River stocks in the Yakima River basin*. This alternative also would not fulfill the Council's request that supplementation be tested in the Yakima River Basin, which is another purpose of the project (see Section 1.2). Since the proposed alternative to test supplementation at other locations would not meet either of these purposes, and since none of the facilities outside the basin could provide equal or better opportunities to perform both types of supplementation research, this alternative is not discussed further in this RDEIS.

2.7 Comparison of Alternatives and Summary of Impacts

This section summarizes the information in the following two chapters and presents a comparison of the environmental consequences of the two YFP action alternatives and the No Action alternative. Table 2.5 shows this comparison graphically. The environmental consequences of the alternatives for each of the major resources affected were rated as **high, moderate**, or **low**. These ratings take into consideration the mitigation summarized in Section 4.2.2. For a more detailed discussion of impacts, please see the corresponding discussions in Section 4.1. The following criteria were taken into consideration in these ratings:

A **high** impact is one that:

1. Cannot be substantially mitigated;
2. Substantially reduces the quantity or quality of a regionally or nationally significant resource;
3. Would adversely affect the long-term productivity of the environment;
4. Irreversibly or irretrievably damages significant resources;
5. Consumes substantial quantities of non-renewable natural resources.

A **moderate** impact is one that:

1. Creates an impact that can largely be mitigated;
2. May adversely affect the quantity or quality of a regionally or nationally significant resource;
3. May adversely affect the long-term productivity of the environment;
4. May involve some irreversible or irretrievable damage to the environment;

5. Consumes only moderate quantities of non-renewable natural resources.

A low impact is one that:

1. Creates few or no impacts that must be mitigated;
2. Does not reduce the quantity or quality of a regionally or nationally significant resource;
3. Is unlikely to adversely affect the long-term productivity of the environment;
4. Involves little or no irretrievable or irreversible damage to the environment;
5. Consumes only minor quantities of non-renewable natural resources.

There are only minor differences in environmental consequences between Alternatives 1 and 2. Alternative 2 incorporates the same program for upper Yakima spring chinook as alternative 1, but adds a feasibility study for coho using the fish already being released into the basin under the CRFMP. It should be noted that there is no change in environmental impact attributable to incorporation of the coho feasibility study into the YFP because the coho release program is ongoing and will continue whether the feasibility study is included in this project, or not. Potentially high impacts on wild, native, and non-target fish populations under both alternatives would be mitigated through careful adherence to the adaptive management process. While the No Action alternative would not affect resources through the construction of facilities, it could result in a moderate impact on anadromous fisheries in the Yakima River basin. This is because the anadromous fisheries are rapidly declining at present, and the No Action alternative would do nothing to reverse the decline.

Table 2.5 Environmental Consequences of the Yakima Fisheries Project Alternatives

	Alternative 1	Alternative 2	No Action
Water Resources			
Surface water	M	M	L
Ground water	M	M	L
Floodplains/wetlands	M	M	L
Biological Resources			
Aquatic biological resources	M	M	M
Vegetation	L	L	L
Wildlife	M	M	L
Special Status species	M	M	L
Air Resources and Noise	L	L	L
Socioeconomics	L	L	L
Recreation and Visual	M	M	L
Cultural Resources	L	L	L
Resource Management (Land use and Solid/Hazardous waste)	M	M	L

H = High impact M = Moderate impact L = Low or no impact

2.7.1 Water Resources

2.7.1.1 Surface Water

Surface water quantity impacts for Alternatives 1 and 2 would be low. All surface water use for the project would be nonconsumptive; water would be returned to the source stream or river immediately downstream of the point of diversion after it is cycled through the facility. There are potential problems with water availability at the alternative Keechelus acclimation site when reservoir releases are stopped or slowed to allow refill. Low flows at the mouth of the Teanaway River in late summer and fall might affect upstream migration and spawning of spring chinook salmon returning to the vicinity of the Jack Creek site. Consistent with the Northwest Power Act of 1980 and the Council's 1994 Fish and Wildlife Program (Section 4.1.1.1), existing water rights would not be directly affected by the proposed project, and the ongoing water adjudication process in the Yakima River Basin would also not be affected by the project. Indirect effects on water rights are possible, but would most likely occur with or without the YFP.

Surface water quality could be moderately affected by the project in the short-term during construction of the facilities. Erosion control measures would be implemented to minimize this impact. Effluent from the facilities would cause nutrient levels to be raised only slightly; the levels would remain within acceptable limits identified by the U.S. Environmental Protection Agency (EPA).

Due mainly to the potential for erosion during the construction period, the overall impacts of Alternatives 1 and 2 on surface water were judged to be moderate. No impacts on surface water quality or quantity would occur as a result of the No Action Alternative.

2.7.1.2 Groundwater

Impacts on groundwater resulting from Alternatives 1 and 2 were judged to be moderate, based on the moderate amount of groundwater to be used (0.5 m^3/s or 18 cfs for the Cle Elum hatchery and 0.06 m^3/s or 2 cfs for each of the three acclimation sites) and the inability to return the water directly to the aquifer. The water would, however, be discharged to a nearby stream or river after cycling through the facilities. Groundwater pumping is not expected to adversely affect other wells in the vicinity of the Cle Elum hatchery or the acclimation sites. No impacts on groundwater would occur as a result of the No Action Alternative.

2.7.1.3 Floodplains and Wetlands

Alternatives 1 and 2 would result in moderate impacts on floodplains and wetlands, because these areas could not be avoided totally in siting the facilities. However, the sites for the project facilities would be designed to minimize these impacts, and wetland losses would be mitigated through the construction of replacement wetlands in accordance with local, state, and federal policies. Wetland impacts at the Cle Elum hatchery site would total 0.1 ha (0.24 ac.); potential impacts at the Jack Creek and Clark Flat acclimation sites are expected to be even less. The No Action Alternative would not affect floodplains or wetlands.

2.7.2 Biological Resources

2.7.2.1 Aquatic Biological Resources

The highest potential impact, both positive and negative, of the proposed project under Alternatives 1 and 2 is on the aquatic biological resources of the Yakima River Basin. The project has a good potential for increasing knowledge about the use of supplementation and the adaptive management process, while increasing the number of upper Yakima spring chinook returning to the basin. It also has the potential to affect existing wild and native fish populations adversely through genetic and ecological interactions. The overall impacts on aquatic biological resources of Alternatives 1 and 2 were judged to be moderate, based on the commitment of the project managers to use the adaptive management process to learn from and continually adapt their actions to prevent or correct problems that arise. The impact of the No Action Alternative was also judged to be moderate in this case, given the potential to continue the declining anadromous fish population trends in the Yakima and Columbia River basins without the knowledge and results that could be gained from implementing Alternatives 1 or 2.

2.7.2.2 Vegetation

Impacts on vegetation from Alternatives 1 and 2 are expected to be low. A total of approximately 8 ha (20 ac.) of vegetation would be cleared for project facilities at four sites. None of the sites are located in rare or unique vegetative communities, and most have been previously disturbed. The No Action Alternative would not result in impacts on vegetation.

2.7.2.3 Wildlife

Impacts on wildlife that would result from the implementation of Alternatives 1 or 2 were judged to be moderate. A moderate amount of wildlife habitat (8 ha or 20 ac.) would be permanently affected by the facilities. Wildlife would be temporarily displaced during construction, and, in some cases, would be permanently displaced by the facilities. A wildlife mitigation plan for both the YFP and for possible inclusion in the Columbia River Basin Fish and Wildlife Plan is being developed for the Cle Elum site in consultation with the WDFW and the YIN. No impacts on wildlife would result from the implementation of the No Action Alternative.

2.7.2.4 Special Status Species

Few impacts are expected on the listed threatened or endangered species in the vicinity of the project sites. It is unlikely that listed Snake River anadromous fish stocks would be found in the Yakima Basin or that Yakima fish would stray into the Snake River Basin. None of the sites contain suitable Northern spotted owl, grizzly bear, Peregrine falcon nesting, or marbled murrelet habitat. The project would increase prey available for bald eagles. However, bald eagles wintering at the Clark Flat site could be disturbed by increased human activity, and gray wolves have been reported in the vicinity of the Jack Creek and Keechelus acclimation sites. For these reasons, the impact was judged to be moderate. Consultation with the USFWS on ways to minimize these impacts would be completed prior to construction. Impacts to candidate and state-listed species are not anticipated. The status of petitioned species now under review by NMFS and USFWS (e.g. bull trout, steelhead) will be monitored and consultation will be initiated if they are listed. No impacts would result from the No Action Alternative.

2.7.3 Air Resources and Noise

Impacts on air resources and noise would be minor, and would be limited within the State guidelines. The majority of the impact would occur during construction from vehicle exhaust emissions, noise, and dust generation. No impacts would result from the No Action Alternative.

2.7.4 Socioeconomics

Impacts on socioeconomics would be beneficial but low. Employment and income would be expected to increase in the areas surrounding the project from expenditures of funds for construction, operation and maintenance, monitoring and evaluation, and harvest. A portion of the employment and income would economically benefit the Yakama Indian Nation. Secondary effects from additional rounds of economic activity were included. The No Action Alternative would not result in these positive impacts on the economy.

2.7.5 Recreation and Visual

Alternatives 1 and 2 could potentially affect the wild trout fishery, both negatively and positively. Negative impacts could result from adverse ecological and genetic interactions, while positive impacts could result from the increased prey base that would be provided by juvenile chinook smolts. Visual resources would be altered by the construction of the facilities. Other recreational resources are not expected to be affected negatively, and the addition of interpretive facilities planned at the Cle Elum site would provide additional recreational resources. The overall impact was judged to be moderate due to visual impacts and potential impacts to the wild trout fishery. The No Action Alternative would result in neither positive nor negative impacts to these resources.

2.7.6 Cultural Resources

Little to no impacts on cultural resources would result from the implementation of Alternative 1, 2, or the No Action Alternative. Surveys at the facility sites revealed no cultural resources that would be affected by construction. If cultural resources were discovered during construction, consultation would immediately be initiated with the State Historic Preservation Office (SHPO) and the YIN.

2.7.7 Resource Management

A moderate amount of land (about 8 ha (20 ac.) would be affected by the construction of facilities under Alternatives 1 and 2, but the facilities would be consistent with local and state land use policies in most cases. Most of the impact would result from the unavoidable siting of pumps and intake and outlet facilities in riparian and protected shoreline areas. Potentially prime farmland soils are found at the Clark Flat and Easton Dam sites, but the sites are not irrigated or currently used for farming, other than grazing at the Clark Flat site. The project staff is consulting with Kittitas County agencies to ensure project consistency with County and State land use policies and regulations. A moderate amount of solid waste and small amounts of hazardous wastes would be generated at the facilities. No land use or waste generation impacts would result from the No Action Alternative.

3. AFFECTED ENVIRONMENT

3.1 Introduction

This chapter describes the existing resources that may be affected by either of the alternatives for the proposed YFP. Siting and construction of the Cle Elum hatchery (Alternatives 1 and 2) was previously discussed in the original Environmental Assessment (BPA, 1990a); updated information is included in this EIS. Siting and construction of several alternative locations for the three preferred acclimation sites for upper Yakima spring chinook (Alternatives 1 and 2) are also addressed in this document.[4]

3.2 Water Resources

Surface water resources and their current uses are described below for the Yakima River and its tributaries. Surface water would be used for the Cle Elum hatchery facility and the acclimation sites. Groundwater resources would also be used for the Cle Elum site. Unless otherwise noted, the information presented below was taken from the EA (BPA, 1990a).

3.2.1 Surface Water Resources

The Yakima River drains a 15,941-square-kilometer (km^2) (6,155-square-mile (mi^2))basin in central Washington, flowing 436 km (217 mi.) from Keechelus Lake in the Cascade Mountains (elevation 746 meters(m) or 2,448 feet (ft.)) to the Columbia River near Richland (elevation 91.4 m or 300 ft.) (See Figure 2.4.) Yearly precipitation in the Yakima River Basin ranges from about 20 centimeters (cm) (8 inches (in.)) in the eastern lowlands to over 254 cm (100 in.) in the Cascade Mountains.

The river flows in a southeasterly direction through the Kittitas Valley from Cle Elum to Ellensburg. The river then turns south as it cuts a canyon through Manastash and Umtanum Ridges (Yakima Canyon). The river continues south past Roza Dam and Selah Gap to the City of Yakima. It then flows past Union Gap, Wapato Dam, and Sunnyside Dam and into the lower valley for the final 169 km (105 mi.) to the Columbia River. The river flows in a southeasterly to easterly direction in the lower valley and passes over the last two irrigation diversion dams at Prosser and Horn Rapids.

Major tributaries to the Yakima River include the Kachess, Cle Elum, Teanaway, and Naches rivers in the upper portion of the basin and Ahtanum, Toppenish, and Satus

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[4] As explained in Chapter 2, 3 of the 15 acclimation sites originally identified for upper Yakima spring chinook have been identified as preferred: the Easton site (with two siting options), Jack Creek, and Clark Flat. However, two additional alternative acclimation sites (Keechelus Dam and Cle Elum upper) are discussed in this EIS in addition to the preferred sites.

Creeks in the lower portion. The Naches River is the largest tributary to the Yakima River. It extends about 72.4 km (45 mi.) from its confluence with the Yakima River near Yakima upstream to the Bumping River confluence; the Little Naches and Bumping Rivers combine to form the Naches River at this location.

Six storage reservoirs have been developed in the headwaters area of the Yakima River to supplement flows during the irrigation season (March to October). Keechelus, Kachess, and Cle Elum Lakes flow into the Yakima River above Cle Elum. Bumping, Clear, and Rimrock Lakes flow into tributaries of the Naches River.

3.2.1.1 Water Quantity

The average annual discharge from the Yakima River Basin is 3.54 cubic kilometers (km^3) (2.9 million acre-feet) of water. About 2.93 km^3 (2.4 million acre-feet) are diverted from the Yakima River for irrigation, of which approximately 1.83 km^3 (1.5 million acre-feet) return. Smaller amounts are diverted for industrial and municipal use and hydroelectric power generation. Irrigation and other diversions have caused problems for Yakima River basin fish, as smaller tributary streams are dewatered during migration and/or spawning times.

Highest flows occur during spring runoff (April to June); lowest flows occur during late summer, fall, and winter. Typically, fluctuations in flow are large in winter, moderate in spring, and small in late summer. The average annual flow is 9.6 cubic meters per second (m^3/s) (338 cubic feet per second (cfs)) below Keechelus Lake; 57.8 m^3/s (2,040 cfs) at Cle Elum, 65 m^3/s(2,297 cfs) at Umtanum, 71.8 m^3/s (2,534 cfs) near Parker, and 111 m^3/s (3,921 cfs) at Kiona (U.S. Army Corps of Engineers (Corps), 1978).

Water Resources at Hatchery and Acclimation Sites

Simulated and gauged mean monthly discharges for rivers and creeks affected by the siting of the project facilities are shown below, in Table 3.1. The table indicates mean monthly discharge for the period of operation, or during the months of January through June for all of the facilities except the Cle Elum hatchery. The Cle Elum hatchery would operate year-round. Mean monthly discharges are shown for all months at this site. Other specific information on site-specific streamflow characteristics follows.

The Cle Elum hatchery site is located on the Yakima River upstream from the town of Cle Elum. The hatchery would operate year-round and would be supplied with a combination of surface and groundwater. The surface water requirement of 2.0 m^3/s (72.1 cfs) would be pumped from the Yakima River, run through the facility, and then returned to the river along with the groundwater used in the facility. Monthly mean flows for the Yakima River at Cle Elum range from an average high of about 200 m^3/s (7,100 cfs) in June to an average low of 13 m^3/s (460 cfs) in October. The lowest monthly mean flows range between 8.5 and 9.9 m^3/s (300 and 350 cfs) during the driest years. Under current agreements for protection of fishery resources (the Quackenbush ruling, see discussion in Section 3.9.2.1), flow in the Yakima River at the Cle Elum hatchery site is maintained at

325 cfs (9.1 m^3/s)during the typical fall low-flow period. Extreme low flows, however, may be as low as the 5.3 m^3/s (190 cfs) observed in October, 1994.

Table 3.1 Summary of Estimated Stream Flow for Surface Water Sources for Yakima Fisheries Project Facilities, January through June

Site	Water Source	Requirement m^3/s	Average Monthly Flow Rates [m^3/s (cfs)]					
			January	February	March	April	May	June
Cle Elum Hatchery and acclimation site	Yakima River[1]	2.0 (72.1)[2] (hatchery) 0.24 (8.7) (acclimation site)[5]	21.2 (757)	20.9 (748)	23.9 (855)	33.2 (1184)	53.0 (1892)	80.9 (2890)
			July 98.8 (3530)	August 100.9 (3602)	Sept. 31.4 (1120)	October 13.6 (486)	Nov. 16.3 (583)	Dec. 14.4 (516)
Easton acclimation site (both options)	Yakima River[1]	0.24 (8.7)	13.4 (477)	11.6 (414)	12.7 (453)	13.0 (464)	19.3 (691)	14.7 (526)
Jack Creek acclimation site	N.F. Teanaway[3]	0.24 (8.7)	2.5 (91)	1.8 (65)	2.2 (79)	4.2 (149)	6.1 (217)	5.3 (189)
Clark Flat acclimation site	Yakima River[4]	0.24 (8.7)	33.7 (1205)	33.3 (1191)	38.1 (1362)	58.5 (2090)	83.5 (2983)	84.6 (3020)
Keechelus acclimation site	Yakima River[1]	0.24 (8.7)	4.7 (169)	3.6 (129)	1.3 (47)	6.7 (240)	15.7 (562)	16.1 (576)

[1] Estimates based on stream gauge data.
[2] Reduced during periods of river flow less than 9.8 m^3/s (350 cfs).
[3] Estimates based on North Fork Rattlesnake Creek mean monthly flow data, extrapolated using USGS equation (1978).
[4] Estimates based on USBR hydrologic model.
[5] Cle Elum acclimation site would be operated during January-June only.

The acclimation sites would be supplied by a combination of surface water from adjacent tributaries and rivers and groundwater from nearby wells. All flows would be returned to the river. The water would be pumped to the raceways. Diversion of water from streams, at flow rates of 0.24 m^3/s (8.7 cfs) per site (serving all six raceways), would be scheduled to occur between January and May of each year. Flows in the affected creeks or rivers are normally high in April and May. Raceways are scheduled to be drained after the fish have been released by the end of May. These flows would be supplemented with 0.06 m^3/s (2 cfs) of groundwater from nearby wells.

- **Easton Acclimation Site (both siting options).** Six raceways would be located near the Yakima River downstream of the Easton Diversion Dam, just northwest of the town of Easton. Water would be pumped to the raceways from the Yakima

River. Monthly mean flows below Easton Dam range from an average high of 70.4 m^3/s (2,485 cfs) in May to an average low of about 0.7 m^3/s (24 cfs) in November. However, the USBR now provides for minimum flows at Easton for spring chinook salmon spawning of 5.7 m^3/s (200 cfs) during September and minimum incubation flows of 4.2 m^3/s (150 cfs) during winter, in conformance with the Quackenbush Decision (USBR, 1990b).

- **Jack Creek Site.** Six raceways would be located along Jack Creek near its confluence with the North Fork of the Teanaway River. The Teanaway River is the second largest tributary to the Yakima River and drains an area of about 518 km^2 (200 mi^2). Water would be pumped to the sites from the North Fork of the Teanaway River. Simulated monthly mean flows for the North Fork at the Jack Creek site during the proposed period of use range from an average high of 6.1 m^3/s (217 cfs) in May to an average low of 1.8 m^3/s (65 cfs) in February. Simulated monthly mean flows for the Teanaway River near the mouth range from an average high of 24.6 m^3/s (870 cfs) in May to an average low of 2.5 m^3/s (90 cfs) in August. Periods of no or very little flow are common near the mouth from July through October. Flows during the period August 2 through October 19, 1989, ranged from 0.3 to 0.5 m^3/s (10 to 19.2 cfs). Although the mouth is well downstream of the acclimation site, upstream migration and spawning of spring chinook salmon could be affected by these low flows.

- **Clark Flat Site.** Six raceways would be located on the banks of the Yakima River near Thorp. Yakima River flows in this vicinity are similar to those described for the Cle Elum site. Water would be pumped from the river to the raceways.

- **Cle Elum Site.** Six acclimation raceways would be located next to the proposed Cle Elum hatchery site upstream of the city of Cle Elum on the Yakima River floodplain. Yakima River flows in this vicinity are similar to those described for the Cle Elum hatchery. Water would be pumped from the Yakima River to the raceways, using the same intake facilities as for the hatchery.

- **Keechelus Site.** Six raceways would be located along the Yakima River downstream of Keechelus Dam. Either water would be pumped from the Yakima River to the site, or gravity flow directly from the dam might be explored. Mean monthly flows near Keechelus Dam have been measured as high as 46.2 m^3/s (1,630 cfs) in August. Simulated monthly mean flows at this location range from an average high of about 20.8 m^3/s (735 cfs) in August to an average low flow of about 1.8 m^3/s (65 cfs) in March. However, low flows of about 0.08 m^3/s (3 cfs), largely from seepage, have occurred from October through April when releases from Keechelus Dam have been stopped after the irrigation season to allow the reservoir to refill.

3.2.1.2 Water Quality

Parameters affecting both aquatic life and human health can be analyzed to determine water quality conditions. The Washington Department of Ecology (WDOE) has defined water quality criteria for all surface waters in the State of Washington (WDOE, 1988). Criteria are defined for temperature, pH, turbidity, fecal coliform bacteria, dissolved oxygen, and toxicants (ammonia and selected metal and organic constituents). The criteria for some of these parameters depend on how a water body is classified. All waters are classified as fresh or marine, and as Class AA (extraordinary), Class A (excellent), Class B (good), Class C (fair), or Lake Class.

Most of the Yakima River and its tributaries are classified Class A. The Yakima River above the Cle Elum River is classified Class AA. The Naches River above River Mile 35.7 and the Tieton River are also classified Class AA. Water quality problems in the Yakima River basin are largely restricted to the lower 40 percent of the river, roughly from Sunnyside Dam to the confluence with the Columbia River (BPA, 1990a).

Water temperature is critical to the survival of many aquatic organisms, especially fish. High water temperatures limit the amount of dissolved oxygen that can be carried in the water, and a low concentration of dissolved oxygen (less than 4 milligrams per liter (mg/L)) has an adverse effect on aquatic life. Water temperatures in most of the Class A segments of the Yakima River rarely exceed 21°C (70°F); the Class AA segments rarely exceed 16°C (61°F). However, summer temperatures at Prosser and Kiona (on the lower river, through which the anadromous fish must pass on their way down from the supplementation areas) frequently exceed 24°C (75°F); 90% mortality of some fish species can occur at temperatures above 21°C (70°F) (WDF/WDW, 1991). Water temperatures are affected by the operation of water storage reservoirs in the upper portions of the Yakima River basin and by irrigation diversions. Diverting and reserving water for storage reduce the amounts of water flowing downstream; the resulting reduced amounts of instream water heat up more quickly.

Spring chinook smolt outmigration occurs at Prosser from late March through early June, with the average date of 50% passage on April 22. Steelhead smolt outmigration ranges from early March through mid-June , with the date of average 50% passage on April 30. Fall chinook smolts migrate from mid-April through early July, with the average date of 50% passage on May 31. The average monthly temperature at Prosser, as well as the monthly maximum and minimum temperatures, are as follows:

- March average of 7.7 C (45.9 F), with a maximum of 12.7 C (54.9 F) and minimum of 2.0 C (35.6 F);
- April average of 11.8 C (53.2 F) with a maximum of 17.6 C (63.7 F) and minimum of 8.1 C (46.6 F);
- May average of 15.9 C (60.6 F), with a maximum of 21.8 C (71.2 F) and minimum of 11.2 C (52.2 F);
- June average of 19.2 C (66.6 F), with a maximum of 26.7 C (80.0 F) and minimum of 13.9 C (57.1 F); and

- July average of 22.2 C (71.9 F), with a maximum of 26.8 C (80.2 F) and minimum of 17.3 C (63.1 F).

The estimated mean monthly temperatures at Richland in the lower river were 18.0 C (64.5 F) for May, 21.0 C (69.8 F) for June, and 24.5 C (76.1 F) in July.

The dissolved oxygen level of the Class A segment of the Yakima River is at least 8.0 mg/L during normal daylight hours. Data reported for bimonthly sampling at Union Gap (above Ahtanum Creek) and at Kiona from 1980 to 1985 show that dissolved oxygen exceeded 8.5 mg/L on every occasion. However, dissolved oxygen problems have been observed during summer evening hours in the lower Yakima River. A 24-hour sampling in August 1973 identified dissolved oxygen concentrations as low as 4.2 mg/L in the river downstream from Mabton.

Extremes in pH have an adverse effect on aquatic life. Values for pH (hydrogen ion concentration in water) in surface waters generally range from about 6 to 9. The pH of the Yakima River is typically between 7 and 8, but exceeds 8.5 on rare occasions.

Turbidity is a measure of suspended matter that interferes with the passage of light. (The direct effect of suspended matter on aquatic life is noted below, under the discussion of solids.) Light interference elevates water temperatures and decreases plant growth by absorbing radiant energy. The turbidity criterion for Class AA and Class A fresh waters is not to exceed 5 nephelometric turbidity units (NTU) over background when the background turbidity is 50 NTU or less. The background turbidity in the Yakima River is less than 50 NTU. Bimonthly measurements in the Yakima River from 1980 to 1985 showed that total turbidity averaged 6.1 NTU (0.7- to 35-NTU range) at Union Gap and 8.5 NTU (2– to 48-NTU range) at Kiona. Measurements taken at 12 stations in the Yakima River from April to October 1974 showed a trend of increased turbidity at successive downstream stations. Average values ranged from a low of 2 NTU at Cle Elum to a high of 17 NTU at Kiona. Turbidity increases downstream of Union Gap as irrigation returns enter the Yakima River.

Total suspended solids (TSS) include all materials (sand, silt, clay, and organic material) held in temporary suspension in the water. Suspended solids have an adverse effect on fish health and plant productivity. Also, these solids settle out in calm water and adversely affect aquatic life by smothering bottom organisms. For these reasons, guidelines have been recommended: maximum levels of 25, 80, and 400 mg/L offer a high, moderate, and low level of protection for aquatic communities, respectively (Corps, 1978). Based on these guidelines, average TSS concentrations in the Yakima River at Union Gap offer a low to moderate level of protection from May through November and a moderate to high level of protection from January through March. Thus, aquatic life in the Yakima River is most likely to be affected by TSS during the winter and early spring.

Nutrients feed the growth of aquatic plants and microbes (algae and bacteria). Excessive nutrient concentrations lead to excessive plant growth. Such growth contributes to depressed oxygen levels from plant respiration and decomposition, and presents an esthetically unpleasant appearance. The principal nutrients that control plant growth are nitrogen and phosphorus. Critical thresholds for these two nutrients are 1 to 2 mg/L nitrate nitrogen (Rinella et al., 1992) and 0.1 mg/L total phosphorus (USEPA, 1986; Rinella et al., 1992) to avoid excessive growth. Bimonthly average nutrient concentrations at Union Gap range from 0.12 to 0.36 mg/L for nitrate-nitrogen and from 0.067 to 0.113 mg/L for total phosphorus. Nitrate levels downstream at Kiona are about five times higher than those at Union Gap during the irrigation season, presumably from fertilizers in irrigation-return water.

Yakima River Basin fish populations are potentially affected by historical use of chlorinated pesticides leaching from soil. Total concentrations of dichloro-diphenyltrichloroethane (DDT) in four of the mid-watershed tributaries (Birchfield Drain, Granger Drain, Sulphur Creek, and Spring/Snipes Creek) have high enough concentrations to cause a chronic response in resident fish populations, although reproduction does not appear to be affected. Resident fish are more likely to be affected than anadromous fish because of their feeding habits and long exposure time.

3.2.2 Groundwater Resources

Shallow unconfined groundwater is generally found next to rivers and streams in the Yakima River Basin. Groundwater sources include rainfall, snowmelt, and irrigation water that infiltrates porous surface soils. The ready infiltration and groundwater recharge make the shallow groundwater susceptible to pollution from the application of pesticides and fertilizers to the land surface, as well as from animal and human wastes.

Deeper and/or confined groundwater is generally derived from rainfall and snowmelt in the higher elevation areas surrounding the watershed. Such groundwater is likely to be less affected by pollution from lowland agriculture and industry because it is not hydraulically connected to surface sources.

Typically, shallow unconfined groundwater is hydraulically connected to the surface waters. At higher elevations and in the upper parts of the watersheds, the rivers and streams may be maintained by discharge from groundwater. In the lower reaches of the rivers and streams, and from behind dams and other surface water impoundments, water may flow into and recharge the groundwater.

Groundwater resources are described below in the area of the Cle Elum hatchery, which would require a year-round source of 0.5 m^3/s (18 cfs) of groundwater from a proposed well field. Water withdrawn from wells at the site would be returned to surface waters through the hatchery outflow.

Surface material at the site consists of about 4.6 m (15 ft.) of Quaternary alluvium and glacial outwash. The surface material is underlaid by a dense clay unit that acts as a confining layer for a confined (artesian) sand and gravel aquifer below. Bedrock consists of sedimentary rocks of the Roslyn Formation.

The USBR investigated the site area in 1989 with a six-line resistivity study to aid in delineating potential locations for water supply wells (USBR, 1990a). Four potential drilling sites were selected, and one observation and one production well were drilled. A flowing artesian aquifer was found at approximately 32.6 m (107 ft.) below the land surface, and aquifer tests indicated that the production well could yield about 0.03 to 0.04 m^3/s (1.3 to 1.5 cfs) for sustained periods of time, based on a maximum pumping rate of 3028 liters per minute (800 gallons per minute) during the test.

CH_2M Hill conducted additional groundwater investigations at the Cle Elum site in 1991, including three seismic refraction line tests to estimate depth and configuration of the bedrock at the site (USDOE, 1991). Based on results from the seismic study and USBR results, CH_2M Hill drilled a 40.6-cm (16-in.) test/production well to a depth of 65 m (213 ft.). The well encountered flowing artesian groundwater at a depth of 34.4 m (113 ft.) in the sand and gravel aquifer, which continued to a depth of 57.6 m (189 ft.).

Aquifer pumping tests were performed at pumping rates up to 5678 liters per minute (lpm) or 1,500 gallons per minutes (gpm) to determine aquifer parameters. Analysis of test data indicated that the well could be expected to sustain a yield of up to 0.09 m^3/s (3.3 cfs). Temperature and test data also suggested that the aquifer is effectively isolated from the Yakima River by the clay layer, and that there is insignificant leakage (recharge) at the site from the river to the aquifer.

Based on their results, CH_2M Hill recommended installation of four additional 40.6-cm-diameter (16-inch-diameter) wells located in a line along the Burlington Northern Railroad right-of-way, each pumped at 0.09 m^3/s (3.3 cfs). These wells, plus two existing USBR production wells, would supply the groundwater requirements for the Cle Elum hatchery.

Groundwater resources at the acclimation sites have not yet been investigated. However, due to the small amounts of water (0.06 m^3/s or 2 cfs) necessary, maintaining sufficient flows is not anticipated to be a problem at these sites.

3.2.3 Floodplains and Wetlands

The proposed YFP facility sites were selected to minimize floodplain impacts. Detailed floodplain studies have been completed for the Cle Elum hatchery facilities; they would be outside the floodway of the Yakima River. The river pump station at Cle Elum, however, would be located at the edge of the floodway, and portions of the facilities would be located in the 100-year floodplain, as designated by Federal Emergency Management Agency flood hazard mapping. All buildings, however, would be constructed above the 100-year flood level.

Although detailed flood studies have not been completed at the acclimation sites, these sites were selected to minimize flood impacts. Preliminary studies were conducted and the facilities were sited by experienced floodplain hydrologists. Detailed floodplain studies would be completed, as necessary, during final design of the facilities.

Based on National Wetland Inventory maps, a variety of wetlands has been identified in the vicinity of the Cle Elum Hatchery and of several of the proposed and alternative acclimation sites (Table 3.2). However, the National Wetland Inventory maps indicate only general habitat types; verification requires a quantitative evaluation (called a *delineation*) of wetland habitats. Qualitative habitat surveys were conducted by the Pacific Northwest Laboratory in fall 1991, spring 1992, and summer 1994 at each of the planned and alternative acclimation sites. Based on the field reconnaissance, wetland habitat potentially affected by planned YFP facilities was identified, and recommendations were made to relocate facilities or acclimation sites. Additionally, a wetland delineation was completed for the Cle Elum hatchery site facilities by CH2M Hill in 1994.

Table 3.2 Wetland Designations of Planned and Alternative YFP Site Locations Based on National Wetland Inventory Maps.

Facility/Location	Wetland Designation
Cle Elum hatchery site	palustrine emergent seasonally flooded/well drained
Cle Elum acclimation site	no wetlands designated on site
Easton acclimation sites	
Easton gravel pond site option	no wetlands designated on site
Easton Dam site option	no wetlands designated on site
Jack Creek acclimation site	riverine upper perennial open water permanently flooded
Clark Flat acclimation site	palustrine forested seasonally flooded
Keechelus acclimation site	no wetlands designated on site

- **Cle Elum hatchery site.** Wetlands in the area consist of the oxbow ponds and excavated depressions that are intermittently surrounded by sedges, cattails, rushes, alder, bitter cherry, chokecherry, black cottonwood, red osier dogwood, wild rose, snowberry, black hawthorn, and blue elderberry.[5] The proposed facility site was located to minimize losses to any wetlands in the area. It is on a terrace above the oxbow ponds, in an area that has previously been disturbed. A fringe of riparian wetland occurs at the site of the proposed discharge from the lower oxbow pond.

- **Cle Elum acclimation site.** No wetlands were identified at the acclimation site.

- **Easton sites - Easton gravel pond site option.** Quarry ponds are located slightly north of the site and an emergent marsh south of the site; however, there are no wetland habitats on the site.

- **Easton sites - Easton dam site option.** No wetlands were identified at the site.

[5] Scientific names for all mentioned species are found in **Appendix C.**

- **Jack Creek acclimation site.** The Jack Creek site is located next to the riparian habitat along Jack Creek, in an open field. The site is located in the floodplain that constitutes the only potential wetland habitat. Vegetation includes primarily cottonwood and willow.

- **Clark Flat acclimation site.** The area adjoining the river at the site is designated palustrine by the National Wetlands Inventory and the WDFW Priority Habitats System Database (WDFW, 1994). This riparian area adjacent to the river supports willows and mature cottonwoods.

- **Keechelus acclimation site.** Although the site itself is not located within a designated wetland, the surrounding area includes a wetland complex associated with Keechelus Marsh (WDFW, 1994).

3.3. Biological Resources: Aquatic

Supplementing the populations of upper Yakima spring chinook salmon in the Yakima River Basin may affect other aquatic resources. Descriptions of the fisheries and other aquatic resources that may be affected by the YFP are provided below. Resident trout resources are described in Section 3.3.1.7, and the resident trout fishery is described separately, in Section 3.7.1, to facilitate discussion of specific concerns raised during the YKFP scoping process.

3.3.1 Fisheries Resources

Around the turn of the century, 600,000 to 960,000 salmon and steelhead returned to the Yakima River annually (Bryant and Parkhurst, 1950; USBR and USFWS, 1976; YIN et al., 1990). The Yakima River contained spring, summer, and fall chinook salmon; sockeye salmon; coho salmon; and summer steelhead. Wild sockeye and coho salmon are now extinct; the handful of sockeye and coho salmon now present in the Yakima River Basin are the result of strays from other Columbia River watersheds or hatchery plants of nonlocal fish into the Yakima River. They have not established naturalized populations in the Yakima River. Summer chinook are believed to be extinct, but this has not been confirmed. Spring and fall chinook salmon and summer steelhead are present, but at a fraction of their original numbers. The 5-year mean annual return of salmon and steelhead to the Yakima River system is approximately 5,500 adults. Species of concern are discussed below.

3.3.1.1 Spring Chinook Salmon

Spring chinook salmon are prized as sportfish and for commercial, ceremonial, and subsistence fishing. Spring chinook salmon historically comprised one of the largest anadromous fish runs in the Yakima River Basin. Smoker (1956) estimated spring chinook salmon production from the Yakima River alone accounted for about 13.8 percent of the total Columbia River spring chinook salmon run in the early 1950's.

The historical size of the spring chinook salmon run has been estimated at about 200,000 fish (YIN et al., 1990). Since 1957, however, annual returns of spring chinook salmon to the Yakima River have ranged from 166 to 9,442 fish, with the 1990-94 average at 2,941 fish (Fast, per. comm., 1994).

The capacity of the Yakima River to support spring chinook salmon smolts has been estimated using two computer models: the Council's model and the instream flow incremental methodology (flow model). The estimated smolt capacity for the Yakima basin, as derived from the Council's model, ranges from 2.4 million for current production areas and present conditions to 3.8 million, including all potential habitat with all habitat improvements. The flow model predicts the smolt capacity at 1.5 million under current conditions.

Based on 2 years of extensive genetic analysis by WDFW (Busack et al., 1991), there appear to be three genetically distinct substocks of spring chinook salmon in the Yakima River Basin: the American River, Naches River, and upper Yakima stocks. These stock distinctions are based on differences in electrophoretic data, age composition, and observations of spawning timing between 1989 and 1993.

Adult spring chinook salmon begin migrating upstream past Prosser Dam in late April and have completed passage by late July. Spring chinook salmon begin spawning in the American River in late July, and the other Naches populations spawn about 4 weeks later. Upper Yakima River populations spawn in early-to-mid September and usually reach peak spawning by late September. American River and Naches populations reach peak spawning by mid-August and mid-September, respectively. All spring chinook salmon populations have completed spawning by mid-October. American River spring chinook salmon return primarily as 5-year old fish, while adults destined for the upper mainstem of the Yakima River are generally 4 years old.

Historical and current distribution of Yakima spring chinook salmon are illustrated in Figure 3.1. The historical spawning areas for Yakima spring chinook salmon include the Yakima River upstream from the City of Ellensburg, the Naches River, the Cle Elum River (upstream and downstream from Lake Cle Elum), the Tieton River (north and south forks), Rattlesnake Creek, and the Bumping, Little Naches, Teanaway, and American rivers. Other areas that may have been important are the Cooper and Wapatus rivers and Taneum, Swauk, Manastash, Wenas, Cowiche, Ahtanum (plus tributaries) and Logy creeks.

Spring chinook salmon currently spawn in the Yakima River upstream from the city of Ellensburg and immediately downstream to Roza Dam; the Cle Elum River downstream from Lake Cle Elum; the mainstem Naches, Bumping, Little Naches, and American rivers; and Rattlesnake Creek.

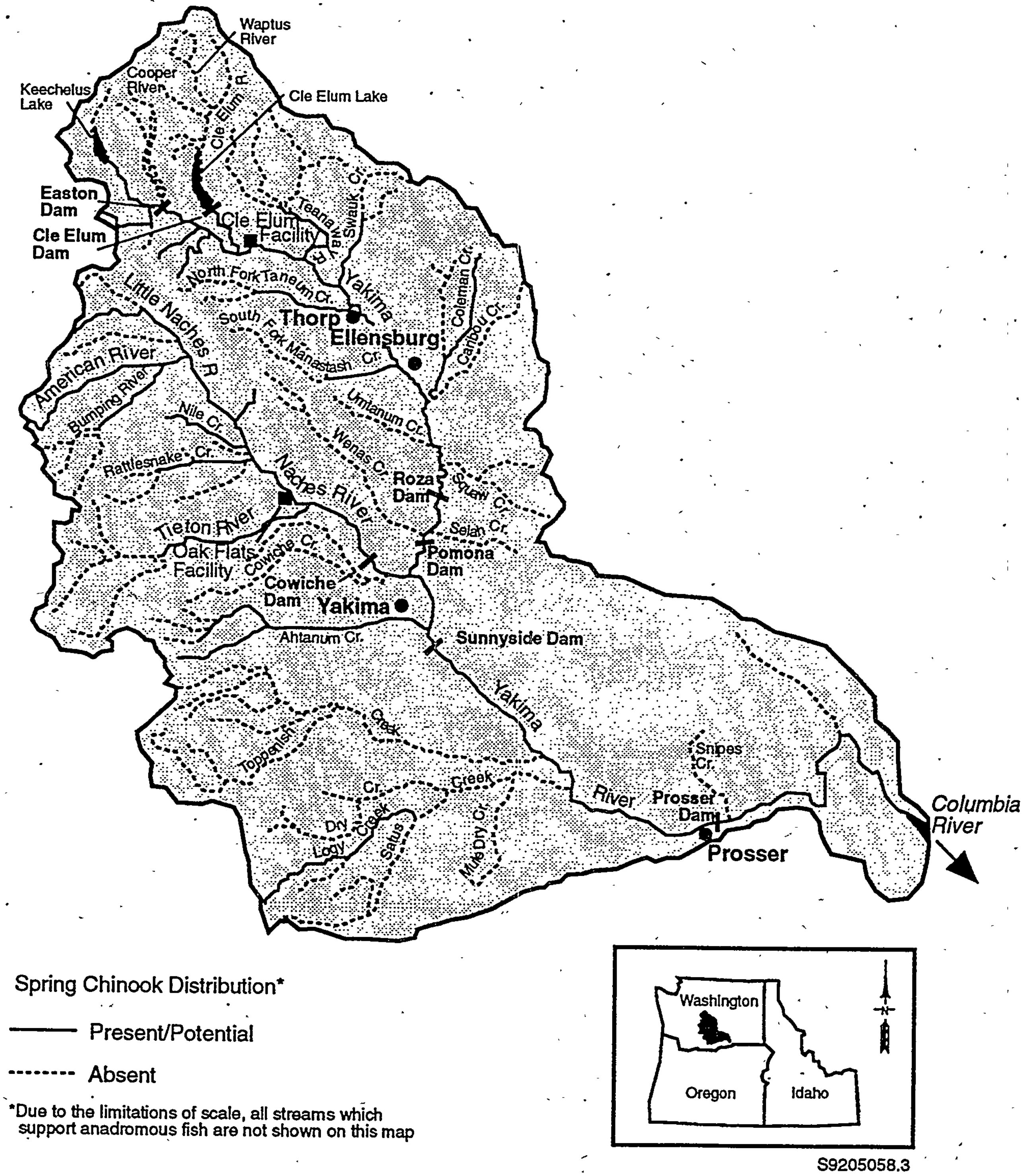

Figure 3.1 Historical Distribution of Yakima Spring Chinook Salmon.

Spring chinook fry emerge from the gravel from late March through early June. The juveniles rear in the Yakima for 1 year before outmigrating to the ocean. The smolt outmigration occurs from late March through early June at Prosser. The average date at which 50% of the smolts have migrated past Prosser is April 30. Adults can return from the ocean after 1, 2, 3, or 4 years, with the Upper Yakima stock generally 2-year ocean fish and the American River stock mostly 3-year ocean fish.

Causes for Decline

About 90 percent of the Yakima spring chinook salmon fishery was lost between 1850 and 1900. A portion of this decline was attributable to lower Columbia River fisheries. The in-basin causes of this decline include:

1. construction of unladdered dams (especially Pomona Dam around 1880 and Sunnyside Dam in 1893) that completely blocked adult migration during part of their run;
2. entrainment of fry and smolts in unscreened diversion canals (few of which were screened before 1934);
3. periodic destruction of spawning beds by downriver log drives that forced large volumes of water to be released from dams like the one at Pomona;
4. intensive local fishing;
5. irrigation activities;
6. elimination of braids and natural floodways by diking and channelization; and
7. drastic reduction in the number of beavers and beaver ponds, and the resultant loss of natural water storage and rearing habitat (Davidson, 1953).

Constraints on Natural Production

Spring chinook salmon production in the Yakima River Basin is limited by both too-high and too-low instream flows at the wrong times of the year, lack of passage around irrigation diversions in tributaries, degraded riparian and instream habitat, and low oxygen levels from excessive water temperatures in the lower basin.

3.3.1.2 Summer Chinook Salmon

Little is known about the historical Yakima River summer chinook salmon population levels. Recent estimates for the historical run size, however, place the combined salmon run of fall and summer chinook salmon at up to 250,000 fish. Natural production might result in a run of around 10,000 summer chinook salmon adults, estimated using parameters for the Wenatchee River stock (YIN et al., 1990).

In the Wenatchee River, adults ascend to the middle and upper reaches of the river during summer and early fall. Spawning occurs in late September and early October

(WDF/WDW, 1990). Juveniles emerge from mid-February through mid-April, rearing as they migrate through the Wenatchee and Columbia rivers. Peak outmigration occurs in June and July, with migrants continuing to pass mainstem dams through August.

Historic spawning and rearing areas for summer chinook salmon are believed to have been in the middle reaches from Sunnyside Dam to Roza Dam on the Yakima River and in the lower Naches River from the mouth to the Tieton River. The last summer chinook spawning nest (redd) was recorded in 1970, and summer chinook salmon may now be extinct in the Yakima River.

Causes for Decline

The in-basin causes for historic decline include construction of unladdered dams, entrainment of juveniles in unscreened diversion canals, log driving and sudden releases of water, intensive local fishing, diking and channelization, and loss of natural water storage and rearing habitat. Additionally, irrigation withdrawals resulted in low flows and high water temperatures in July and August, the period during which summer chinook salmon adults would normally migrate in the mainstem.

Constraints on Natural Production

Factors limiting natural production of summer chinook salmon in the Yakima River are high water temperatures, low flows, predation, and poor water quality downstream of Sunnyside Dam during July and August. The water temperature and flows in the lower river are affected by slow-movement and shallow-water exposure to sunlight, as well as by warm silt-laden irrigation returns. Flow subordination from power plants would likely provide improved passage. Likelihood of improvements to water temperature in the middle and lower river is considered "slight" (USBR/WDOE, 1987).

3.3.1.3 Fall Chinook Salmon

Fall chinook salmon were fairly abundant in the Yakima River Basin. Historical production of fall chinook salmon may have been as high as 250,000 adult fish (YIN et al., 1990). Little is known about the historical distribution of fall chinook salmon within the Yakima River, although the production area is believed to have been confined to the area between the Sunnyside Dam and the Columbia River confluence (Fast et al., 1990). There are no data describing the historical run timing, age composition, sex ratio, size-at-age, fecundity, or population structure of Yakima fall chinook salmon.

Data suggest the portion of the Yakima fall chinook salmon run that spawns upstream from Prosser Dam averages approximately 853 fish (based on counts at Prosser Dam from 1983 to 1992). Some of these fish likely originated in the Marion Drain, a 27.4-km (17-mi.) canal carrying irrigation return water, located 58 km (36 mi.) upstream from Prosser Dam. Significant spawning also occurs downstream from Prosser Dam. Fall chinook juveniles rear for several months in the Yakima basin and migrate past Prosser from mid-April through early July, with the average date of May 31 for when 50% of the smolts have passed Prosser.

Based on adult counts at Prosser Dam, the upper river run begins around the second week in September, peaks after mid-October, and is completed by the third week of November. The movement of spawners into the Marion Drain may be triggered by water surges associated with shutting down the irrigation diversion to Satus Ridge and raising of the Marion Drain control gate.

The Preliminary Design Report for the project (BPA, 1990b) assumed a single fall chinook salmon population with the life history traits identical to those of Hanford Reach fall chinook salmon (Howell et al., 1985). A reevaluation of this assumption reveals uncertainty regarding the actual adult age structure and sex ratio of mainstem Yakima fall chinook salmon. The uncertainty is due to 1) problems associated with locating and sampling adults in a large turbid river system such as the lower Yakima River and 2) biases inherent in spawning ground sampling methods (Peterson, 1954; Clutter and Whitesel, 1956; Eames and Hino, 1981; Eames et al., 1981).

New genetic information about the Marion Drain stock (Busack et al., 1991) suggests that there are two populations of fall chinook salmon occurring in the Yakima River Basin. *The larger population* is found in the mainstem Yakima River, with the highest concentrations downstream from Benton City. The lower mainstem fish may represent approximately 70% of the total spawning population in the Yakima River, although there are no accurate census data for mainstem spawners downstream from Prosser Dam. The mainstem fish are genetically indistinguishable from fall chinook salmon found in the Hanford Reach area of the mainstem Columbia River and associated hatchery stocks (commonly referred to as upriver brights). *The second population* (Marion Drain) is genetically different from the mainstem Yakima River population, and is similar to fall chinook salmon populations found in the Snake (Lyons Ferry Hatchery) and Deschutes rivers. The Marion Drain population may represent original Yakima fall chinook salmon, and the mainstem population is composed of a mix of original Yakima fall chinook salmon hybridized with hatchery releases of Hanford Reach/Priest Rapids-type fish (including Umatilla strays).

As discussed in Section 1.4, under the CRFMP of *U.S. v.* Oregon, the YIN's current fall chinook program in the Yakima River Basin includes the production and release into the Yakima of 1.7 million smolts from the Little White Salmon National Hatchery. Between 1983 and 1994, the smolts were transported and directly released into the Yakima River. With funds provided under the Mitchell Act program, the YIN has developed acclimation facilities in the vicinity of Prosser Dam for final rearing and release of these fall chinook smolts; they began operation in 1994.

Causes for Decline

The in-basin causes for decline of Yakima fall chinook salmon are high smolt and presmolt mortality from predation, sedimentation of spawning substrate, degraded water quality in the lower river, irrigation activities, and losses at lower Yakima River dams.

Preterminal harvests have had some impact on fall chinook salmon production. Exploitation rates of 48% have been estimated for the lower Columbia River (below Bonneville Dam), Alaska, and ocean fisheries for the period 1984-1993. However, there has been no significant inriver Yakima fall chinook salmon fishery for at least 40 years.

Constraints on Natural Production

Factors limiting fall chinook salmon production within the Yakima River Basin may be smolt and presmolt mortality, sedimentation in spawning areas downstream of Sunnyside Dam, and water quality and high temperatures in the lower Yakima River.

3.3.1.4 Coho Salmon

Indigenous natural coho salmon no longer occur in the Yakima River Basin. The only natural production now occurring is thought to be the result of hatchery fish outplantings in the basin or strays from hatchery releases outside of the Yakima basin. Mullan (1984) estimates that coho salmon comprised 19 percent of the total salmon runs upstream of Roza Dam between 1949 and 1967. This run of coho salmon may have numbered 114,000 fish annually. Unfortunately, there are no historical data on age composition, size at age, or stock structure of Yakima River coho salmon.

In recent years, 700,000 coho salmon smolts have been released into the Yakima River Basin annually as part of the *U.S. v. Oregon* CRFMP. These releases were intended to promote and diversify local fishing opportunities for the YIN. The program uses early-run fish from lower Columbia River hatcheries (mainly Cascade Hatchery), and has produced very few returning adults. The average number of coho observed at Prosser Dam from 1989 to 1992 was 140. However, as discussed in Section 1.4, the YIN initiated a program in 1994 to acclimate these fish in ponds near Wapato.

Coho salmon spawn in late October to November. Columbia River coho salmon typically spend 1 year in freshwater before outmigrating as yearling smolts in the spring (April-May). After outmigrating, coho salmon spend about 18 months at sea before returning to spawn. Sexually precocious males (jacks) return to spawn after 6 months at sea.

The historical distribution of coho in the Yakima basin is shown in Figure 3.2. The historical mainstem production areas for Yakima coho salmon were probably restricted to the reaches upstream of the mouth of the Teanaway River. Virtually all major upper Yakima River tributaries (Teanaway River and Taneum, Manastash, Swauk, Big, and Umtanum creeks) supported coho salmon. The Naches River and tributaries upstream from the Tieton River also produced substantial numbers of coho salmon. Lower production has been reported in the upper Tieton River (upstream from Rimrock Lake), the upper Cle Elum River and its tributaries (upstream from Cle Elum Dam), and Ahtanum and Logy creeks (Bryant and Parkhurst, 1950; Smoker, 1956; Anonymous, 1967; Mongillo and Falconer, 1980).

Causes for Decline

The in-basin causes for decline include construction of unladdered dams, entrainment of juveniles in unscreened diversion canals, sudden releases of water for log driving, irrigation activities, intensive local fishing, diking and channelization, and loss of natural water storage and rearing habitat. Factors outside the basin included the advent of the major dams on the mainstem Columbia and the steady increase in fishing effort in the ocean and lower mainstem Columbia.

Constraints on Natural Production

Factors limiting natural production of coho salmon in the basin are lower mainstem Columbia River and ocean harvest rates and smolt mortality within the mainstem Yakima River. An issue that affects the enhancement strategy for coho salmon is lack of tributary spawning and rearing habitat, and water limitations imposed by existing uses.

3.3.1.5 Sockeye Salmon

The once-abundant Yakima River sockeye salmon is extinct. The sockeye run contributed significantly to the Columbia River fishery at the turn of the century. Before dam construction, four sockeye nursery lakes were accessible to sockeye salmon: the 502-ha (1,240-ac.) Keechelus Lake (blocked 1904), the 1110-ha (2,744-ac.) Kachess Lake (blocked 1904), the 802-ha (1,982-ac.) Cle Elum Lake (blocked 1909/1910), and the 255-ha (631-ac.) Bumping Lake (blocked 1910). Sockeye salmon juveniles used Bumping, Cle Elum, Kachess, and Keechelus Lakes for fresh-water rearing. Spawning areas were probably located above these lakes. Based on the historic nursery area of the Yakima River Basin, and using a mean productivity rate of sockeye salmon in Lake Wenatchee of 38.8 adults per ha (15.7 adults per ac.) (Mullan, 1986) and an upward adjustment of the Wenatchee production rate (to account for losses at mainstem dams that did not occur historically), the historical annual Yakima River sockeye salmon run is estimated to have been approximately 200,000 adult fish (Robison, 1957; YIN et al., 1990).

The sockeye salmon run was eliminated so long ago that accurate details of sockeye salmon life history in the Yakima River Basin are unknown. In the Wenatchee River, sockeye salmon adults migrate into the river from July through September, with spawning occurring from the middle of October to the end of November in tributaries to Lake Wenatchee. Eggs incubate until the end of February when they hatch, with emergence occurring in March through May. If hatched in lake tributaries, newly emerged fry migrate downstream into the lake where they rear for 1 to 2 years. Smolt migration usually occurs between May and June of the following year.

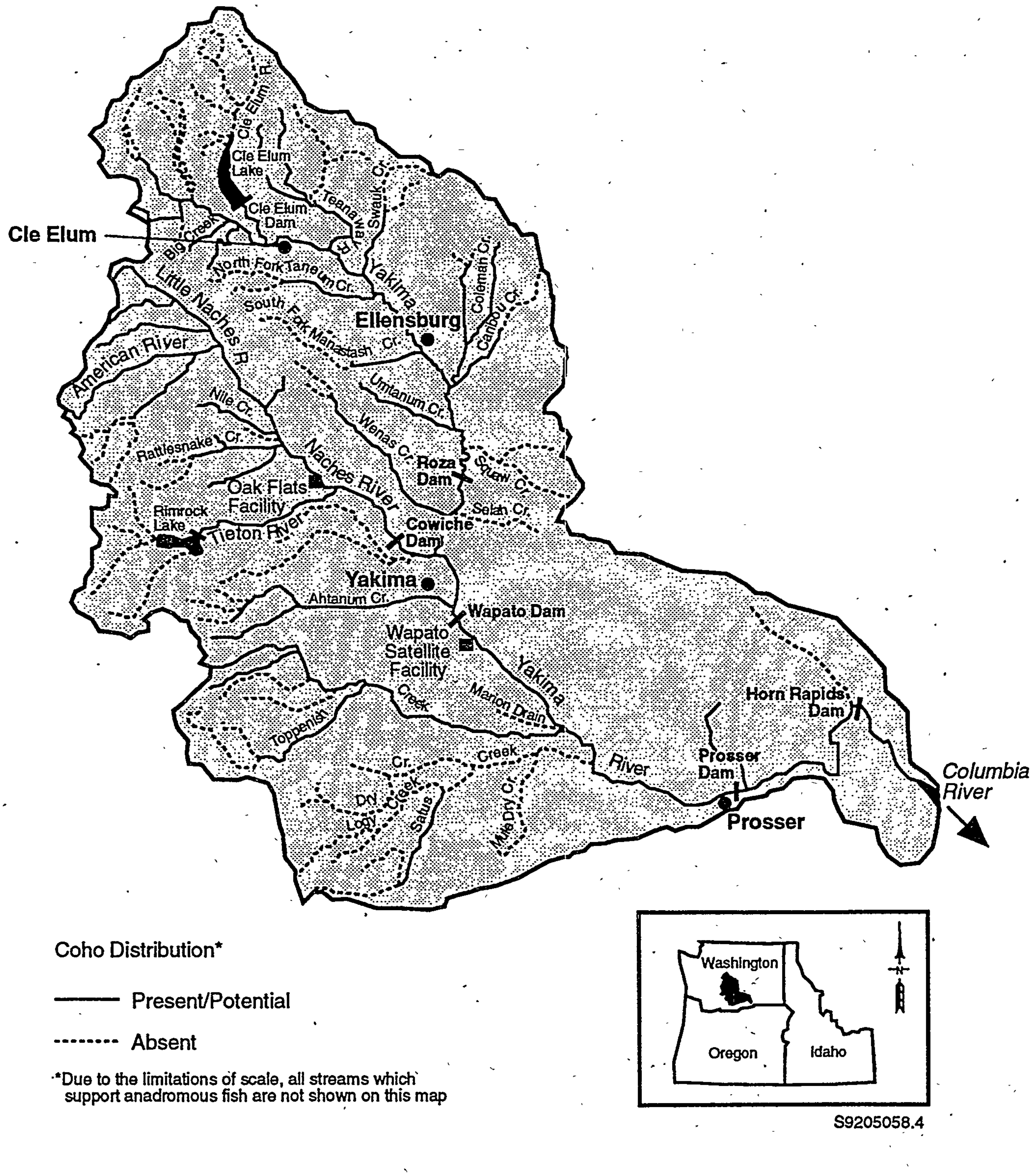

Figure 3.2 Historical Distribution of Yakima Coho Salmon.

Causes for Decline

Habitat destruction and overfishing drastically reduced run abundance before the early 1900's. Sockeye salmon runs were eliminated from upper reaches of the Yakima River Basin with development of irrigation storage reservoirs in the early 1900's. Since 1986, the NMFS has been conducting a feasibility study to determine whether introduced sockeye salmon could successfully outmigrate from Cle Elum Lake and the Yakima River system (Flagg et al., 1988, 1989). A final report on the study is anticipated to be completed in October of 1995.

Constraints on Natural Production

The one major constraint to natural production of sockeye salmon in the Yakima basin is the lack of passage for juveniles and adults at all of the major irrigation storage reservoirs in the system. No significant natural production of sockeye salmon can occur in the basin until both upstream and downstream passage is provided at these facilities.

3.3.1.6 Summer Steelhead

Historical summer steelhead runs were estimated to range between 80,000 and 100,000 adult fish. Summer steelhead were found in all the reaches of the mainstem Yakima River and its tributaries that supported spring chinook salmon, as well as in many other tributaries. Because steelhead spawners prefer smaller streams with steeper gradients than do spring chinook salmon, virtually all accessible permanent streams and some intermittent streams once supported steelhead. Even today, some steelhead spawn in such lower-valley tributaries as Spring and Snipes creeks. There was probably no downstream limit to summer steelhead distribution.

The historical stock structure of wild summer steelhead in the Yakima River is unknown. Biological data describing age composition, length, sex ratio, or fecundity of Yakima summer steelhead begins in 1979. The relative numbers of wild fish vary from year to year. In recent years, total returns have averaged about 1,700 fish, with hatchery fish contributing about 10 to 20 percent of the total run as monitored at Prosser Dam. Returns of hatchery summer steelhead to the Yakima River were from fish reared at the former WDW's Yakima Hatchery. Before 1990, releases from this facility averaged slightly under 100,000 (with ranges of 50,000 to 200,000) summer steelhead smolts that were released mainly into the Naches River. From 1991 through 1994, production from this hatchery was reduced to about 33,000 smolts, or the number of smolts required for investigations of species interactions in the Yakima River system above Roza Dam. No further releases of steelhead smolts from the Yakima Hatchery are planned.

Production areas for steelhead occur throughout the Yakima River Basin. Little production, however, occurs upstream from Roza Dam. The greatest number of steelhead estimated to have passed above Roza Dam in any of the past five years is 125 fish.

An effort to ascertain the number of steelhead stocks in the Yakima River was initiated in 1989 (Busack et al., 1991). Three genetically distinct steelhead populations have been identified in the river by electrophoretic analysis. The three populations are Naches River and tributaries, and the Yakima River upstream of Roza Dam.

No evidence of gene flow from hatchery steelhead was found in Satus or Toppenish Creeks, but gene flow from hatchery steelhead was apparent in the Naches River and the Yakima River above Roza Dam. In addition, some gene flow has occurred between hatchery rainbows and steelhead in the Naches and upper Yakima.

Juvenile life history traits of steelhead are more diverse than those of Pacific salmon. Steelhead from the Satus and Toppenish systems apparently emerge during May through June. Steelhead in the Naches system emerge during June through August. This asynchrony is doubtless the result of the relatively lower water temperatures in the Naches River. In the Yakima Basin, naturally produced steelhead smolts migrate predominantly at age 2; however, some smolts also migrate at ages 1, 3, and 4. Steelhead smolts migrate past Prosser from early March through mid-June, with the average date of April 30 for passage by Prosser of 50% of the smolts. Adults can rear in the ocean for 1 to 3 years before returning to the Yakima basin to spawn. Unlike Pacific salmon, which die after spawning, steelhead can recover and return to the ocean for 1 or more years and return to the basin to spawn again.

Causes For Decline

The in-basin causes for decline include construction of unladdered dams, entrainment of juveniles in unscreened diversion canals, log driving, fishing, diking and channelization, and loss of natural water storage and rearing habitat. Steelhead-specific causes for decline include diversions and riparian degradation, and the completion of Roza Dam in 1940 severely limited access to about half of the steelhead habitat. (In 1989, steelhead access was improved via modification of the fish ladder system.) As the hydraulic regime of the Yakima River has been altered by flow management activities, high summer flows have led to suboptimal rearing conditions for emergent fry. In addition, low spring flows have affected upstream migration of adults.

Constraints on Natural Production

Natural production for most salmonid stocks in the Yakima River Basin, including steelhead, is limited by high summer flows and suboptimal spring flows in the mainstem, lack of passage around irrigation diversions, degraded riparian and instream habitat, and excessive temperatures in the lower portions of the Toppenish and Satus creek drainages. As noted above, the existing hydraulic regime provides severe conditions for steelhead/ rainbow fry: their life history requires that they emerge from spawning gravels in the summer. This may be a severe bottleneck to natural production of this species.

3.3.1.7 Resident Salmonids

Eight species of resident salmonids are known to exist in the Yakima River drainage, including the resident form of summer steelhead, or rainbow trout. Other resident fish species include Westslope cutthroat trout, bull trout, mountain whitefish, and kokanee. Introduced species include eastern brook trout, brown trout, and lake trout. Brown and lake trout have a very limited distribution, but eastern brook trout are more widely distributed and occupy areas similar to those used by cutthroat trout. Cutthroat and bull trout generally inhabit clean cold water of high elevation streams, whereas rainbow trout occupy the river's mainstem and the low- to mid-elevation areas of tributaries. Of particular interest to anglers are the resident rainbow trout in the mainstem Yakima River above Roza Dam. The rainbow trout fishery in this area is arguably one of the best stream angling opportunities for wild trout in the State (see Section 3.7.1 for a discussion of the rainbow trout fishery).

Preliminary genetic analyses of resident rainbow trout in the upper Yakima River have discerned five genetic groups (Pearsons et al., 1993). Using electrophoretic methods, the analysis found that rainbow trout and steelhead were genetically similar where they occurred together. Hatchery-origin rainbow trout have hybridized with wild rainbow trout and steelhead in the Yakima River (Campton and Johnston, 1985; Pearsons et al., 1993). In general, the genetic contribution of hatchery rainbow trout to wild trout appears to be greatest in the mainstem Yakima River and low-elevation tributaries, and least or non-existent in high-elevation tributaries. Despite the level of interbreeding, the groups identified as rainbow trout still are genetically discernible from four hatchery rainbow trout strains that have been released into the river in the past.

Rainbow trout spawn throughout the entire upper Yakima basin, with the possible exception of some high-elevation portions of a few tributaries (Pearsons et al., 1993; Pearsons et al., 1994). In the mainstem of the upper river, rainbow trout spawn in clean gravels, next to cover, with velocities averaging about 0.6 m/second, a water depth of 0.3 m, and redd areas of 1.9 m^2. They spawn in close proximity to the bank, and may use side-channel habitat. Rainbow trout in the upper river spawn from February through June, although some fall spawning may also occur (Hindman et al., 1991; McMichael et al., 1992; Pearsons et al., 1993). The peak time of spawning is positively correlated with elevation, with spawning beginning first in low-elevation areas and later in high-elevation areas (Pearsons et al., 1993; Pearsons et al., 1994).

Taneum and Swauk creeks have the highest densities of rainbow trout of the upper Yakima River (0.10 fish/m^2 in index sites) (Pearsons et al., 1994). In the mainstem Yakima River, trout densities averaged about 300 fish/km in five index sections (Pearsons et al., 1993; Pearsons et al., 1994). The length of rainbow trout at each age was smaller in tributaries than in mainstem sections, with the exception of low-elevation streams such as Cherry and Wilson creeks. Rainbow trout in the upper Yakima basin generally do not live longer than six years, with few reaching lengths of over 56 cm (22 in.).

Kokanee (landlocked sockeye) are present in a number of lakes in the Yakima River Basin including Cle Elum, Kachess, Keechelus, Rimrock and Bumping lakes.

3.3.1.8 Resident Non-salmonids

Few studies have been conducted on non-salmonid resident fish populations in the Yakima River. Patten et al. (1970) surveyed fish populations in the Yakima River during 1957 and 1958 and found 33 species present. The USBR (1979) collected four new species in 1979, bringing the total to 37 species, of which 10 were from the family *Salmonidae*. The six most abundant resident non-salmonid species present in the basin were chiselmouth, redside shiner, northern squawfish, largescale sucker, speckled dace, and torrent sculpin. Carp are the most abundant exotic non-salmonid species. Important non-salmonid sport species in the Yakima River below Prosser include exotics such as largemouth and smallmouth bass and channel catfish.

Fish assemblages in the tributaries of the upper Yakima River are typical of coldwater assemblages found throughout the Pacific Northwest. In 1993, the WDFW identified three major assemblage types in the upper Yakima River system (Pearsons et al., 1994). Assemblage types were distinguished using stream elevation above sea level, temperature, and size. Fish species that characterized assemblages in sites that were relatively high in elevation and within small streams (elevation 2,040-3,620 m, discharge 0.002-0.7 m^3/s. stream, width 2.7-9.3 m) were bull trout, cutthroat trout, and brook trout. Assemblages inhabiting relatively low elevation sites in small streams (elevation 1,540-2,040 m or 5,052-6,693 ft., discharge 0.001-0.01 m^3/s or 0.035-0.35 cfs, width 1.8-3.9 m or 5.9-12.8 ft.) were represented by a high proportion of speckled dace. Assemblages inhabiting relatively low elevation sites in larger streams (elevation 1,430-1,960 m or 4,692-6,430 ft., discharge 7.3-29.4 m^3/s or 258-1,038 cfs, width 33.8-56.6 m or 110.9-185.7 ft.) were characterized by northern squawfish, chiselmouth, various suckers, redside shiners, longnose dace, mountain whitefish, and spring chinook salmon. Rainbow trout and sculpins were ubiquitous and were present in all assemblages. Bridgelip suckers make spawning migrations into some tributary streams such as Umtanum, Swauk, and Taneum creeks. These suckers migrate shortly after rainbow trout migrate into the same streams to spawn (Pearsons et al., 1993; Pearsons et al., 1994). Leopard dace have not been collected recently in areas that contained them during surveys in 1957 and 1958 (Patten et al., 1970; Pearsons et al., 1993; Pearsons et al., 1994).

3.3.2 Other Aquatic Resources

Little information about Yakima River aquatic resources other than fish is available. Available information concerning these resources and a brief description of ongoing studies are summarized below.

In 1975 to 1976, the U.S. Environmental Protection Agency (EPA) collected benthic macroinvertebrates from four sites in the Yakima River to develop a suitability index for swimming and fishing in the Yakima River (CH_2M Hill, 1977). These data were not published but were later summarized by the United States Geological Survey (USGS) in their surface water assessment of the Yakima River Basin (Rinella et al., 1992). Organisms belonging to the blackfly family were dominant at the proposed Cle Elum hatchery site in August. Caddisflies were the most abundant taxa in November and December samples from Cle Elum, and in the summer and winter samples from Ellensburg and Yakima. Aquatic earthworms were dominant in August and November samples at Kiona. Caddisfly larvae were dominant in December. Density or abundance of aquatic insects appears to decrease in the lower Yakima River. For example, the average number of organisms (over three sample periods) decreased from 2,300 individuals and 28 taxa at Ellensburg to 120 individuals and 12 taxa at downstream Kiona (Rinella et al., 1992). Kiona also had the lowest numbers of insects considered to be sensitive to degraded water-quality conditions. However, other factors, such as increased temperature, fine sediment, and organic carbon, likely contribute to observed differences in the composition of the aquatic community (Rinella et al., 1992).

The USGS has collected extensive data on periphyton and macroinvertebrates in the Yakima River at several sites from 1987 to 1990. In addition, fish tissue samples were collected for analysis in 1989 and 1990. The USGS also has data concerning the chlorophyll pigment content and biomass of periphyton from the Yakima River at Cle Elum, the Naches River near North Yakima, and the Yakima River at Kiona. Dissolved and suspended carbon analyses are also available for these sites.

Information regarding the aquatic macroinvertebrate community in the upper Yakima River Basin has been collected through a cooperative project between the WDFW and Central Washington University (Paul James, unpublished data). This project was conducted in the Teanaway River over a 4-year period (1991-1994). The study found that 40-50% of the benthic insects by number were mayflies, with stoneflies, caddisflies, and true flies composing the remaining 50-60%. Aquatic macroinvertebrates found in the drift were composed of terrestrial insects (35-50%), mayflies (20-30%) and true flies (15-25%). The Cle Elum District of the USFS is also initiating a monitoring program in streams, but to date no data have been published.

3.4 Biological Resources: Wildlife and Vegetation

The construction of facilities for the Yakima Fisheries Project may affect vegetation and wildlife. These biological resources are described below.

3.4.1 Vegetation and Wildlife

The proposed facility sites along the Yakima River and its tributaries are located in naturally forested and nonforested areas east of the Cascade Mountains in Yakima and Kittitas Counties. Forested areas are characteristically dominated by conifers and the nonforested areas by desert shrubs and grasses. Some of the forested areas have been logged, and much of the nonforested area has been grazed by domestic livestock. Some areas are under cultivation. A narrow band of broad-leaved, deciduous trees forms a more-or-less continuous riparian corridor along the shorelines of the Yakima River and its tributaries.

Wildlife use of the areas varies with vegetation and the amount of disturbance at the site. Riparian vegetation and adjoining cultivated fields in the Yakima River Basin provide habitat for elk and a variety of other big-game species. Breeding and wintering birds also use the Yakima River and shoreline vegetation.

Vegetation and wildlife use near the proposed Cle Elum hatchery facilities are described in the EA (BPA, 1990a) and summarized below. The existing vegetation and wildlife at each of the proposed and alternative acclimation sites are also described. Discussion is limited to wildlife species of regulatory and recreational importance, with general community descriptions provided, where appropriate.

- **Cle Elum hatchery site.** The proposed site is located on a parcel that consists of an old oxbow or river channel cut off from the Yakima River by the Burlington Northern Railroad. The approximately 200-ha (500-ac.) parcel includes wetlands, riparian forest, upland forest, and several large ponds. The proposed site for the hatchery development supports second-growth ponderosa pine/Douglas fir upland forest. Black cottonwood also grows abundantly throughout the area. Understory vegetation is sparse.

  Wildlife observed during winter site visits included osprey, common snipe, killdeer, belted kingfisher, hairy woodpecker, northern flicker, red-breasted nuthatch, raven, black-capped chickadee, golden-crowned kinglet, varied thrush, and Douglas squirrel. One beaver dam was noted.

  The riparian area along the Cle Elum River below Cle Elum Lake and the mainstem Yakima River in the vicinity of the Cle Elum site is used by wintering bald eagles and cavity-nesting waterfowl. Large ponderosa pines and cottonwoods along the river that provide perches for wintering bald eagles are limited on the site. A pond on the northeast end of the site about 610 m (2000 ft.) away from the proposed developed area contains two large snags that support osprey nests. The area is used by cavity-nesting waterfowl that nest along the John Wayne Trail, about 2 km (1.2 mi.) from the site.

  The site is located within an elk wintering area (WDFW, 1994); about 100 animals use the area along the Cle Elum River below Cle Elum Lake Dam. The elk range on either side of the river and have wander into the southern portion of the site.

  Large woody debris abundant on the site provides habitat for reptiles and amphibians. Reptile and amphibian species observed on the site include sharp-tailed snakes, alligator lizards, Western fence lizards, garter snakes, and rubber boas (Renfrow, 1994).

- **Easton gravel pond acclimation site.** The western half of the Easton gravel pond option is surrounded by a forested stand of approximately 90% canopy. Understory vegetation includes snowberry, bedstraw, alder, vine maple, cottonwood, blackberry, thimbleberry, oceanspray, and rose. Several large-diameter cottonwoods are located at the periphery of the site, and a section of alder adjoins the site. Several snags occur throughout this stand. The site is located next to the I-90 corridor, and adjacent forest land has been heavily logged. The eastern half of the site is characterized by highly disturbed soils that have been imported by physical deposition or from flooding. Cottonwoods occur along the eastern edge of the site. Ground and understory vegetation is patchily distributed and includes daisy, fireweed, mullein, aster, goldenrod, and dock. The western edge of the site is bordered by a willow, cottonwood, and alder thicket which adjoins a backwater of the river. The backwater is vegetated by rush, willow, and cattail. A forested stand adjoining this pond includes young-age-class cottonwood. Understory vegetation includes snowberry, vine maple, hawthorn, coltsfoot and thimbleberry. Based on observations at the site, great blue herons, downy woodpeckers and other cavity-nesting species, and amphibians are found at the site.

- **Easton Dam acclimation site.** The site is located next to existing facilities and may be the location of a former switchyard. The river is about 0.16 to 0.2 km (one-tenth to one-eighth of a mile) downslope and to the north of the site. Location of the return pipe would require removal of about 10 trees from the adjoining sideslope that descends at a 45-degree angle about 4.6 to 6 m (15 - 20 ft.) to the river. The site is opposite Lake Easton State Park and is highly disturbed. Vegetation was likely planted with both woody and evergreen as well as herbaceous species. Vegetation includes mullein, clover, vetch, thistle, daisy, squirrel tail, strawberry, rush, pearly everlasting, tumblemustard, cottonwood, snowberry, Ponderosa pine, Douglas fir, kinnickinnick, Oregon grape, blackberry, knapweed, willow, bursage, and lupine. No wildlife species were observed during the site visit.

- **Jack Creek acclimation site.** The shoreline vegetation along Jack Creek consists of cottonwood and alder. The site is located in an open field. The adjacent forest is dominated by Douglas fir and ponderosa pine with some grand fir. Some of the more mature trees in the area may provide perch sites for bald eagles. The common shrubs are snowberry, red osier dogwood, hawthorn, and vine maple. The grassy area supports wheatgrass, knapweed, yellow salsify, and yarrow.

  The Jack Creek site is open range and has been heavily grazed by cattle. Over-grazing likely has altered the complement of wildlife in the area. The area is also a hunting unit and receives repeated recreational use by campers, hunters, and anglers.

- **Clark Flat acclimation site.** The shoreline vegetation at the Clark Flat site consists of a narrow corridor of cottonwood and alder associated with shrub willows, wild rose, snowberry, red osier dogwood, choke cherry, and mock orange. There is some reed canary grass, a wetland indicator species, growing along an irrigation ditch. The site is in an open area with scattered shrubs of bitterbrush. The common herbs include knapweed, Carey's balsamroot, Sandberg's bluegrass, cheatgrass, and Russian thistle. The site is not in the coniferous forest zone, but there are a few scattered ponderosa pine trees and a single oak tree in the general area. The adjacent slopes support bitterbrush and bluebunch wheatgrass.

  The Clark Flat site is situated in a field that shows sign of overgrazing. The few bitterbrush in the area may attract deer in the winter. Tall trees along the Yakima River likely provide perch sites for bald eagles during the winter and fall. A private home is located within 0.8 km (0.5 mi.), and a railroad track traverses the north side of this site. The adjacent slopes are grazed by livestock and may also be used by mule deer and elk as winter range.

- **Cle Elum acclimation site.** The shoreline vegetation at the Cle Elum acclimation site is characterized by a corridor of tall cottonwood and shorter-stature alder trees. The site is located in a swale probably formed by excavation to create a levee located between the site and the river. Herbaceous plants are sparse, with knapweed dominating the herbaceous vegetation growing on the levee. The nearby slopes are vegetated with ponderosa pine and Douglas fir.

  The Cle Elum site has previously been disturbed and is situated between two gravel roads that show signs of frequent use. There is a large marsh within a kilometer of the site, but the project facilities are not likely to affect the wildlife quality of the marsh.

- **Keechelus acclimation site.** Shoreline vegetation at the Keechelus Dam site is sparse because extremely steep banks confine water flow to the main stream channel. Several cottonwood trees are rooted in the slope opposite the acclimation site. The site would be located in a small clearing in the adjoining coniferous forest, east of the creek. The forest stand includes a mixture of Douglas fir, western hemlock, western red cedar, lodgepole pine, western white pine, grand fir, and Pacific yew. The understory consists primarily of bracken fern, Oregon grape, blackberry vines, and bear grass.

  The Keechelus Dam site is situated next to the concrete banks of the existing outflow, outside of the adjacent timber stand. The timber stands contains critical habitat for the spotted owl, but no birds were observed during site surveys (see section 3.4.2). A pair of osprey was observed nesting within 1.6 km (1 mi.) of the site. A gray wolf adult and two juveniles were reported about 3.2 km (2 mi.) from the proposed acclimation pond site in 1992 (WDFW, 1994).

3.4.2 Threatened, Endangered, and Special Status Species

Section 7(c) of the Endangered Species Act (ESA) (16 CFR 1536) requires Federal agencies to consult with the USFWS and/or the NMFS, as appropriate, to ensure that actions they authorize, fund, or carry out do not jeopardize the continued existence of a listed species or result in the adverse modification or destruction of their critical habitat. Upon determination that an endangered or threatened species may be present in the area of a proposed action, the responsible agency must prepare a Biological Assessment (BA) to identify how the listed species might be affected. A BA is being prepared for this project to address the listed species discussed below, and any necessary consultation will be completed prior to the final EIS. Candidate and petitioned species would not be addressed in the BA, but their status would be monitored and consultation would be initiated if they were added to the threatened or endangered species list.

Population segments of several anadromous fish species have been listed under the ESA in the upper Columbia River system in recent years (e.g. Snake River sockeye, fall and spring/summer chinook). None of the listed species or population segments or their critical habitats are present in the Yakima subbasin, and it is unlikely they would be affected by the proposed project. Most other anadromous species in the Columbia River system have been included in coastwide status reviews now being conducted by the NMFS. These species include steelhead, coho, chinook and sockeye salmon in the Yakima River Basin. Decisions regarding potential listings have not yet been made by NMFS. The occurrence of these species in the Yakima River drainage is discussed in section 3.3.1 of this RDEIS.

The USFWS recently determined that listing of bull trout under the ESA was "warranted but precluded." This species exists in the Yakima River system. Nonmigratory populations of bull trout are primarily restricted to cold, headwater streams across the Pacific Northwest. Other bull trout populations exist in the upper Yakima (e.g., Cle Elum, Waptus, Kachess, and Keechelus lakes; Kachess River; and Box Canyon, Mineral, Rocky Run, and Gold creeks). Bull trout also occurs in the Naches subbasin. A resident population exists in the upper reaches of the North Fork of the Teanaway River and has been encountered during recent sampling activities of ongoing species interactions studies (Pearsons et al., 1993) (see Section 3.3.1.7). For example, bull trout have been collected in juvenile outmigrant sampling operations in the North Fork of the Teanaway River and Jungle Creek. Also, a small number of individuals has been observed in index sections of the mainstem Yakima River near Ellensburg and Cle Elum; another was sampled from the mainstem of the Yakima River near the mouth of the Naches River during steelhead broodstock collection efforts in 1993. Finally, researchers observed a single bull trout while monitoring a trap located at the mouth of Swauk Creek near its confluence with the Yakima River mainstem.

According to the USFWS, several Federally listed bird species may occur in the vicinity of the various facilities. These include the bald eagle, northern spotted owl, marbled murrelet, and peregrine falcon. The gray wolf may occur in the vicinity of the Jack Creek and Keechelus Dam sites (M. Hinchberger, USFS, pers. comm.). The grizzly bear may occur near the Cle Elum and Jack Creek sites.

According to the list provided by the USFWS, several Federal candidate species may also occur within the project area: Columbian sharp-tailed grouse, ferruginous hawk, loggerhead shrike, Cascades frog, harlequin duck, northern goshawk, northern red-legged frog, spotted frog, western sage grouse, Pacific fisher, and Hoover's tauschia. (Frederick, 1994) (see Appendix D for list). However, WDFW personnel have indicated that only the Cascades frog, harlequin duck, northern goshawk, northern red-legged frog, spotted frog, and Pacific fisher are likely to occur in the vicinity of the project sites (B.Renfrow, WDFW, pers. comm.)..

The species listed by the USFWS as threatened or endangered are discussed below.

- **Bald Eagle.** During the 1988 Midwinter Bald Eagle survey, 38 bald eagles were counted in the Yakima River Basin. The 5-year average (1984-88) was 33 eagles. Wintering eagles are attracted by fish, waterfowl, and big-game and domestic livestock carcasses. Their movements depend largely on available food sources such as those listed above, perches, and roost sites. A BA of the project's effect on bald eagles was prepared as part of the EA (BPA, 1990a). BPA determined that the project would have no effect on nesting or wintering bald eagles, their habitat, or food supply.

  Surveys were conducted by the Pacific Northwest Laboratory from December 1991 through May 1992 to determine bald eagle use of habitat near proposed acclimation sites. All tributaries of the Yakima River and the Yakima River itself with proposed acclimation sites were surveyed. Primary concentrations of eagles were observed on tributaries to the Yakima River. All eagles observed were perched in large trees, with the exception of two adults, one of which was found soaring over Nile Creek and the second near Nelson Springs. Additionally, a survey for bald eagle nesting activity was conducted in May 1993 by the Pacific Northwest Laboratory. The aerial survey covered the entire Yakima River mainstem from Stampede Pass to the Columbia River, and the Naches River. No bald eagle nesting was observed.

  The Jack Creek and Clark Flat sites have been identified by the WDFW (1994) as bald eagle wintering areas. The floodplain and associated wetlands of the Clark Flat site are used by approximately 25 to 30 wintering eagles (WDFW, 1994).

- **Northern Spotted Owl.** The USFS and the WDFW were contacted regarding the occurrence of northern spotted owls in the vicinity of the proposed acclimation and hatchery sites. No suitable habitat is present at either the Cle Elum acclimation or hatchery sites, or at the Clark Flat or Easton acclimation sites. The Jack Creek site is included within both the 2.9- and 4.3-km (1.8- and 2.7-mi.) radii for habitat management for the Teanaway and Jack Creek owls. The most recent observations for Jack Creek were recorded in 1993 (WDFW, 1994). The Cle Elum site is located within the 2.9- and 4.3-km (1.8- and 2.7-mi.) radii for habitat management for the Prospect Creek and Oso Creek owls. The most recent sighting of the Prospect Creek owl was during 1994 (WDFW, 1994). The Keechelus site is located within the 2.9- and 4.3-km (1.8 and 2.7-mi.) radii for habitat management for the Mosquito Creek, Jack Creek, Cold Creek, and Little Kachees Lake Owls. Habitat surveys were conducted at all sites in 1993 by the Pacific Northwest Laboratory. No suitable owl habitat was identified at of any of the sites; however, suitable habitat was located in the vicinity of the Keechelus and Jack Creek sites. A calling survey was also conducted at the Keechelus site by Pacific Northwest Laboratory in 1993; no spotted owl activity was recorded. Calling surveys have been conducted at the Jack Creek site by others.

- **Peregrine Falcon.** Peregrine falcons require rocky cliffs or outcrops for nesting and use marshes, lakes, rivers, and open habitat for foraging. Peregrine falcons may travel up to 16.1 km (10 mi.) between nesting and feeding habitat. The WDFW inventoried portions of the Wenatchee National Forest for active nest sites; however, no active nests have been identified. Individuals migrate through the region during August and October, and have been observed in the forest. Use of habitat by peregrine falcons can be affected by timber harvest, road construction, and recreation.

- **Marbled Murrelet.** No observations of marbled murrelets have been reported in the WDFW database for the project sites; however, specific surveys for marbled murrelets have not yet been conducted. Murrelets use mixed stands of mature and old-growth conifers and range a maximum reported distance of 80.5 km (50 mi.) from ocean waters (Pacific Seabird Group, 1994). Murrelet habitat would be expected only at the Jack Creek and Keechelus sites. The Jack Creek site is out of the range of the species. Although the Keechelus site may border murrelet nesting area, the proposed activity would not remove murrelet habitat from the site.

- **Grizzly Bear.** Surveys for suitable grizzly bear habitat in the vicinity of the proposed acclimation sites were conducted during spring 1992. No recent sightings of grizzly bear have been reported near the Keechelus, Clark Flat, or Easton sites. In 1989, one grizzly bear sighting was reported for the Teanaway Butte area, approximately 16 km (10 mi.) north of Cle Elum (Almack, 1990). The home range of the individual would overlap the Cle Elum and Jack Creek sites.

- **Gray Wolf.** Gray wolf howling surveys were conducted in the Teanaway watershed (Jack Creek site) during early summer 1992. An unconfirmed siting of a gray wolf was reported for the vicinity of the North Fork of the Teanaway River during 1992. No recent sightings have been confirmed in this area, but the site lies within the known historical range of the species. One adult and two yearling gray wolves were reported near the Keechelus site in 1992 (WDFW, 1994).

Sharp-tailed snakes, a State "monitor" species, have been reported to occur at the Cle Elum site (Renfrow, 1994).

No endangered or threatened plants are known to occur at any of the proposed sites (WDFW, 1994), although the Keechelus and Easton gravel pond sites may provide habitat for unique species in the adjacent wetlands. A number of rare vascular plant species are known to occur in Kittitas County. These are listed by the Washington Department of Natural Resources as endangered, threatened, or sensitive species (see Appendix D). In addition to Hoover's tauschia, these include pine broomrape, green-fruited sedge, swamp saxifrage, adder's tongue, and Victorin grape-fern.

3.5 Air Quality and Noise

3.5.1 Air Quality

Air quality in the Yakima River Basin ranges from good to excellent. Air quality at all YFP sites complies with the National Ambient Air Quality Standards and Washington State standards. Higher elevation areas in the upper basin have excellent air quality. Lower valley areas can have high levels of natural windblown particulates originating from fallow croplands during windy periods. Burning crop and forest residues and vehicle travel on gravel roads are often sources of particulates during the summer and fall. The urban Yakima area, which is surrounded by hills and ridges, can experience poor atmospheric dispersal of pollutants from automobiles and industry during winter inversions. Occasionally, standards for carbon monoxide and suspended particulates are exceeded for short periods in the Yakima metropolitan area.

3.5.2 Background Sound Levels and Noise

Ambient noise levels at the potential facility sites in the Yakima River Basin are probably typical for rural to semi-urban locations and range from 40 to 50 decibels (A-weighted) (dBA) at rural locations such as the Cle Elum hatchery site, to 50 to 60 dBA at more urbanized locations closer to highways (such as the Easton gravel pond site).

3.6 Socioeconomic Resources

The YFP may affect socioeconomic resources in Kittitas and Yakima Counties. The population trends of these two counties are summarized in Table 3.3. Yakima County is classified as metropolitan, while Kittitas County is classified as nonmetropolitan. While some economic impacts could extend to other counties in the area, Kittitas and Yakima Counties would experience the greatest economic impact because of the size and type of proposed facilities in these counties, the size and nature of the local economies, and the interaction of economic flows (BPA, 1990b, Appendix D). Current socioeconomic resources for these areas are described below.

Table 3.3. Population Trends of Affected Counties

Year	Kittitas	Yakima
1930	18,154	77,402
1940	20,230	99,019
1950	22,235	135,723
1960	20,467	145,112
1970	25,039	144,971
1980	24,877	172,508
1990	26,725	188,823
1993	29,200	197,000

3.6.1 Kittitas County

Kittitas County covers 6009 km^2 (2,320 mi^2). The estimated total population for the county in 1993 was approximately 29,200, with 4.9 persons per km^2 (46.1 persons per mi^2). Blacks, Indians, and Hispanics make up 5.4% of the population. The principal economic activities in Kittitas County are education (Central Washington University), food processing, agriculture, and services. Agriculture crops include hay, grains and fruit; ranching is also important. The 1992 sources of total income are shown in Table 3.4. The inclusion of Central Washington University accounts for the high percentage of government activity. Per capita income is $10,490; the county ranks 32 out of 39 Washington counties. With a 1993 unemployment rate of 11.1%, Kittitas County is designated a distressed area.

Table 3.4 Earnings and Personal Income in 1992 (in Thousands of 1995 Dollars), and as a Percent of Total, for Kittitas and Yakima Counties

Industry	Kittitas County		Yakima County	
Agriculture	$22,806	4.7%	$356,371	9.8%
Mining	$72	0%	$483	0%
Construction	$9,775	2.0%	$96,545	2.7%
Manufacturing	$25,357	5.2%	$284,961	7.9%
Trans./Utilities	$17,812	3.7%	$102,066	2.8%
Trade	$53,119	10.9%	$452,074	12.5%
Services	$44,650	9.2%	$549,685	15.2%
Government	$103,085	21.2%	$372,314	10.3%
Transfer Payments & Misc.	$209,712	43.1%	$1,348,489	37.2%

Source: Regional Economic Information System on CD by the US Bureau of Economic Analysis, Economics and Statistics Division

3.6.2 Yakima County

Yakima County covers 11,067 km^2 (4,273 mi^2). The estimated total population in 1993 was about 197,000. Population density is about 17.8 persons per km^2 (46.1 persons per mi^2). Thirty percent of the population is of Black, Indian or Hispanic origin. The principal economic activities in Yakima County are agriculture, food processing, wood products, and manufacturing. Yakima County is one of the nation's richest agricultural counties, and leads the State in apple, pear, peach, and grape production, while other agricultural specialties such as hops and mint also play a major role. The 1992 personal income sources are shown in Table 3.4. Per capita income was $10,380. With an unemployment rate of 12.5%, the Yakima Metropolitan Statistical Area is the only Metropolitan Statistical Area in the State to be designated a distressed area.

The Yakama Reservation lies primarily within Yakima County. It comprises a significant cultural, social, and economic subset of the county, and will receive a large portion of the YFP economic impact because of the YIN's status as the Lead Agency for the YFP for operations, maintenance, monitoring, and evaluation activities.

Because of the Yakama Reservation, Yakima County has a signficant Native American population of 8,420, or 4.5% of the population. Per capita annual income for the Native American population from the 1990 census was $5,676; this is 53% of Yakima County's per capita annual income and only 38% of the Washington State per capita annual income. The Native American population has low labor participation rates, and unemployment rates exceeding 15%. Of all persons living on the Yakima Reservation, 32.8% have incomes below the poverty level.

3.7 Recreational Resources

Recreational activities near potential YFP sites include sportfishing, rafting, and floating. The Yakima River is not designated as a Wild and Scenic River. The following sections discuss aspects of the wild trout fishery (a primary sportfishery), aesthetics and visual resources, and other recreational resources in the Yakima River Basin. Unless otherwise noted, information is taken from the EA (BPA, 1990a).

3.7.1 Wild Trout Fishery

The primary recreational fishery in the Yakima River Basin is trout, with whitefish (winter) fished to a lesser extent. There is presently no recreational steelhead fishery in the Yakima River. The WDFW considers the Yakima River trout fishery of special significance to the State. The Department estimates that 330,000 recreation angler trips are made per year on the Yakima River and tributaries. They also estimate that 108,000 angler trips per year are made to fish above Roza Dam on the mainstem Yakima River. In 1990, the Yakima River was designated a catch-and-release fishery to preserve trout populations in the area. At the same time, the river was opened for year-round fishing.

3.7.2 Aesthetics and Visual Resources

The Wenatchee National Forest has inventoried the visual quality of the forest lands in the vicinity of some of the project sites. In their Forest Plan, the Cle Elum Valley is classified as having "slightly altered" visual conditions. The visual quality objective for the forest lands in the valley is classified as partial retention. This classification allows for minor disturbances which may be noticeable but which do not attract attention.

The **Cle Elum** Hatchery and acclimation sites are located in the vicinity of the Milwaukie, St. Paul, and Pacific railroad right-of-way. Unregulated use and recreation disturbance limit the aesthetic value of the site, although it is located in a natural-appearing setting.

Both of the **Easton** site options lie within a scenic corridor designated by the Washington State Department of Transportation (WDOT). The gravel pond site option is situated in and next to an active WDOT gravel operation. It is bisected by a road maintained for commercial hauling. The Easton Dam site option is located next to a diversion dam, fish screening facility, and the railroad tracks.

The **Jack Creek** and **Clark Flat** sites are located adjacent to areas disturbed previously by agriculture and/or grazing. The sites are immediately adjacent to USFS recreation and county roads, respectively, and provide access for recreation upstream within the watershed.

The **Keechelus Dam** site lies within a scenic corridor designated by WDOT. However, existing recreation disturbance and disturbance associated with dam maintenance and unregulated use of the site limit the aesthetic value of the site.

3.7.3 Other Recreational Resources

As mentioned above, the Yakima River is used extensively for fishing. Other recreational activities in the Yakima Basin include hunting, camping, cross-country skiing, and off-road vehicle (ORV) use.

Hunting near the Yakima River includes upland bird, elk, deer, some waterfowl and a few bighorn sheep. Many campgrounds along the river are managed by the U.S. Bureau of Land Management (BLM) in the mid-summer for river rafters and in the autumn and winter for fishers and hunters.

The upper portions of the Yakima River Basin are used for winter snowmobiling and cross-country skiing. There is a snow park below Keechelus off Interstate 5.

The Yakima River and its tributaries also are used for rafting and floating, occasionally near project sites. In the stretch of the Yakima River around Cle Elum and Ellensburg, boating is discouraged because of potentially dangerous obstructions. However, boaters continue to use this area. The river level drops substantially in September when the flow from the three large upstream reservoirs is curtailed, and rafting activities diminish along this stretch of the river. The heaviest rafting and floating use on the Yakima River occurs in the stretch between Ellensburg and Roza Dam. No potential sites for the YFP are located along this portion of the river.

3.8 Archaeological, Historical, and Cultural Resources

A series of cultural resources surveys and test excavations were conducted at proposed central and satellite facility sites for the YFP by personnel from Archaeological and Historical Services (AHS), Eastern Washington University, during 1988-89. Additional work has since been conducted for the proposed acclimation sites. The findings from these activities are discussed below. As required by the National Historic Preservation Act (see Section 5.7), all cultural resources discovered were evaluated as to their eligibility for the National Register of Historic Properties (NRHP). AHS has consulted with YIN officials and the State Historic Preservation Office (SHPO) regarding all prehistoric cultural resources identified at the proposed facility sites.

The findings and recommendations for the Cle Elum hatchery site were discussed in the EA (BPA, 1990a). Surveys were also conducted for the acclimation sites by AHS. A summary of these findings and results of additional surveys follow.

- **Cle Elum Hatchery Facility.** No cultural materials were found during the initial site visit in 1989. An additional survey of the proposed expansion site by AHS in 1991 also revealed no cultural resources. No cultural resources are likely to exist intact on the property because it has been severely disturbed.

- **Easton sites.** No cultural resources were observed at the Easton gravel pond site option, and none are likely to exist. The site has been completely disturbed by gravel excavation for construction of Interstate 90.

  A portion of an abandoned railroad siting was located at the Easton Dam site option, but it is not one of the significant property types affiliated with the Milwaukee Railroad. The archaeological report concludes that there would be no effects of the proposed project on significant cultural resources.

- **Jack Creek site.** No cultural resources were observed at the Jack Creek acclimation site. The route of the proposed supply pipe appears to have been disturbed. The area has been logged, and a flood channel and old roadbed cross the proposed site.

- **Clark Flat site.** No cultural resources were observed at the Clark Flat site, and none appear likely to exist. The site has been considerably disturbed.

- **Cle Elum site.** No cultural resources were observed at the site, and none are likely to exist, since it appears to be heavily disturbed.

- **Keechelus site.** Two historic resources were noted at the Keechelus Dam site. A historic dump is recorded as part of the Keechelus Lake Construction Camp (USFS Site 0617-03-23, Houck and Gamble, 1984) at the proposed location for facility development. Presumably associated with construction of Keechelus Dam, the dump has been disturbed by logging activities and does not appear likely to yield information important to the history of the dam. The dump does not meet criteria for inclusion in the NRHP; the SHPO determined that the site was not eligible for the NRHP. A steel pony-truss bridge with wood plank deck spans a small creek on the access road connecting the site with Interstate 90. The bridge is an excellent example of a significant bridge type and is potentially eligible for inclusion in the NRHP.

  Load limits of vehicles using the pony-truss bridge should not exceed 10 tons as posted. Should need arise to exceed that tonnage or to replace or alter the bridge, a determination of eligibility for the NRHP would be prepared for the bridge.

3.9 Resources Management

Resource management activities related to the YFP include fisheries management, land-use management, and solid and hazardous waste management, all of which are discussed below.

The State and Tribal project managers have regulatory authority over fisheries and fisheries production in the Yakima River Basin, but not over many land and water uses that may affect the fisheries resources. Water quality and quantity issues are subject to laws administered by the WDOE. Instream and nearstream activities are subject to the State Hydraulic Code and other State and Federal laws. Section 404 of the Clean Water Act (CWA) authorizes the Corps to issue dredge and fill permits for United States waters. The USFS controls land-use activities on National Forest System lands.

There are numerous ongoing cooperative programs to protect and promote fish and fish habitat in the Yakima River Basin. These include:

- Yakima River Basin Water Enhancement Project - This project is a result of Federal legislation passed in 1994. When fully implemented, the emphasis of the project will be to increase the reliability of irrigation water for farmers and for fish by emphasizing conservation through modernization of equipment and delivery systems. Besides the USBR, participants include the state and federal agencies, the YIN, irrigation districts, and individual landowners.

- Timber/Fish/Wildlife Agreement - This agreement, commonly referred to as TFW, provides a forum and adaptive management context to address a multitude of Washington's forest practice issues and their interaction with other forest values, including fish resources. It provides a linkage to the Forest Practices Act and is advisory to its regulatory body, the Forest Practices Board. In the Yakima River Basin, a wide range of participants are involved including state agencies, YIN, USFS, timber companies, environmental organizations, irrigation interests, and universities.

- Yakima Resource Management Cooperative - This group was formed to develop and implement a cooperative management review process for forested areas of the upper Yakima River Basin. The group is comprised of representatives from the timber industry, state and federal resource agencies, the YIN, and environmental groups. Fish habitat interests include road management, watershed analysis and restoration, stream sediment/temperature management and monitoring, and database management.

- Fish Habitat Enhancement Programs - Several projects are currently being undertaken that are directly aimed at instream and riparian habitat improvements. First, the YIN recently implemented projects under the "Jobs for the Environment" program, which is directed at improving degraded elements of the upper Yakima River floodplain. Specific activities have been directed at improving nursery habitat for newly emergent salmon fry, and creating and improving their overwintering habitat. The YIN has lead this effort and collaborates with WDNR, Plum Creek Timber Co., Washington Central Railroad, WDFW, USBR, BLM, and Kittitas County. A second major effort is the Salmon Corps, a part of the Americorps program, whereby local volunteers work to restore and enhance salmon habitat. Examples of their activities in the Yakima River Basin include fencing projects to protect streambanks and improve riparian vegetation, and planting of trees and other vegetation along streams to stabilize streambanks, provide shade, and trap inflow of sediments. This program is directed by the YIN, and involves local landowners, the City of Yakima, Yakima County, BPA, and USBR. Finally, the Yakima River Salmon Enhancement Project is a joint venture between the WDOT, the Yakima Greenway Foundation, the YIN, and the Salmon Corps. This project is attempting to improve overwintering habitat for salmon by introducing large woody debris into selected side channels of the Yakima River between Union Gap and Selah.

- System Operations Advisory Committee - Resulting from court decisions regarding water resources in the Yakima River Basin, this group advises USBR on matters pertaining to flow and its impacts on fish resources. Participants include representatives from the YIN, WDFW, NMFS, USFWS, and irrigation districts.

- Proposed Lower Teanaway Flow Enhancement Project - This proposed project is intended to improve flows for fish while maintaining delivery for irrigation needs. Cooperators include BPA, landowners, irrigation district, WDFW, and YIN.

- Proposed Re-regulation Reservoir Below Sunnyside Dam - This project has progressed through its design stage but has not yet been implemented. It is intended to bolster flows in a particular section of the river to stabilize those needed for fish. This project involves the YIN, USBR, WDFW, irrigation districts, and WDOE.

- Operation of Adult and Juvenile Fish Counting Facilities - Cooperative agreements exist to monitor adult and juvenile fish at various existing facilities in the Yakima River Basin. These efforts involve the USBR, BPA, irrigation districts, YIN, and WDFW.

3.9.1 Fisheries Management

3.9.1.1 Harvest Management

Fisheries management activities are outside the scope of the proposed project. However, changes in policies and planned efforts would influence mitigation efforts in the basin. The YFP is designed to operate within the constraints of existing harvest management regimes. BPA has no harvest regulatory authority. The tribal and state fishery managers recognize the need for adequate harvest management regulations and will regulate the fisheries to assure that YFP objectives are met.

In the Yakima River Basin, salmon and summer steelhead harvest management is a cooperative venture between the YIN and the WDFW. A subbasin harvest management planning process currently exists for spring chinook salmon and summer steelhead.

A summary of the status of specific resource management activities in the Yakima River Basin is below; a more detailed discussion is presented in Appendix E.

Existing Harvest Management and Managers

Existing harvest is managed by several agencies with different (and sometimes overlapping) jurisdictions.

Ocean Harvest Management

The coastal states regulate harvest in ocean waters out to 4.8 km (3 mi.) from the U.S. coast. The North Pacific Fishery Management Council and the Pacific Fishery Management Council regulate harvest from 4.8 to 322 km (3 to 200 mi.) off the U.S. coast. Decisions on management in U.S. waters are made in the context of public hearings and review. Canadian ocean waters are managed by the Canadian Department of Fisheries and Oceans. All of these fisheries are regulated under the guidelines of the Pacific Salmon Treaty.

Columbia River Harvest Management

The Washington and Oregon Departments of Fish and Wildlife independently regulate non-Indian recreational harvest for salmon, steelhead, and other species in the Columbia River system. The WDFW controls recreational salmon, steelhead, and other fisheries in the Washington tributaries of the Columbia River. ODFW regulates recreational fishing for salmon, steelhead, and other game species in Oregon tributaries. Their regulations are also adopted in the context of public hearings. Technical staff of Tribal, state, and Federal co-managers develop recommendations for Indian and non-Indian commercial fisheries. The Columbia River Compact, a Federally sanctioned compact between the states of Washington and Oregon, is empowered to approve regulations for non-Indian commercial fisheries.

The YIN and other Columbia Basin Treaty Indian Tribes (Nez Perce, Umatilla, Warm Springs) regulate Indian treaty fishing in Zone 6 (Bonneville to McNary dams) within the bounds set by the Columbia River compact. Tribal regulations generally are adopted also by the states into state law. Other Tribes in the Columbia Basin also have treaty fishing rights.

Yakima River Basin Harvest Management

In the Yakima River Basin, salmon and steelhead harvest management is a cooperative venture between the YIN and the WDFW. A subbasin harvest management planning process currently exists for spring chinook salmon and summer steelhead.

Tribal subsistence fishing regulations for the Yakima River are adopted by the Yakama Nation Tribal Council. Technical staff prepare a set of options for fisheries that will provide for tribal fishing opportunity while meeting conservation needs. The Tribal Council reviews each option and adopts the one that best balances the needs of tribal anglers with the needs of the resource.

The annual harvest plan for Yakima River spring chinook salmon is part of a larger process aimed at providing equitable harvests for treaty and nontreaty anglers in terminal fisheries above Bonneville Dam. The State and Tribal co-managers have agreed that treaty/nontreaty harvest sharing need not be 50/50 in each terminal fishery, so long as the sum of projected harvests across all co-managed terminal fisheries is approximately 50/50 or is considered "equitable." This allows flexibility between the parties to prioritize harvest needs in terminal areas. (For details on the subbasin harvest planning process, see Appendix E.)

Relationship between Harvest Management and Supplementation

Without supplementation, harvest management alone could not serve to rebuild spring chinook status above current levels. In the Yakima River Basin, current harvest levels on wild and naturally-spawning populations of chinook salmon are relatively minor. For example, the CRFMP requires that harvests of Yakima River spring chinook salmon in the Pacific Ocean and mainstem Columbia River remain below 12 percent when the aggregate upriver spring chinook salmon run does not reach the Bonneville Dam escapement goal of 128,000. This has been the case every year since 1977. Since 1989-94, the average terminal harvest rate in the Yakama River Tribal subsistence fishery has been 7.9 percent of the total adult run returning to Chandler. Despite these low harvest rates, spring chinook salmon stock abundance in the Yakima River is not increasing. (For information on steelhead, see Appendix E.)

As mentioned in previous sections, coho are believed to be extinct in the Yakima River Basin. Under the CRFMP, there is no formal harvest allocation scheme for upper Columbia River coho stocks, and the YFP coho program would be unlikely to materially affect current management. As part of the preferred alternative for the YFP, the feasibility of increasing coho returns to improve harvest opportunities in the basin will be evaluated. Positive results from the evaluation may lead to future consideration of coho restoration or supplementation using broodstock obtained from Yakima River returns.

Non-Supplemented Harvest

Harvest of a wide variety of species not targeted for supplementation is also managed within the Yakima subbasin by the WDFW. These include warmwater game fish species such as bass, perch, channel catfish, resident coldwater fishes (e.g. rainbow trout, bull trout), whitefish and squawfish. These species must be managed concurrently to achieve a balance among objectives such as recreational opportunity, resource protection and maintenance, and impact on YFP supplementation activities or target stock rebuilding.

3.9.1.2 Predator Control

Predation was identified as an important factor potentially influencing current and potential production of anadromous fish in the Yakima River Basin (Watson et al., 1993). Predators (e.g., northern squawfish, channel catfish, bass, and gulls) may be responsible for high losses of smolts before they leave the Yakima River Basin. Low flows in April and May may exacerbate smolt losses in the Yakima River.

Although no program has yet been implemented, a study of the potential impact of predators on anadromous salmon would provide valuable information on the extent to which predation influences smolt mortality and production potential, and would help identify possible means to reduce smolt losses (e.g. predator management).

3.9.1.3 Production

The CRFMP was negotiated in 1987 as an interim settlement to the *U.S. v. Oregon* litigation. This plan provides for the yearly release of 1.7 million upriver bright fall chinook and 0.7 million coho smolts into the Yakima River Basin. The fall chinook and coho smolts are currently being imported from out-of-basin hatcheries on an annual basis. Steelhead previously produced at the WDFW's Yakima hatchery were not produced after 1994.

3.9.1.4 Fish Passage

The council's 1982 Fish and Wildlife Program included the construction of new fish passage facilities in the Yakima River Basin, with a goal of providing protection for rearing and migrating adults and juvenile salmon and steelhead at diversion dams and canals. Construction was begun in 1984. By 1989, construction of new fish ladders and screens was completed on most of the major diversion dams and canals in the Yakima Basin. In 1990, construction began on screening over 60 medium and smaller diversion canals and ditches. Construction of these screens is projected to extend through the year 2000. Twelve of the Phase II screening projects will be operational by outmigration of 1995.

3.9.2 Water Management

A number of water management activities affect the fisheries resources in the Yakima River Basin. These include the following.

3.9.2.1 Quackenbush Decision

In November 1980, U.S. District Judge Quackenbush entered a ruling (*Kittitas v. Sunnyside Valley Irrigation Dist.*) that requires the USBR to operate the Yakima Irrigation Project in such a way as to protect spring chinook redds in the upper Yakima River. This ruling has given rise to the annual "flip-flop" operation, in which releases from basin storage reservoirs are manipulated to prevent dewatering of spring chinook redds.

3.9.2.2 Yakima River Basin Water Adjudication

The adjudication of surface water rights in the Yakima River Basin was initiated by the WDOE. On October 12, 1988, under the caption of *Department of Ecology v. Acquavella et al.*, Yakima County Superior Court No. 77-2-01484-5, the DOE filed its Statement of Facts, which contained the names of all known claimants of water rights in the basin, including the United States of America. In addition to other Federal claims, the United States filed a claim for instream flows on behalf of the YIN. This claim was based upon the Yakama's reserved water rights as established by the Treaty of 1855 (12 Stat. 951, June 9, 1855), which included water rights for fish, wildlife (and other natural resources), irrigation, and other non-agricultural uses.

In November 1990, Yakima Superior Court Judge Walter Stauffacher issued an Amended Summary Judgment in *Acquavella, supra*. In his decision, Judge Stauffacher defined the treaty-reserved instream flow rights for fish as follows:

> "The maximum scope of the diminished treaty water right for fish is the specific 'minimum instream flow' necessary to maintain anadromous fish life in the river, according to the prevailing conditions as they occur. . . ." *Ibid.*

However, the court did not quantify specific instream flow levels, but left the flow level determinations up to the USBR, which relies upon the advice of the Systems Operations Advisory Committee (SOAC). The Partial Summary Judgment was appealed to the Washington State Supreme Court.

On April 22, 1993, the State Supreme Court upheld Judge Stauffacher's Partial Summary Judgment. It is not clear at present what impact this ruling may have upon salmon and steelhead in the Yakima River Basin.

3.9.2.3 Roza and Chandler Power Plant Flow Subordination

For the past several years, the USBR has, in response to drought, curtailed power production at Roza and Chandler power plants in order to provide increased instream flows in sections of the Yakima River. Discussions concerning the level and duration of subordination are continuing.

3.9.2.4 Habitat Improvement

In 1987, the Council initiated the development of an integrated system plan for the Columbia River Basin. The council's Integrated System Plan (YIN et al., 1990) is based on recommendations from fishery agencies and Tribes for each of the Columbia Basin's 31 subbasins. System planning is intended to specify enhancement projects and priorities for implementation over the next several years. Habitat enhancement activities for the Yakima River Basin are identified in the Yakima Subbasin Plan.

The Plans' habitat improvement strategies were prioritized, based on expected smolt capacity increases and other juvenile and adult contributions; estimated costs; and other biological and ecological objectives. Implementing these habitat improvement activities is expected to increase the effectiveness of the YFP. The project managers would integrate the habitat improvement activities with management and planning of the proposed YFP, but these activities would proceed regardless of which YFP alternative were chosen.

3.9.2.5 Increased Streamflows

Fisheries biologists generally agree that unseasonably high or excessively low instream flows (due to irrigation releases and withdrawals) are the largest single in-basin constraint on natural production in the Yakima River Basin. In low-water years, the demand for water for consumptive uses exceeds the water supply available from the Yakima River.

Thus, attempts are being made to address instream flow needs through legislation, cooperation, and other means. Other efforts, which include measures to enhance Yakima River Basin water resources, also are expected to benefit anadromous fish production. In October 1994, legislation was passed by Congress (the Yakima River Basin Water and Conservation Act, Public Law 103-434) to authorize water conservation activities, including improvements to irrigation water delivery systems and a basin-wide water conservation program.

3.9.3 Land Management

Land management activities can affect fisheries habitat in the Yakima River Basin. Several programs are ongoing in the Yakima Basin, including those discussed below.

3.9.3.1 Wenatchee National Forest Land and Resource Protection Program

Much of the salmon and steelhead-spawning and rearing habitat in the Yakima River Basin is located on or near the Wenatchee National Forest. Lands controlled by the Wenatchee National Forest are managed pursuant to the Land and Resource Protection Program. This plan includes protection of and improvement to salmon and steelhead spawning and rearing habitat.

Recently, the Forest Service has adopted the Anadromous Fish Habitat and Watershed Conservation Strategy (or PACFISH). They will follow this strategy to conserve Pacific salmon, steelhead and sea-run cutthroat trout throughout their range in Oregon, Washington, Idaho, and portions of California. Anadromous fish habitat management is also addressed in the President's Forest Plan.

3.9.3.2 Timber, Fish and Wildlife

The Timber, Fish and Wildlife agreement was developed in concert with State agencies, tribes, citizen groups, and the timber industry; the group has assembled to try to develop forest practice rules that accommodate competing demands on resources while maintaining salmon and steelhead spawning and rearing habitat, among other resources, located on state and private timberlands.

3.9.4 Land Use at Proposed Project Facility Sites

Construction of the project facilities would involve a number of sites and land-use policies, plans, and procedures. For example, the Keechelus and Easton Dam sites are owned by the USBR. If these sites were chosen, a grant of a right-of-way would be required for each site. Other land-use policies affecting the Cle Elum hatchery site were discussed in the EA (BPA, 1990a), and are updated and summarized below. Current land-use management at acclimation sites is also discussed below. Ownership and location of the facility sites are summarized in Table 3.5. Consistency with local land use plans is addressed in Section 5.2, and farmlands are addressed in Section 5.10 of this EIS.

- **Cle Elum hatchery and acclimation site.** The Cle Elum hatchery and acclimation site is located on private land within a forested area. The site is not improved for recreation, but there is some recreational use.

- **Easton site.** One alternative tract for the Easton gravel pond site option is owned by the WDOT; the other alternative tract is privately owned.

  The Easton Dam site option is located on the south side of the Yakima River just downstream of Easton Dam. It is in a field situated between the fish screens for the Main Canal, a dirt road paralleling the river, and some railroad tracks. It is owned by USBR.

Table 3.5 Location and Ownership of Land at Proposed Facility Sites

Site	Location	Ownership
Cle Elum hatchery	T20N, R15E, Sections 27, 28, 33, 34	Burlington Northern RR, Plum Creek Timber Roslyn, WA
Easton acclimation site		
Easton gravel pond site option	T20N, R13E, Section 12, SE/4, SW/4	WDOT and private
Easton Dam site option	T20N, R13E, Section 11, NW/4, SE/4	USBR
Jack Creek acclimation site	T21N, R16E, Section 8, E/2, E/2	Boise Cascade Corp. Yakima, WA
Clark Flat acclimation site	T19N, R17W, Section 28, SW/4	Privately owned
Cle Elum acclimation site	T20N, R15E, Section 33, W/2, W/2	Plum Creek Timber Roslyn, WA
Keechelus acclimation site	T21N, R12E, Section 10, SW/4, SW/4 T21N, R11E, Section 12, E/2, E/2	USBR

- **Jack Creek site.** The acclimation site is owned by Boise Cascade, with recreational access provided. It is generally forest land. Although not improved for recreational use, it is used by campers, hunters, and fishers. Cattle grazing has occurred in the vicinity.

- **Clark Flat site.** The Clark Flat site is situated in a privately owned field that has been extensively grazed. An illegal dump site on the property appears to have been cleaned up.

- **Keechelus site.** The Keechelus Dam site lies on Federally owned land, but is too close to the dam to be of recreational significance. Public access to this location is generally closely controlled by the USBR.

3.9.5 Solid Waste and Hazardous Materials Management

Facility operation would generate a number of waste materials. The following subsections describe current solid waste and hazardous materials management plans developed for the YFP.

3.9.5.1 Solid Waste

Because most of the proposed facility sites are currently vacant or have very little development, a limited amount of solid waste generation, collection, and disposal is occurring at facility sites. However, solid waste collection and disposal service is available in each of the counties in which facilities are proposed.

In Kittitas County, an exclusive franchise has been granted to Waste Management of Ellensburg, Inc., for solid waste collection and disposal. Under this agreement, Waste Management is required to provide service to any location in the county when requested.

3.9.5.2 Hazardous Materials and Waste

The Cle Elum hatchery site was audited in 1990 for the presence of hazardous substances. None was identified at either of the sites. Hazardous substance audits were also conducted at the alternative acclimation sites in 1993. No evidence of hazardous materials or toxic substance contamination were discovered at the Easton Dam, Jack Creek, Clark Flat, Cle Elum, and Keechelus sites. The Easton gravel pond site was found to have been used for asphalt batching over the last 20 years, and concern was raised regarding the potential for hydrocarbon contamination. If this site were selected, and hazardous substances were identified at the site, they would be disposed of and the site would be remediated, if necessary, in accordance with applicable regulations. The location of the acclimation site or the site layout would be adjusted, if necessary.

Several chemicals would be used in conjunction with the fish handling facility operations. The chemicals and their handling are discussed in section 4.1.11.1. The use of herbicides, lubricant oils, and greases at the facilities is also discussed in this section.

4. ENVIRONMENTAL CONSEQUENCES

This chapter contains an analysis of the potential environmental consequences of each project alternative, organized by resource. Potential impacts resulting from the project alternatives (Alternatives 1 and 2) include the impacts of construction and operation of acclimation sites and fish culture facilities, as well as biological and ecological impacts on the aquatic ecosystem. Project impacts for the No Action Alternative are also discussed, as well as cumulative impacts.

4.1 Direct and Cumulative Impacts

4.1.1 Water Resources

4.1.1.1 Alternatives 1 and 2

The proposed project would affect both water quality and quantity in the Yakima River basin. A combination of surface and ground water would be used for the proposed facilities. Both water quantity and water quality impacts are discussed below for both alternatives.

Surface Water Resources

Water Quantity

Low or, at times, insufficient instream flows for fish passage, spawning, and rearing result from irrigation diversions and currently affect fish production in the Yakima River Basin. Efforts are underway to correct some of these problems (see discussion in Section 3.9.2); however these efforts are independent of the Yakima Fisheries Project, and the facilities proposed for the YFP are designed to operate with or without increased instream flows. All YFP facilities are designed to be "water neutral": that is, operation of project facilities would not affect the existing instream flow levels in adjacent streams (except in short bypass sections) or the delivery of water to irrigation districts, canal companies, and individual farms. Operation of these facilities would be consistent with the existing pattern of water deliveries and water management in the Yakima River Basin. Project operation would require withdrawal of water from surface resources during certain times of the year. All facilities, however, are designed to be nonconsumptive: the water would be returned back to the source after it flows through the facility. Consequently, operation of the facilities would not adversely affect surface water supplies available for other uses. BPA or the project managers would apply for a permit for non-consumptive appropriation of surface waters from the WDOE for each of the sites.

Section 3.2.1.1 presents information on flows for the stream segments that would be tapped to supply surface water to YFP facilities. Given the nonconsumptive use of water, and the timing and amount of withdrawals, hatchery and acclimation site operation and maintenance are not expected to affect flows adversely. The acclimation sites would be operated only from January through June, when surface water flows are typically greatest. At the Cle Elum site, water would be required year-round, but surface water would be supplemented by groundwater, and surface water withdrawals would be reduced during periods of river flows less than 350 cfs (9.8 m^3s). Water for facility sites would be pumped from an adjacent location on the river or stream and returned directly to it.

Except for the Keechelus site, streamflows for facility sites are adequate to support operations without affecting aquatic resources in the bypassed reaches of the source stream. Distances between the diversion (intake) and return (outfall) points would be minimized to reduce adverse effects on aquatic life in the source streams. At the *Keechelus* site, streamflows would not be available at those times when the reservoir releases are stopped to allow refill. The possibility of using water piped directly from the reservoir is being explored.

At the *Jack Creek* site, low flows in the Teanaway River downstream of the site near the confluence of the Teanaway and the Yakima Rivers during the late summer and fall months might affect upstream migration and spawning of spring chinook salmon. Water conservation measures (such as converting irrigation from surface to groundwater use) are being studied to see whether they could improve flows in this reach.

Water rights in the Yakima River Basin, including rights for instream flows, are the subject of a general stream adjudication begun by the State of Washington in 1977 (see section 3.9.2.2). The adjudication process is the means by which any instream flow rights would be established in the basin. Furthermore, project facilities are designed to operate under current water management practices and would be reviewed in light of any future changes in water management. The adjudication process will proceed totally independently of the YFP. BPA is not a participant in the adjudication process, and project facilities would not affect that process in any way.

Increased instream flows would benefit fish resources in the Yakima River Basin, regardless of the future of the YFP. Attempts are being made to address instream flow needs through legislation, cooperation, or other means. BPA and the project managers support such efforts and encourage all entities in the Yakima River Basin to pursue such measures. In the meantime, however, the YFP is designed to operate with existing instream flows, and would obtain the non-consumptive water use permits required by the State of Washington for the hatchery and acclimation site facilities. **In summary, operation of project facilities would not directly affect existing water rights in the Yakima River Basin.**

It is possible that water rights might be *indirectly* affected by the project. While it is not the intention of the project managers to affect water rights, several members of the public expressed concern about YFP fish moving into tributaries that currently do not support anadromous fish, and consequently increasing the demand for instream flows in these tributaries for fish. As stated above, the YFP is independent of the water rights adjudication process, and current efforts to address instream flow needs, regardless of whether the YFP proceeds, are ongoing. Existing legislation, including YIN Treaty-reserved rights, and State and Federal laws and regulations, govern habitat protection for anadromous fish in the Yakima River Basin. The implementation of these laws and regulations is independent of the YFP and will continue even if the YFP is not funded. Also, the Pacific Northwest Electric Power Planning and Conservation Act of 1980 (Section 10[h]) and Section 14 of the Council's 1994 Fish and Wildlife Program, state that "Nothing in this program will alter or establish the respective rights of the United States, states, Indian tribes, or any person with respect to any water or water-related right." Existing laws and regulations dealing with habitat protection will not be modified by the YFP, nor will the YFP create new legislation. **Therefore, the YFP would not cause increased demands for instream flows in addition to those currently being sought, nor would the project cause water rights to be taken from irrigators.**

<u>Water Quality</u>

The construction and operation of the proposed project facilities might result in impacts on surface water quality. Construction can cause erosion, which can result in increased turbidity in receiving streams. A General Permit issued by the WDOE is required for construction on 2 or more ha (5 or more ac.) that result in discharge of storm water offsite, unless they are covered under an individual permit. Some construction activities would unavoidably violate state water quality standards on a short-term basis. In such cases, a Water Quality Modification would be obtained from the WDOE, as required.

Primary effects from operation of the facilities might include impacts on receiving streams from nutrient loads coming from the various fish hatchery, rearing, and acclimation facilities. This movement of nutrient load into receiving streams can result in excessive algal growth. However, no definitive information exists concerning impacts of this type under the operating conditions planned for this project. Potential effects would be largely mitigated by hatchery management practices, dilution in receiving waters, and natural processes, including degradation. National Pollution Discharge and Elimination System (NPDES) permits would be obtained from EPA Region 10 for the discharge of any pollutant regulated under the Clean Water Act, and all facilities would operate within the parameters permitted.

The approach used for assessing potential cumulative impacts of the YFP on water quality was based on flow volumes and nutrient concentrations of both the facility effluents and the receiving water. Estimated concentrations of nutrients in the receiving water were then compared with levels known to produce changes in receiving ecosystems. "Worst-case" scenarios (when effluent contributions are greatest, usually during periods of lowest river flow) were developed to calculate "worst-case" impact. Since resulting concentrations were below problem levels, no further calculations were made for other times of the year.

In the analysis, predicted nutrient levels were compared against the following criteria (EPA, 1986; Rinella et al., 1992):

- Maximum nitrate levels should not exceed 1 to 2 mg/L.
- Upper critical level of phosphate is 0.1 mg/L.

A discussion of the calculations for the planned facilities and an estimate of the potential impacts are presented below for Alternatives 1 and 2. Flow conditions and estimated nutrient concentrations are summarized for the Cle Elum hatchery in Table 4.1 (below).

Cle Elum Hatchery facility. Discharge from this site would be near the upper end of the oxbow ponds located at the site (Figure 2.5). In order to reach this discharge point, approximately 300 m (1,000 ft.) of new stream channel would be created between the hatchery and an isolated pond. The pond would be reconnected to the rest of the oxbow system through 90 m (300 ft.) of former river channel that is currently dry. Approximately 300 m (1,000 ft.) of the oxbow pond system would be converted back into a riverine condition by the effluent flows from the hatchery. The discharge from the hatchery of 2.0 m^3s (72 cfs) would be 5 to 12 times greater than the existing flows through the oxbow system, and would increase the flushing rate of the lower two oxbow ponds ten-fold or more.

The effluent would be discharged back to the Yakima River through a modified outlet structure at the location of the existing oxbow pond outlet. Retention time of the effluent in the oxbow ponds would be less than 12 hours.

The maximum concentrations of the nutrients nitrogen and phosphorus from the hatchery would occur during August through October (Table 4.1). Calculations were based on a production level of 810,000 fish and the scheduled feeding rates shown in Appendix A of the Preliminary Design Report (BPA, 1990b). The flow through the oxbow pond system would be 80 to 90 percent hatchery effluent, so it is appropriate to compare the effluent nutrient concentrations with the target concentrations for avoiding excessive plant growth of 1 to 2 mg/L of nitrogen and 0.1 mg/L of phosphorus. Maximum concentrations of nutrients in the hatchery effluent (Table 4.1) would range between one-fifth and one-tenth the target values for flowing waters (USEPA, 1986; Rinella et al., 1992), and should not cause excessive plant growth in the oxbow ponds.

Further dilution of the effluent would occur after discharge from the oxbow ponds to the Yakima River. Historic low flows during September through November have been very low in some years. However, under current management agreements the minimum flow at the Cle Elum site has been set at 325 cfs (9.1 m^3s) for protection of spring chinook eggs in the river. Return of the hatchery flow of 2.0 m^3s (72 cfs) to the river would result in a 3.5-fold dilution of the effluent at the 9.1 m^3s (325 cfs) total flow.

Table 4.1 Maximum Nutrient Discharge from the Cle Elum Hatchery (Concentrations as mg/L Nitrate-Nitrogen and Total Phosphorus)[a]

	Month		
	August	September	October
NO_3-N	0.10	0.13	0.11
Total P	0.014	0.016	0.015

[a] Assuming background concentrations in the source water (Yakima River) of 0.03 mg/L nitrate-N and 0.01 mg/L phosphorus

Acclimation Sites. Nutrient loading to tributary streams from operation of acclimation raceways were estimated using an effluent volume of 0.24 m^3s (8.7 cfs) and lowest stream flow values in March, April, and May. Nitrogen and phosphorus concentrations for effluent from the acclimation raceways were based on fish feeding rates at full production capacity and over an average of known water temperatures during the acclimation period (H. Senn, Fish Management Consultants, pers. comm.). These values are 0.30 mg/L nitrogen and 0.021 mg/L phosphorus for each acclimation site.

Estimated concentrations in receiving waters were based on previously measured values; 0.03 mg/L nitrogen and 0.01 mg/L phosphorus for the Yakima River and tributaries. Based on these values, none of the sites was estimated to exceed recommended levels for nitrogen or phosphorus. Thus, it is highly unlikely that any problems involving excessive nutrients and resulting algal growth would be encountered in receiving waters as a result of discharges from acclimation raceways.

Cumulative Surface Water Quality Effects

The additive effects of effluents from the fish culture facilities on the Yakima River and its tributaries were analyzed to determine the potential for cumulative effects for both alternatives. Total cumulative nutrient discharge to the Yakima River system from the hatchery and acclimation sites would be highest during March and April when nitrate-N concentrations would be 0.22 to 0.30 mg/L in a total effluent of 65 cfs. However, these discharges would be distributed throughout the upper Yakima basin.

Results of these calculations indicate that hatchery effluents under either alternative would not adversely affect the aquatic ecosystem as a result of increased nutrient loading. For small streams, any increase in nutrient would be localized and of short duration. Additionally, nutrient inputs for low-nutrient headwater streams might increase primary production, leading to enhanced potential for fish production.

Groundwater

Yakima River Basin floodplain soils and sediment are highly permeable. Consequently, its groundwater resources are susceptible to contamination from pesticides, fertilizers, and animal and human wastes. Project managers would implement measures to ensure that project facility construction and operation do not adversely affect groundwater quality, including treatment of runoff from access roads and other impervious surfaces. Operation of acclimation sites is not expected to alter local groundwater conditions because small volumes of water would be used. No adverse effects on shallow groundwater aquifers are expected from the construction and operation of the acclimation sites.

The Cle Elum central facility would obtain groundwater from wells in a confined aquifer that is hydraulically isolated from other Yakima River Basin water resources. To determine whether pumping of this aquifer would affect existing wells, well logs of 44 existing wells in the vicinity of the site were investigated. Of the 44 logs, only one showed characteristics indicating that the well might be drawing from the same aquifer as the hatchery site wells. Computer simulations show that the hatchery wells are sufficiently separated in distance from this residential well that it would not be affected by pumping at the hatchery wells.

Floodplain/Wetlands Assessment

In accordance with the Department of Energy regulations on Compliance with Floodplain/Wetlands Environmental Review Requirements (10 Code of Federal Regulations (CFR) 1022.12), BPA has prepared the following assessment of the impacts of the Yakima Fisheries Project on floodplains and wetlands. A notice of floodplain/ wetlands involvement for this project was published in the Notice of Intent to prepare the EIS.

Three alternatives for the project, including the No Action Alternative, are described in chapter 2 of this EIS. The floodplain and wetlands locations are described in Section 3.2.3. Since no additional facilities would be constructed under Alternative 2, there would be no difference in floodplain/wetlands impacts between the two alternatives. The No Action Alternative would not affect floodplains or wetlands.

Floodplain effects

Under Executive Order 11988, Federal agencies must avoid or minimize adverse impacts associated with short-term or long-term modification and occupancy of floodplains. Modification and destabilization of the floodplain could have potentially adverse effects not only near the disturbance, but in the stream channel and floodplain great distances downstream. Adverse impacts include the potential for flood damage to the facilities, increased flooding due to displacement of water from the normal floodplain by the construction of the facilities, and increased potential for erosion of floodplain soil and sediment near the construction sites.

After detailed studies of the site, CH2M Hill determined that the river pump station at the Cle Elum hatchery site would be the only facility located in the 100-year floodplain for the Cle Elum site (Weigum, 1994). Detailed studies have not yet been conducted at the acclimation sites; development and operation of these facilities would occur outside the floodway but possibly within the defined 100-year floodplain. County authorities and the Federal Emergency Management Agency would be contacted to ensure that any new construction would not alter floodplain characteristics or channel flow capacity. Certain design restrictions or limitations may apply. If facilities were located within the floodplain, they would be designed to withstand flooding. Construction impacts within the 100-year floodplain would be mitigated by ensuring that construction would not raise the expected level of the 100-year flood and would include minimal use of impervious surfaces. Overall, the proposed project activities would not adversely affect human life, property, or natural floodplain values.

Wetland effects

Wetland vegetation was observed near the Cle Elum hatchery facility and Clark Flat and Jack Creek acclimation sites (see Section 3.2.3). The proposed Cle Elum hatchery is sited on a terrace above the oxbow ponds, in an area that has previously been disturbed, to minimize loss to any wetlands in the area. Wetland delineations conducted by CH2M Hill in 1994 indicate that impacts on wetlands would occur from the siting of the water discharge structure and the access road. Total wetland impacts at these two areas would be 0.1 ha (0.24 ac.). The discharge of hatchery water through the oxbow ponds might result in inundation of wetland vegetation, decreased flushing time for nutrients in the wetlands, higher channel velocities, and increased siltation and sedimentation. The current site of the proposed interpretive center facilities could potentially affect adjacent wetlands through septic system and parking lot drainage. These impacts would be mitigated through the Corps wetlands permitting process and through careful design and siting of the facilities. The loss of 0.1 ha (0.24 ac.) of riparian wetland at the site would be mitigated by constructing 0.2 ha (0.54 ac. or 1,000 lineal feet) of outflow channel to the oxbow system with 0.14 ha (0.34 ac.) of fringing riparian emergent wetland, and by constructing an additional 0.06 ha (0.14 ac.) of isolated emergent wetland.

Detailed delineations of the acclimation sites have not yet been completed, but preliminary characterizations were considered during selection of the sites. Delineations would be completed before facility final design, siting, construction and operation to avoid impacts on wetland habitat. Information from delineation surveys would be used during final design to develop mitigation measures, if necessary, to ensure that the project would result in no net loss to wetlands. Review and concurrence through the Corps permit process would be completed as necessary before site development. Disturbance of wetlands during construction activities would be avoided whenever possible. If disturbance could not be avoided, the area of disturbance would be minimized to the extent practicable. Most disturbance would be temporary and would not constitute any net loss to wetlands. Upon completion of construction, excavated areas would be backfilled, and disturbed land restored to its previous condition wherever possible.

4.1.1.2 No Action Alternative

Under the No Action Alternative, current surface and groundwater resources practices would continue, including the water rights adjudication process and legislative efforts to improve instream flows. Some measure of habitat enhancement (through increased flow, improved water quality, or physical habitat changes) would be implemented through the Council's Columbia Basin Fish and Wildlife Program.

Since no project facilities would be constructed under this alternative, there would be no impacts on surface or groundwater resources from the use of these resources. Water quality would not be affected by the release of nutrients from the facilities. Floodplains and wetlands also would not be affected under the No Action Alternative.

4.1.2 Fisheries Resources

4.1.2.1 Alternatives 1 and 2

Introduction

Several concerns were raised in the YFP EIS public scoping meetings and on the DEIS about potential project impacts on existing fisheries resources. Major concerns included genetic and ecological risks to wild fish populations and potential impacts on resident trout resources upstream from Roza Dam.

The hatchery-released fish and naturally produced offspring of returning adults from the YFP could interact genetically and ecologically with existing naturally spawning fish populations. In some cases, potential impacts could be considered adverse (for example, could result in decreased growth rate or numbers for existing resident trout populations). In other situations, however, existing populations might increase in response to increased natural production of chinook fry that could serve as prey for resident trout or squawfish populations (Martin et al., 1992).

At present, estimation of the actual effects of proposed supplementation activities on Yakima River fish populations (both resident and anadromous species) must be largely speculative because applicable data is scarce, and the field of study has limitations, as do theoretical analytical approaches needed for accurate predictions. However, it is likely that the released supplementation fish themselves, coupled with a possible increase in natural production (approaching the carrying capacity of the basin) from returning adult hatchery spawners, would affect pre-existing fish populations to some extent. This section of the EIS discusses the risks identified and other potential impacts of both Alternatives 1 and 2 and summarizes the results of recent studies that address them.

Risk Analysis

As a part of the adaptive management framework adopted for this project, the potential impacts mentioned above and others were addressed in risk analyses (see Section 2.2 for a discussion of adaptive management as it applies to this project). The risk analyses systematically examined the objectives, strategies, assumptions, and uncertainties for the proposed actions. They also addressed the risks of the project not meeting its objectives. While these analyses do not directly address the risks of the project on the Yakima River Basin ecosystem, they do address these risks through the objectives that have been adopted for the project. A risk analysis was prepared for upper Yakima spring chinook supplementation as proposed in both Alternatives 1 and 2 in 1993 (Mobrand, 1993) and a risk analysis for the coho study as proposed for Alternative 2 was prepared in 1995[6].

Project objectives for the YFP spring chinook program were identified in four categories: genetics, natural production, harvest, and experimentation. Accordingly, the spring chinook risk assessment document discussed in detail the risks of not meeting the objectives in all four of these categories, as described below:

- Experimentation risk - the risk of not being able to meet the experimentation objectives for the project, which are to learn how to use supplementation as a strategy to increase natural production and harvest opportunities.

- Harvest risk - the risk of not being able to meet the harvest objectives for the project, which are generally defined as increasing the harvest opportunities for all anglers consistent with the requirements of the genetic, natural production, and experimentation objectives.

- Genetic risk - the risk of not being able to meet the genetic objectives for the project, which are generally defined as maintaining the long-term fitness of the target populations while keeping the ecological and genetic impacts on non-target populations within specified biological limits.

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6 This risk analysis will be included in the coho chapter of the 1995 Planning Status Report, in preparation. It will be completed prior to the Final EIS, and included in it.

- Natural production/ecological interaction risk - the risk of not being able to meet the natural production/ecological interaction objectives for the project, which are generally defined as optimizing natural production while managing adverse impacts from interactions between and within species and stocks.

The coho study is much simpler than the spring chinook program. Since it is solely a monitoring effort, its objectives can be most concisely summarized in one category: experimentation. Specifically, the experimentation objectives of the coho study are:

- to determine the feasibility of returning natural production of coho salmon to the Yakima River Basin;

- to determine the potential harvest benefits from reintroduction of coho salmon in the Yakima River Basin; and

- to determine the predation impacts of releasing 700,000 acclimated coho smolts on fall chinook populations in the Yakima River Basin.

The purpose of the coho risk analysis, then, is to evaluate and discuss the risk of the coho program not being able to meet these experimentation objectives.

To address the identified risks, three different approaches were used. Measures were identified to be monitored to contain the risk; objectives were refined; and/or alternative strategies were selected. Not all of the identified monitoring measures were feasible; these will be considered for future research and development. Feasible measures were incorporated into a monitoring plan. The monitoring plan for upper Yakima spring chinook is discussed in section 2.3.3, and the plan for coho monitoring in section 2.4.3.2.

Experimentation Risks and Impacts

The experimentation risks were identified as the risks of not meeting the experimentation objectives for the project. Since the objectives of the spring chinook program and coho study are different, their experimentation risks are discussed separately below.

Upper Yakima Spring Chinook. Two types of experimentation risks were identified for this program:

- The risk of not being able to test that production levels have increased in sections of the river where supplementation has occurred or that there are significant differences between the Optimal Conventional Treatment and the New Innovative Treatment; and

- The risk of not learning about the quality of the supplemented fish and about their impacts on the ecosystem.

The first risk addresses the success of the supplementation project in terms of numbers of fish returning to spawn. The second risk addresses the quality of the supplemented fish, as judged on the basis of four categories: survival of the fish after they are released until they return to spawn; reproductive success of the fish (number of offspring produced per spawner); long-term fitness of the fish (genetic diversity and long-term productivity); and ecological interactions of the fish with the existing ecosystem (as measured by population abundance and distribution, growth rates, carrying capacity, survival rates, transfer of disease and gene flow). The second type of experimentation risk is based on the assumption that the naturally spawning fish represent the best quality for the system. Therefore, in order to determine the success of this aspect of supplementation, the supplementation fish would be compared with the naturally spawning fish to determine whether the YFP has reached the goal of creating fish as close as possible to the naturally spawning fish, as judged by the four categories listed above.

In order to address these risks for supplementation of upper Yakima spring chinook under Alternatives 1 and 2, an experimental design has been developed. No new or refined strategies were proposed by the risk assessment, but several measures were identified to be incorporated into the monitoring plan.

Lower Yakima River Coho Salmon. For the coho study under Alternative 2, the experimentation risks have been defined as the risk of not being able to meet the experimentation objectives for coho, which are listed above.

Coho are currently considered to be extinct in the Yakima River Basin, but approximately 700,000 hatchery-spawned yearling coho have been released there since 1982 (except in 1984), as part of the *US v Oregon* CRFMP. Before 1994, these released coho were not acclimated, and their survival rate from smolt to returning adult has been about 0.04% (Watson, 1993), or about 280 fish from a release of 700,000. Strategies to meet the first two objectives are based on the detection and counting of returning adults from the annual smolt release of 700,000. Obviously, knowing the survival rates of these fish is essential to meeting these objectives, so understanding the overall survival picture is a key element of the risk analysis.

Several factors potentially affecting the survival of coho have changed since the 1993 estimates, which may lead to increased survival in the future. First, the acclimation of the smolts definitely resulted in an increase in their survival from the time of their release to their passage through the smolt monitoring facility at Prosser Dam. A recent 3-year study comparing survival of acclimated and nonacclimated early stock coho in the Umatilla River demonstrated that acclimation increased survival by 50% (Technical Advisory Committee, 1995). Second, the ocean and river harvest of coho was greatly reduced in 1994, due to the poor returns of adult fish throughout the Columbia River Basin. Third, the NMFS is reviewing a petition to list coho as an endangered species coastwide. If this occurs, there could be a substantial reduction in the ocean and river harvest quotas in the future.

On the other hand, there is considerable uncertainty in predicting survival rates to adulthood of any fish in the Columbia basin. Major factors influencing survival include survival through outmigration in both the Yakima and Columbia Rivers, ocean survival, future harvest levels for both sport and commercial fisheries, and upstream migration survival of adults returning to the Yakima basin. All of these factors are outside the control of the project.

Risks to Research Objective 1 - determining the feasibility of returning natural production of coho salmon to the Yakima River Basin. The risk of most immediate concern is that the survival rate to adulthood will be so low as to preclude sufficiently precise estimation of survival rates. Imprecise estimates are likely to give an unduly pessimistic view of survival to be expected from a potential future expansion of the coho program.

The second major risk to this objective is the inability to evaluate the reproductive success of the returning adults. This is a very real risk in that the coho smolts are currently being acclimated in areas that would not support natural production of coho (due to low flows and high temperatures in summer). If coho adults return to spawn near their acclimation release site, the resulting progeny would either have to migrate out of the Yakima basin or die during the summer rearing period. Estimates of natural production from returning adults would obviously be better if the fish were released in areas that are determined to be good coho spawning and rearing habitat, but this is not possible under the current release program.

Both of these risks could be reduced substantially by the release of larger numbers of smolts, but at this time the potential increased risk to other species due to interactions seems too great to permit these larger releases.

Risks to Research Objective 2 - determining the potential harvest benefits from reintroduction of coho salmon in the Yakima River Basin. Estimation of potential harvest benefits from releasing coho depends entirely on the rate of return of adult fish to the local fisheries, so the risks to this objective are identical with the first risk listed for objective 1. If accurate information on the number and rate of returning adult coho salmon cannot be obtained, the ability of the managers to make an informed decision on whether or not to expand coho releases would be impaired. An incorrect decision has obvious consequences for the long-term objective of increasing coho salmon harvest opportunities for all anglers.

Risk to Research Objective 3 -- determining the predation impacts of releasing 700,000 acclimated coho smolts on fall chinook populations in the Yakima River Basin. Coho releases have been approached cautiously because of the possibility that coho smolts may prey upon juvenile fall chinook as the coho migrate through fall chinook production areas in the lower reaches of the Yakima River Basin. Objective 3 calls for a monitoring program designed to resolve this question of predation. Since the research would be carried out entirely on the released smolts before they leave the basin, survival to adulthood is not a factor here. Risks to objective 3 all relate to the possibility that sufficiently precise estimates of the predation impact from coho releases cannot be obtained through the monitoring. The consequences of this are clear. The managers could decide to expand coho program when expansion would depress fall chinook production, or they could decide not to expand and thus forego production and harvest opportunities when expansion is warranted.

Development of a sufficiently extensive and powerful research program to obtain the necessary information on coho predation is a difficult task. Therefore, the study will occur in stages. The first stage would essentially be a feasibility study conducted during the first year of the program. During this stage, preliminary data would be collected that will be used to design a more sophisticated second-stage study that would yield the desired information needed to decide upon expanded coho releases. Even with the benefit of the first-stage preliminary information, there could still be a risk of not gaining the information needed to determine precisely the predation impact of coho on the fall chinook population. However, this risk cannot be evaluated until the first stage work is completed. It is important to understand that the staging of the research is a risk reduction strategy. The first stage work will be used to reduce the risk of the full study.

Harvest Risks and Impacts

The harvest risks identified in the risk analyses are defined as the risks of not meeting the harvest objectives for the spring chinook and coho programs.

Upper Yakima Spring Chinook. Two types of harvest risks were identified in the risk assessment:

- the risk of not being able to control harvest access that could affect long-term sustainable harvest yields through harvest policy and regulations; and
- the risk of not obtaining accurate data on harvest by stock in order to estimate harvest rates that will be sustainable in the long term.

The first risk addresses the expectation that a regulatory package and complementary policy can be put in place that will ensure implementation of the harvest strategy. The assumption is that fisheries in the basin can be managed and regulated and that laws can be enforced. A functional regulatory presence can only be effective in supporting project objectives if certain underlying assumptions are effective and in place to guide and support regulatory management:

- Spawner recruit or stock productivity relationships must be developed to establish appropriate harvest rates for each stock component.

- A status-indexed or selective harvest policy must be described in sufficient detail to allow effective implementation.

- Methods to develop pre-season forecasts and in-season updates of run size and composition must be available.

The second risk addresses the necessity to secure accurate information about harvest numbers so managers can evaluate the impacts of harvest on each stock to assess strategies that assure long term sustainability of harvest while achieving complementary project objectives. Some fundamental assumptions must be in place to facilitate collection of pertinent information. Most importantly, the project would supply the following:

- All first generation adult fish resulting from the supplementation project would be readily identifiable by origin for selective harvest purposes.

- All harvest of Yakima spring chinook would be monitored through catch sampling.

The project monitoring plan (section 2.3.3) would include a harvest monitoring program designed to detect specific levels of harvest impacts. A monitoring program sufficient to address each element of risk and to verify assumptions would include adult monitoring to determine the timing and identification of:

- marks on fish in a test fishery;

- adults returning to Prosser;

- fish in the harvest; and

- adults returning to Roza.

It should be noted that the YFP Policy Group does not exercise control over harvest regulations. The assumptions and monitoring plan will provide necessary data to assess project strategies and will be a primary source of information for managers to implement harvest policy. A current Memorandum of Understanding between the YIN and the WDFW captures the manager's intent to coordinate project objectives with harvest management functions.

Lower Yakima River Coho Salmon. The harvest risks for the coho program are discussed under the experimentation risks and impacts section, above.

Genetic Risks and Impacts

Four types of genetic impact/risk are relevant to YFP planning (Busack, 1990; Busack and Currens 1995 (in press)):

1. extinction,
2. loss of within-population variability,
3. loss of between population variability, and
4. domestication selection.

Extinction represents the most extreme type of risk. Once a population is extinct, all its genetic variability is irretrievably lost. Extinction can be caused by any activity that reduces a population below a minimum viable level. Although extinction is a genetic impact, it typically has demographic rather than direct genetic causes.

Loss of within-population variability is commonly associated with hatchery production. Loss can be due to genetic drift as a consequence of small population size or to non-random selection of hatchery broodstock. Since genetic variability is the raw material upon which selection acts, this loss in variability may manifest itself as a decreased responsiveness to natural selection, with a resulting drop in fitness.

Loss of between-population variability is also called loss of population identity. If two populations are mixed, there may be no loss of genetic material overall, but the genetic distinctness of the two populations will be lost. The mixing will cause a recombining of genes that had formerly occurred in combinations called "coadapted complexes." Particular desirable genotypes distinguishing a population, such as run timing or body size, may become absent or less frequent. The new combinations of genes may result in lower fitness in the mixed population, a phenomenon called "maladaptation." The most extreme form of this type of impact is genetic extinction: the fish are still present, but their genetic distinctness is lost.

Domestication selection needs to be considered in assessing the impact of hatchery operations on salmon and steelhead. Hatcheries, despite careful attempts to avoid causing genetic change, may impose new selection regimes on the fish in the course of standard fish culture techniques, causing increased fitness in the hatchery environment, but decreased fitness in the wild.

The four types of genetic risk differ widely in theoretical basis, difficulty of measurement, and empirical evidence in salmonids. Thus, opinions vary widely among geneticists and managers as to the extent to which a population is damaged by sustaining a specified level of impact. Domestication selection is the most controversial; loss of within-population variability, the least. Intermediate in controversy is the importance of loss of between-population variability. Extinction risk, the most theoretical and thus least amenable to evaluation at the project level, is difficult to rank in this context. At this point, the project managers have not conducted population viability analysis to analyze extinction risk, and have made the simplifying assumption that, by minimizing type 2, 3 and 4 genetic impacts, extinction risk is adequately controlled. For purposes of this discussion, any severe type 2 impact should also be considered a type 1 impact.

Quantifying genetic risks and impacts of salmon production programs currently is a crude art. Potential impacts can be described in genetic terms (e.g., percentage loss of variability). Predicting the consequent reduction in fitness, however, is very tenuous, in part because a genetic impact's severity is determined not only by magnitude and duration of a hazard, but probably also by the initial condition of a population, which geneticists have only a limited ability to measure. Nevertheless, it is possible to identify potential genetic risks, and to rate the relative reduction or increase in risk of alternatives. It is also possible generally to rank risk types in terms of probable effect on fitness. Although the ranking could be changed by relative magnitude, type 2 impacts probably have the largest effect on long-term fitness of the population and type 4 the smallest effect. Type 3 is again intermediate.

In order to address these risks for the YFP, a genetic inventory of the stocks to be supplemented in the Yakima River Basin has been prepared, as well as genetic guidelines for hatchery operations. Genetic risks have been addressed in two risk assessment documents which discuss both upper Yakima spring chinook and coho (Busack, 1990; Currens, 1993); and in the overall risk analysis prepared for upper Yakima spring chinook (Mobrand, 1993). The risk analysis for upper Yakima spring chinook identified four new or redefined strategies for meeting the genetic objectives. Genetic risks were also addressed in the monitoring plans for each stock. These activities were conducted by geneticists at WDFW, in cooperation with consulting academic geneticists, and are characterized below.

Genetic Inventory. Genetic research has been conducted since 1989 to enumerate and characterize the salmon and steelhead stocks in the basin. With completion of spring chinook sampling and lab work in 1993, a full generation of data is available. Three spring chinook stocks--American River, Naches, and upper Yakima--have been identified.

Genetic Hatchery Guidelines. Several aspects of hatchery operations, such as broodstock selection and mating protocols, can have profound impacts on the maintenance of genetic diversity. Given the overall genetic conservation goal of the project, a comprehensive set of hatchery operational guidelines must be developed and designed to minimize genetic risks. A draft genetic guideline document for the YFP was completed in 1993 (Kapuscinski and Miller, 1993). These guidelines, developed in consultation with several geneticists, rely heavily on the hatchery guidelines being developed in the Council's genetic workshop program. They provide hatchery personnel with specific recommendations or guidelines for hatchery personnel in making operational decisions in a genetically sound manner. All aspects of hatchery production from broodstock collection to release are addressed.

Genetic Risk Assessment. Project planners have called for two levels of risk assessment: level I for a general statement of risk, and level II for a detailed operational assessment. Level I (also called the *qualitative* genetic risk assessment) was developed to outline the potential genetic risks of the project (Busack, 1990). This document first described the four categories of genetic risk, and described the risks posed by the full project as it was understood at that time. This was the first risk assessment in the basin, and has been used as a model for other assessments.

The level I assessment addressed the features of the project designed to minimize genetic risk, including extensive substock identification work, separate culture of substocks and release into natal areas only, complete tagging of hatchery releases for assessment and control of straying, and a variety of broodstock management practices to maximize effective population size and limit the effects of domestication selection. The adaptive management strategy outlined in Section 2.2 would be used to ensure that methods and research are continually reviewed and refined as the project progresses. A long-term genetic monitoring program would also be implemented to evaluate changes in within- and between-population variability, as well as changes in variability in quantitative fitness-related traits.

A level II document (or *quantitative* risk assessment) was produced for the project in 1993 (Currens, 1993). This document linked genetic risk assessment to other types of biological risk assessment, clarified terminology, and went much farther in quantifying risk than the 1990 document. It emphasized the importance of a management structure in controlling risk, but dealt in much less detail with specific risks posed by specific actions in the project.

An overall risk analysis which included all four types of risk (experimentation, genetic, harvest, and natural production/ecological interaction) was also prepared in 1993 (Mobrand, 1993), as discussed above. This analysis deals with the specific risks posed by the supplementation of upper Yakima spring chinook, and builds upon the previous two risk assessments.
The genetic risk assessment/analysis results for upper Yakima spring chinook supplementation under Alternatives 1 and 2 and for the coho program under Alternative 2 are summarized below (Busack, 1993).

Upper Yakima Spring Chinook. The spring chinook program under both Alternatives 1 and 2 (supplementation of the Upper Yakima stock by annual release of 810,00 smolts, but no supplementation of the Naches or American River stocks) poses genetic risks to all three stocks.

The types and magnitude of risk vary with success of the program in returning adult fish to the basin. If the program were to return fewer adults than are taken as broodstock (i.e., "mining" broodstock), the genetically effective size of the population would be reduced. Assuming a *worst-case scenario* of no returns at all, and current mean population levels, each full generation of the program would decrease the population by 50 percent. The population could withstand one generation of this activity without incurring serious genetic impacts, but type 2 impacts would become serious in the second generation. No type 3 or 4 impacts would be sustained by the population, as the assumption is that very few adult hatchery fish would return to spawn.

The two unsupplemented stocks (Naches, American River) could also be reduced in size as an indirect effect of the reduction of the Upper Yakima stock if effective in-river harvest rates on them were increased substantially. However, for this to happen, smolt-to-adult survival of Upper Yakima hatchery fish would have to be close to zero.

In summary, the Upper Yakima supplementation effort could perform very poorly for a full generation without serious genetic impacts, assuming current average escapement levels were maintained for all three stocks.

Under an assumption of a *successful* Upper Yakima supplementation program (i.e., project returns more spawners than are taken as broodstock), the risk picture is quite different. Type 2 risks to the Upper Yakima stock diminish with increasing program success, but the risk of domestication selection, inherent in all hatchery programs, increases. The magnitude of this type 4 impact depends on the intensity of the selective forces present, and the exposure of the population to them. The latter factor is a consequence of what proportion of time, on average, a gene in the population spends in the hatchery environment. This risk would be limited by the strategies of using only naturally spawning fish as broodstock, by limiting the percentage of wild or native fish removed for hatchery broodstock, and by managing the percentage of hatchery fish on the spawning grounds.

As the success of the Upper Yakima spring chinook supplementation program increases, type 3 risk to the other spring chinook stocks would increase if the effective stray rates into them were to increase, either as a result of a greater tendency of hatchery fish to stray or as a result of increased numbers of Upper Yakima spring chinook straying into these populations at current rates. Domestication selection could also spread into these stocks as Upper Yakima fish stray in. Current stray rates among the three stocks are unknown; however, spring chinook appear, from the limited data available, to have very low straying rates (0-5%), especially when they have been acclimated.

Straying to other basins could also increase because of the causes mentioned above. However, acclimated spring chinook have very low stray rates. There are no known incidences of spring chinook straying from the Tucannon hatchery into other watersheds (Busack and Hopley, pers. comm. 1994).

The increased Upper Yakima spring chinook stock poses another type of risk. As that stock becomes more numerous, the American River and Naches stocks make up a smaller percentage of the in-river mixed-stock fishery. Type 2 impacts could occur if the fishery were not managed for acceptably high minimum escapements of these stocks. For the YFP, however, it is anticipated that moderate harvest levels can be monitored and regulated closely enough to reduce this risk.
The situations above assume a model of three independent stocks. The spring chinook natural production modeling exercise described in Section 2.3.1 took a different approach, considering that a key feature of spring chinook juvenile mortality may be density-dependence due to a type 3 functional predator response. This means the three stocks are linked because juvenile mortality (from predation) in a given stock is determined not only by its abundance but also by the abundance of the other stocks.

Modeling the spring chinook stocks this way changes the risk picture considerably. It is theoretically possible, then, to achieve substantial production *increases* in the two unsupplemented stocks as a result of the Upper Yakima stock supplementation, because the unsupplemented stocks would make up a smaller percentage of the mixed group, therefore lowering the potential for them to be preyed upon. More of the unsupplemented fish would survive and return to spawn and produce more offspring. This would allow higher harvest rates on the Naches and American River stocks, greatly reducing the potential of type 2 impact from mixed-stock fisheries.

Lower Yakima River Coho Salmon. As discussed in the introduction to the risk analysis section, there are no genetic risks imposed on the project, or the Yakima River ecosystem, from the proposed monitoring of the existing coho acclimation and release project.

Genetic Monitoring. Several measures for monitoring genetic risk were proposed in the risk assessment for upper Yakima spring chinook. These were incorporated into the overall monitoring plan (see section 2.3.3).

Genetic monitoring of coho is not necessary; there are no genetic risks to coho since the original coho stocks are extinct in the Yakima and surrounding basins. Measures to monitor the genetic impact of the coho program on other stocks are being developed along with the study to determine the predation impact of coho on these stocks.

Natural Production/Ecological Interaction Risks and Impacts

Two main types of natural production/ecological interaction risk were identified in the risk analysis:

- *Limitations of abiotic (non-living) and biotic (living) components of the environment:* There are factors (e.g. inadequate passage conditions, poor water quality, and limited over-wintering habitat) which limit the production of upper Yakima spring chinook and coho in the Yakima River Basin. The risk lies in either not recognizing these limitations and attempting to increase production without removing them, or attempting to remove these limitations without understanding the structure and function of the environment and its role in production of upper Yakima spring chinook and coho, thereby either making things worse (less production) or wasting resources.
- *Adverse ecological interactions:* There is a potential risk of affecting wild and native populations of fish in the Yakima Basin through an increase of upper Yakima spring chinook and/or coho production. This risk might occur through several mechanisms, including an increase in competition for limited resources or an alteration in the behavior of these other species.

Environmental Limitations. The abiotic and biotic limitations of the Yakima River Basin are being addressed in the context of the habitat enhancement and passage improvement activities that are ongoing in the Yakima River basin (discussed in Section 1.4). They are not directly a part of this proposal; however, YFP scientists and managers are involved in coordinating the planning for many of these activities with those of the YFP.

Ecological Interactions. The possibility exists that hatchery and resident salmonids may interact through several mechanisms, including the following:

- hatchery and resident fish might compete directly for food and space during the freshwater rearing phase (Bachman, 1984; Vincent, 1987; Irvine and Bailey, 1992);
- they might prey on one another (Cannamela, 1992; Martin et al., 1993);
- hatchery fish might alter migratory responses of non-target fish (Steward and Bjornn, 1990);
- hatchery fish might alter habitat use, thereby making non-target species more susceptible to predators (Hillman and Mullan, 1989);
- hatchery fish might alter movement patterns of non-target fish (Hillman and Mullan, 1989);
- hatchery fish might increase transmission and susceptibility to disease of non-target fish (Krueger and May, 1991; Pearsons et al.; 1993); and

- hatchery fish might interbreed with non-target fish (Krueger and May, 1991; Pearsons et al., 1993).

Specific examples of possible species interaction scenarios for Alternatives 1 and 2 include, but are not limited to, the following:

- Hatchery fish *might not readily disperse* from the acclimation site, possibly increasing the potential for competitive and predatory interactions with resident salmonids. A rapid dispersal and outmigration of hatchery fish following their release would reduce the potential for these interactions.

- An *increase in the overall standing crop* of introduced salmonids might result in a reduction in the population of resident species. This could occur as natural production approaches stream-carrying capacity and as density-dependent mechanisms (e.g. competition) affect one or more species. This impact springs from the differences in the relative amount of time the two groups would share common food and space resources. Compared to project smolts, naturally produced offspring of project adults may share resources with resident fish during one or more life history stages. The greatest impact on resident fish may not occur immediately following release of project smolts from acclimation sites, but after YFP-produced adults have returned to spawn naturally and their progeny have emerged. The extent of impacts would be expected to increase as overall production reaches or exceeds the carrying capacity of the habitat.

- *Residualism* is the tendency of hatchery smolts to delay or avoid what would otherwise be normal outmigration in the spring. The spatial and annual incidence of residualism is typically highly variable. When fish residualize, they become a part of the stream-reared fish community, competing with resident fish for resources such as food and space, and becoming potential predators (or prey). However, based on work of Cannemela (1993) and Martin et al. (1992), the natural occurrence of residualism in spring chinook salmon has been found to be low, particularly in the headwater areas, and is not expected to pose a significant risk to resident fish. Residualism for coho has not been reported in the literature.

- Hatchery fish may cause *premature or involuntary migration* of other salmonids if the project smolts that migrate downstream create a "pied piper" condition whereby resident or other wild anadromous salmonids migrate downstream with them (Kuehn and Schumacher, 1957; Hansen and Jonsson, 1985; Hillman and Mullan, 1989). This condition could prove to be detrimental to resident fish that would not otherwise migrate or to anadromous fish that would not normally migrate at that time.

- *A positive or negative change in the growth and condition of resident fish* through a change in their diet or feeding habits could occur following the introduction of hatchery fish. Effects on target populations would depend on the degree of dietary overlap, food availability, size-related differences in prey selection, foraging tactics, and differences in microhabitat use (Steward and Bjornn, 1990).

Potential species interactions among fish in the Yakima River are summarized below (Table 4.2) for Alternatives 1 and 2. This table is not intended to reflect the full range of possibilities for species interactions under these alternatives; however, the combinations listed are generally indicative of potential interactions anticipated. The table lists target vs. non-target species combinations and also identifies interspecific target vs. target species combinations where the potential for their occurrence exists.

Table 4.2: Species Interaction Considerations Among Fish Potentially Present in the Upper and Lower Yakima River Basin Under the Yakima Fisheries Project

General Location	Species Assemblage (target vs. non-target)	Interaction Potential [a]
Upper basin	Spring chinook vs. steelhead[b]	competition, predation
	Spring chinook vs. resident salmonids[b]	competition, predation
	Spring chinook vs. nonsalmonids[b]	competition, predation
	Hatchery-produced vs. naturally produced Spring chinook	competition, predation
Lower basin	Spring chinook vs. fall chinook[b]	predation
	Spring chinook vs. coho[b]	predation
	Spring chinook vs. steelhead[b]	competition
	Spring chinook vs. resident salmonids[b]	competition
	Spring chinook vs. nonsalmonids[b]	competition, predation
	Hatchery-produced vs. naturally produced Spring chinook	competition, predation
	Coho vs. spring chinook	competition, predation
	Coho vs. fall chinook	competition, predation
	Coho vs. steelhead	competition, predation
	Coho vs. resident salmonids	competition, predation
	Coho vs. nonsalmonids	competition, predation

[a] Potential mechanisms of interaction

b Species combinations for Alternative 1. All combinations apply to Alternative 2.

To describe quantitatively the competitive interactions and actual impacts between fish populations is extremely difficult, and requires rigorous monitoring and evaluation. For this reason, a baseline species interaction study has been started for the YFP. As project activities were initiated, they would be monitored closely and modified (if necessary) to better understand and contain the risks of ecological interactions between target species and other species of concern.

Investigations of species interactions above Roza Dam were initiated by the WDW in September 1989, and have continued to date (Hindman et al., 1991; McMichael et al., 1992; Pearsons et al., 1993; Pearsons et al. 1994). This work, funded by BPA, has emphasized potential interactions involving resident trout, but has also included work on spring chinook and other species of concern in the area above Roza Dam. Major objectives of this research have been as follows:

- to characterize the spatial and temporal distribution of rainbow trout spawning;
- to characterize movement patterns of rainbow trout (e.g. within and between mainstem and tributary areas);
- to characterize the distribution and abundance of rearing rainbow trout, and the species associated with them (e.g. spring chinook) during this period; and
- via experimentation, to increase understanding of potential interactions among target and non-target species, to aid development of methods to assess and monitor interactions following implementation of the YFP.

Part of the species interactions study involves experiments designed to examine interactions among target and non-target species. In 1991, a field experiment to assess basic aspects of interactions among hatchery-reared steelhead and naturally rearing fish was begun in the North Fork of the Teanaway River (McMichael et al., 1992; Pearsons et al., 1993; Pearsons et al., 1994). Approximately 33,000 hatchery-reared steelhead were released into a small tributary of the North Fork Teanaway River. The number of steelhead released and release location were selected to reflect the YFP plans existing at the time (Appendix A of BPA, 1990b). Hatchery steelhead smolt release experiments continued over a total of 4 years, with final smolt releases occurring in 1994 and final data collection in 1995. The work aims to develop assessment procedures and experimental designs for long-term monitoring and to learn as much as practicable about potential interactions prior to implementation of the YFP. In addition, small-scale competition experiments between various groups of salmonids have been conducted in the North and Middle forks of the Teanaway River during 1993 (Pearsons et al,. 1994) and 1994. To the extent that these studies pertain to Yakima River spring chinook and coho, a summary of information is provided below.

Upper Yakima Spring Chinook. The distribution of upper Yakima spring chinook overlaps that of three other species of concern (resident rainbow/steelhead, cutthroat, and bull trout) above Roza Dam, which suggests that interactions might occur. Spring chinook juveniles are generally found in the mainstem of the Yakima River and in low elevation portions of some tributaries (Pearsons et al., 1993; Pearsons et al., 1994). Two species of concern, cutthroat and bull trout, inhabit parts of the range of spring chinook, although they are generally found in clear, cold, high-elevation streams (Pearsons et al., 1993). Little information is available about the intensity and outcome of juvenile interactions among these species in the areas of overlap (Martin et al., 1992). The other species of concern, rainbow trout (both anadromous-steelhead, and resident forms) has a wider distribution than spring chinook (Hindman et al., 1991; McMichael et al., 1992; Pearsons et al., 1993; Pearsons et al., 1994) that overlaps the distribution of spring chinook above Roza Dam entirely.

Interactions between migrating hatchery spring chinook and resident salmonids appear to be minimal, based on two small-scale releases of hatchery spring chinook (WDFW, unpubl. data). Most previous work examining interactions between juvenile chinook salmon and rainbow and steelhead trout suggests that interactions are minimal because coexisting fish of different species spawn at different times and occupy different microhabitats. This differentiation occurs because of differences in total length and body morphology between species (Everest and Chapman, 1972; Hillman et al., 1989a, 1989b). However, environmental conditions and an overlap in rainbow trout, juvenile steelhead, and spring chinook sizes in the upper Yakima River might force these species to use similar microhabitats, leading to unusually high levels of interaction. Releases of water from reservoirs during the summer months means that discharge in the upper Yakima River is substantially higher than that under natural conditions. High discharges produce high water velocities, which may limit the availability of habitat for small fish. Small fish such as young salmon, resident trout, and steelhead might be forced to occupy the limited amount of slow water habitat available and compete for food and space. However, preliminary results do not support this hypothesis (WDFW, unpubl. data). Spring chinook and rainbow trout were most closely associated with each other during the fall, when water levels were relatively low.

Observations and experiments in the North and Middle forks of the Teanaway River and upper Yakima River mainstem (McMichael et al., 1992; Pearsons et al., 1993; Pearsons et al., 1994) indicate that aggressive social interactions occur between wild juvenile spring chinook and steelhead and rainbow trout, but that interactions may not greatly affect the growth of certain size classes of trout, at least in the studied tributaries. Juvenile spring chinook dominated approximately half of the observed interactions with rainbow trout in the Middle Fork of the Teanaway River and slightly more than half of the observed interactions with rainbow trout in the mainstem Yakima River. Results from competition experiments (Pearsons et al., 1994) in small enclosures in Teanaway River tributaries suggest that the presence of juvenile spring chinook did not significantly alter growth of the slightly larger-sized age 1+ and age 2+ trout (Pearsons et al., 1994), or of smaller-sized 0+ to 1+ age trout (WDFW, unpubl. data).

Hatchery-reared spring chinook salmon and their naturally spawned offspring may interact with pre-existing naturally produced spring chinook salmon. For example, releases of hatchery spring chinook smolts have been shown to alter the movement patterns of naturally produced spring chinook in the Wenatchee River system (Hillman and Mullan, 1989). Competition for food or space may be particularly intense among members of the same species because of their similar ecological requirements at corresponding life history stages. If the juvenile hatchery-reared spring chinook are larger than their naturally produced counterparts, then the hatchery chinook may dominate behavioral interactions and force naturally produced fish to occupy less optimal habitats. Studies of species interactions in the Middle Fork of the Teanaway River have documented aggressive social interactions among juvenile spring chinook salmon, with larger fish generally predominating (McMichael et al., 1992; Pearsons et al., 1993; Pearsons et al., 1994). Residual hatchery spring chinook significantly affected growth of naturally produced spring chinook in small-scale competition experiments (WDFW, unpubl. data). Residualism by hatchery spring chinook juveniles is known to occur, but generally at low levels. In the Tucannon River residual spring chinook juveniles dominated interactions with their naturally produced counterparts (Steven Martin, WDFW, pers. comm.).

In summary, based on the information available, it appears probable that spring chinook produced from the YFP would compete with pre-existing naturally produced fishes, particularly spring chinook salmon and perhaps rainbow and steelhead trout. The specific outcome of this competition is largely unpredictable at this time, but it is reasonable to expect that growth, abundance, and/or distribution of affected stocks would be altered to a small extent. Also, even minimal interaction impacts on steelhead may be significant to the population at large because steelhead numbers in the upper Yakima River Basin are currently very low. The risks posed by these interactions would be contained through monitoring and the implementation of the adaptive management process.

Lower Yakima River Coho Salmon. Coho salmon juveniles in the lower Yakima River might interact ecologically with fall chinook, spring chinook, steelhead, and resident fishes. During their period of stream residence (for hatchery coho releases, generally in the spring outmigration phase), coho juveniles may prey upon newly emerged spring chinook, summer steelhead, and particularly fall chinook. Stream-reared juvenile coho salmon may compete for food and space with these other species as well. However, these interactions result from the ongoing coho acclimation and release program, and the proposed coho study would not change these interactions. There would be no increased ecological interaction risk posed by the coho study under Alternative 2.

In fact, under the coho program proposed under Alternative 2 for the YFP, the interactions of hatchery coho with other fishes would be closely monitored to determine the rate at which released hatchery coho smolts prey on the others. The study would emphasize juvenile coho interactions with recently emerged fall chinook, ranging primarily in the lower Yakima River. The following information on coho interactions is provided as background for understanding the need for the monitoring proposed under Alternative 2 for the YFP.

The ongoing coho acclimation and release program has the potential to affect the survival of juvenile fish of *other* target and/or non-target stocks. The coho could conceivably be eating a sizable proportion of the juvenile fall chinook production. The current status of the mainstem fall chinook stock is unclear, but the Marion Drain stock appears to be at a low-enough population level that a 20-30 percent reduction in juvenile survival could result in a type 2 genetic impact on that stock.

A small-scale investigation was conducted in 1992 to obtain preliminary information on the occurrence of predation on fish by juvenile hatchery coho, and to assess options for future studies. The stomach contents of 323 coho smolts sampled at the Chandler Juvenile Collection Facility during the spring were examined (James, 1992). No fish were positively identified in the stomach contents, but the capture methodology may have biased the results, since much digestion had occurred prior to stomach content analyses.

Juvenile coho salmon are known to be highly aggressive compared to other juvenile salmonids; thus they may compete with hatchery or naturally produced spring and fall chinook, steelhead or rainbow trout, and resident fishes under certain conditions. For example, in a study conducted by Stein et al. (1972) in an artificial stream, coho socially dominated fall chinook, and fall chinook grew faster alone than with coho present. Lister and Genoe (1970) suggested that coho and fall chinook do not interact because of size-related differences in microhabitat selection. Coho salmon displaced spring chinook from preferred microhabitats in the Wenatchee River drainage but did not affect their growth or density (Spaulding et al., 1989). In the same study, steelhead occupied different microhabitats than salmon. Other workers have documented interactions between coho and steelhead/rainbow trout (Fraser, 1969; Allee, 1974).

In summary, it appears that hatchery coho appear to pose the greatest interaction risk as potential predators on naturally produced fall chinook. If naturally reproducing coho become established in the Yakima River, then a broader range of species interactions would be expected. The risks of these interactions could be contained through the proposed monitoring of predation by coho under Alternative 2 and through monitoring the status of these other species.

Other Species of Concern. The potential for interactions involving other fish species of concern exists and will be subject to continual review by project managers. Bull trout, redside shiner, sculpins, northern squawfish, smallmouth bass, largemouth bass, and mountain whitefish have been identified as resident fish that may interact with spring chinook and coho in the Yakima River Basin.

Data exist but are limited on the distribution and abundance of bull trout in the Yakima River basin. Bull trout are a sensitive species receiving increasing attention, as exemplified by the recent determination by the USFWS that their listing was "warranted but precluded" under the Endangered Species Act. Little is known about the likelihood or outcome of their interactions with fish potentially produced by the YFP. Further information on bull trout in the upper Yakima basin is found in Section 3.4.2 of this RDEIS. Smallmouth bass, largemouth bass, and mountain whitefish also are abundant sport fish in the Yakima River and may interact with or prey on anadromous populations.

Northern squawfish are known to be dominant predators on juvenile salmonids, and have been the subject of considerable research with regard to predator control in the reservoirs of the Columbia River system (Willis and Nigro, 1993). As mentioned earlier in this EIS, no work has been done in the Yakima River Basin to ascertain the abundance and distribution of the squawfish population, particularly the segments of the Yakima mainstem below Roza Dam where mortality of outmigrating salmonids is known to be high. Similarly, no research has been conducted in the Yakima River to assess predator consumption rates and the actual relationship of predators to prey (e.g. spring chinook) density, including the associated impact of this relationship on the YFP. However, natural production modeling activities described in Chapters 2 and 3 (Watson et al., 1993) incorporated reviews of available information on predator-prey relations and developed assumptions amenable to risk analysis and hypothesis testing in the context of the YFP monitoring and evaluation plan. This review and modeling effort indicated that up to 240,000 smolts (27 percent of estimated carrying capacity) could be lost to density-dependent mortality in the Yakima River subbasin. (See also discussion in Chapter 2, section 2.2.3.) Research to assess the occurrence and extent of non-salmonid predation on target species as it relates to specific modeling parameters and the density of prey (i.e., predator swamping) would be highly valuable; however, no research is currently planned to address these issues.

The ecological interaction risks identified above can be addressed through monitoring. However, the risk analysis points out that a monitoring plan to contain or manage the risks of adverse ecological interactions on non-target species can only be developed after specific objectives for these species have been defined or identified. The project managers are in the process of identifying objectives for management of the key non-target species and developing comprehensive monitoring plans. Without monitoring and implementation of the adaptive management process, impacts on non-target species from ecological interactions with the supplemented species could be high.

Transfer of Disease. Another concern identified for the YFP is the transfer of disease through ecological interactions between hatchery and wild fish. The introduction of artificially propagated salmonid stocks to the Yakima River Basin under either alternative poses risks to the health of wild fish in the basin. Hatchery practices increase the risk of disease, which may be transmitted to wild populations after the hatchery fish are released into the natural environment. Generally, artificially propagated fish are more prone to contracting diseases and parasites because they live under unnaturally crowded conditions. Thus, transmission of disease and parasites is easier in the hatchery environment. Hatchery rearing conditions may also adversely stress and affect the physical condition of the hatchery fish and their resistance to disease organisms. Despite the comparatively high incidence of disease in hatchery stocks, however, there is relatively little evidence that diseases or parasites are routinely transmitted from hatchery fish to wild fish.

Both Alternatives 1 and 2 pose some degree of risk to existing stocks through the potential for transfer of diseases through the use of the hatchery to propagate upper Yakima spring chinook. This risk would be minimized by the use of local broodstock. The possible introduction of non-indigenous strains of pathogenic organisms under either alternative would be minimized by stringent inspection and quarantine procedures. This section discusses diseases of concern to salmonid resources, the use of preventative measures, and the potential risks associated with the YFP to existing populations.

Bacterial kidney disease is a particular concern because the causative bacterium (*Renibacterium salmoninarum*) is transmitted in the eggs from infected females to offspring. The disease is considered a significant hazard to cultured salmonids, and is a primary health concern of the YFP. Bacterial kidney disease is often diagnosed as a cause of mortality in fish that are reared for more than a year under hatchery conditions (i.e., spring chinook salmon, coho salmon, and steelhead). This chronic disease may be responsible for mortality at any time during the freshwater rearing of salmon and steelhead, and is also known to affect survival after seawater entry. Bacterial kidney disease can be controlled by antibiotic treatment of female salmonids and avoiding the use of heavily infected fish as broodstock. Preliminary evidence suggests that these husbandry methods may increase survival of fish during culture and result in a reduction of infectious bacterial kidney disease organisms available for dissemination to future generations of hatchery and wild fish.

Project managers are also concerned about *infectious hematopoietic necrosis* and *infectious pancreatic necrosis*. Infectious hematopoietic necrosis can cause mortality in rainbow trout, steelhead, sockeye salmon, and chinook salmon; losses due to the disease usually occur in juvenile fry. Mortality resulting from infectious pancreatic necrosis disease(s) is limited to rainbow trout and steelhead fry; both diseases are most often manifest in hatchery situations. Both viruses have been isolated from maturing wild chinook salmon and hatchery steelhead in the Yakima River system, but an actual occurrence of viral disease has not been observed. As with bacterial kidney disease, acclimation of wild fish to the hatchery environment may eventually lead to the occurrence of viral disease and mortality. The relative risk of transfer of infectious hematopoietic necrosis or infectious pancreatic necrosis virus from diseased hatchery fish to wild salmonids is unknown; however, the relatively low-density fish rearing facilities planned for the YFP would probably reduce these risks.

Finally, hatchery-reared fish are prone, through proximity, to contract *parasitosis.* Fungal, protozoal, and helminth parasites are relatively easy to diagnose, and chemical treatment of the holding water is normally effective. The risk of extension of most internal and external parasites of salmonid fish from hatchery to wild situations is confined to the brief period during outmigration and is therefore limited.

A recent literature review by Miller et al. (1990) found that, in spite of the comparatively high incidence of disease among hatchery stocks, there is little evidence that diseases or parasites are routinely transmitted from hatchery to wild fish. This review found a number of studies indicating that infectious pancreatic necrosis and bacterial kidney disease were *not* transmitted from infected hatchery outplants.

All phases of artificial propagation, fish transfers, and supplementation procedures for both Alternatives 1 and 2 would follow the fish health policy documented in *Policies and Procedures for Columbia Basin Anadromous Salmonid Hatcheries* (IHOT, 1994). Rigorous sanitation and use of disinfection procedures combined with optimum husbandry, isolation and quarantine practices and a strong diagnostic and therapeutic program would minimize fish health concerns and reduce the potential for adverse impacts on wild and hatchery-reared fish from disease during operation of the YFP under either alternative.

4.1.2.2 Cumulative Fishery Resource Impacts

Regulations implementing NEPA require Federal agencies to consider the cumulative impacts of their proposed actions. 40 CFR § 1508.25(c)(1991). The regulations define cumulative impacts as follows:

> "The impact on the environment which results from the incremental impacts of the action when added to other past, present and reasonably

foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time." 40 CFR § 1508.7 (1991)

As described in Chapter 1, the YFP is part of an unprecedented effort by the Council, the BPA, the project managers, and other state and Federal agencies and Indian tribes to rebuild salmon and steelhead runs on the Columbia River. The YFP, together with other supplementation, rebuilding, and enhancement projects, would contribute to this effort and to the Council's goal of doubling current runs while maintaining the genetic diversity of the Columbia River anadromous fish stocks. As mentioned in Section 1.4, commenters on the original draft of this EIS suggested that a comprehensive EIS should be prepared on all of the salmonid restoration and mitigation efforts in the Columbia River Basin, including the Council's Columbia River Basin Fish and Wildlife Program. This comment is being addressed in part by the Comprehensive Environmental Analysis of Anadromous Fish Production (CEA) for the Columbia River Basin currently being prepared by the USFWS, NMFS, and BPA.

The CEA will address the cumulative impacts of salmon and steelhead hatcheries and supplementation projects in the Columbia River Basin on wild and naturally-spawning stocks. The YFP would be designed to be consistent with and evaluated along with all other artificial propagation and supplementation facilities being addressed in the comprehensive analysis. While this RDEIS specifically addresses the impacts of the YFP, it includes the following cumulative impact analysis that considers the impacts of this project on the overall Columbia River Basin fishery.

Increasing Supplementation Knowledge

The YFP aims to develop knowledge about how supplementation techniques can be applied to anadromous fish stocks in the Yakima River Basin. This knowledge may be applicable throughout the Columbia Basin. The stock-by-stock adaptive management approach and flexible physical design proposed for the YFP facilities would provide a robust and unique platform for supplementation research. When taken in combination with other current and future supplementation activities within the region (and regardless of the actual outcome of the YFP in terms of the degree of success achieved in stock rebuilding), the cumulative effect of the YFP would be to increase the chances that other supplementation projects would succeed, and that concomitant resource risks would be reduced. The YFP research, monitoring and evaluation facilities would serve to answer critical uncertainties associated with future supplementation activities approved by the NPPC and funded by the BPA.

In addition, the experimental, stock-by-stock adaptive management approach of the proposed YFP alternatives would allow project managers to discover and correct impacts resulting from the supplementation of one stock and possibly apply this knowledge to other stocks before supplementation is initiated on them. Also, the adaptive management approach would result in constant monitoring, review, and revision of the supplementation program, which could help prevent some cumulative impacts from occurring.

Genetic Fitness

If successful, the YFP would help maintain long-term genetic fitness for Columbia River salmonid resources. The project would track genetically distinct populations; it includes a goal to protect each stock. The project would help to rebuild weak stocks, reducing the threat of extinction, and would sustain the diversity of stocks in the basin. Furthermore, the supplementation approach would test a mitigation alternative that could minimize or control adverse impacts on the genetic composition of supplemented natural stocks, when compared to potential risks posed by traditional mitigation hatcheries. It is expected that the cumulative effect of a successful YFP, taken together with other ongoing and future projects in the Columbia Basin, would be to further protect and maintain within- and among-stock genetic fitness.

If the YFP were unsuccessful for one or more stocks, however, the YFP would add nothing to the genetic fitness of Columbia River salmonid resources. Furthermore, if unforeseen adverse genetic impacts were realized and not contained, and if project operations were continued, the net result would be increased erosion of genetic fitness and greater probability of extinction of affected stocks. The adaptive management process for the YFP has been developed to prevent this through ongoing monitoring and feedback into the management process on an annual basis.

Straying of supplemented Yakima Basin fish into other basins and dilution of their gene pools by these fish is not considered to be a problem for upper Yakima spring chinook, as discussed in the section above on genetic risk analysis. Straying of coho is not considered to be a problem because there are no wild stocks remaining in the Yakima or surrounding basins.

Production and Habitat

In Section 7 of the 1994 version of the Columbia River Basin Fish and Wildlife Program, the Council reiterated its determination that implementation of production and habitat actions be fully coordinated (NPPC 1994). Relevant Yakima Basin production and habitat measures in the 1994 Program include construction and evaluation of a supplementation hatchery for the Yakima Basin (Section 7.4K), additional water storage (7.11A), construction of fish passage projects (Section 7.11B), flows to protect spawning and incubation (Section 7.11C), and production and habitat projects developed through subregional planning (Section 7.0B).

The YFP, if successful, would integrate hatchery and natural production and increase stock abundance, productivity, and use of available habitat. However, results would be amplified when coupled with environmental improvements. The cumulative effect of the YFP with ongoing habitat improvement projects in the Yakima River Basin would be to increase the chances for recovery of salmonid resources in the basin. Successful supplementation would be expected to accelerate the population-rebuilding process and ensure that improved habitat is fully used and runs are restored to harvestable levels. On a regional basis, successful supplementation and other artificial production projects, together with habitat and passage improvements, would help to achieve the full natural and hatchery production potential of the Yakima Basin and the Columbia River system in general. The cumulative effect would be to amplify the basin-wide shift toward optimum habitat utilization and reduced reliance on traditional hatchery production.

Efforts to protect fish produced in supplementation facilities could have side benefits for wild stocks. For example, management actions taken in the past to improve the survival of hatchery fish have not been effective for wild fish, due to differences in life history patterns induced by hatchery rearing. Water management decisions often have been influenced by the timing of peaks in total juvenile abundance in the mainstem. The peaks in abundance frequently represent mass movement of hatchery-released fish and not necessarily the timing of wild juveniles. Fish produced by successful supplementation projects, however, should better reflect the behavioral and biological characteristics of wild progenitor stocks. To the extent that supplementation projects produce fish with characteristics similar to those of wild fish, efforts to improve survival of supplementation fish can be expected to benefit wild fish as well.

If the YFP was unsuccessful for one or more stocks, and hatchery and/or natural production increases were not realized, then the rate of stock rebuilding in the Yakima River Basin would remain at levels consistent with ongoing habitat improvement efforts and other external management actions. If the YFP was unsuccessful in increasing natural production in the Yakima Basin, releases of artificially produced fish from the project would still increase the potential for adverse ecological interactions and disease transfer to naturally reproducing fish in the Yakima and Columbia River systems. The Project's hatchery operational procedures, monitoring plan, and adaptive management process have been designed to identify and contain such risks in the Yakima River Basin. The CEA will address cumulative impacts of all Columbia River Basin hatcheries on naturally spawning stocks migrating in the Columbia River mainstem.

Harvest

The cumulative impacts of the YFP and other similar projects outside the Yakima River Basin may be adverse for some unsupplemented wild stocks. If the YFP and other supplementation projects were successful, the relative proportion of fish from supplementation facilities in aggregate runs returning to the Columbia Basin would increase, and the runs would provide more harvestable fish. Under the CRFMP, catch ceilings in Columbia River fisheries are adjusted in response to observed total run sizes. If supplementation produces more fish, and thus expanded harvest opportunities, harvest pressure on unsupplemented wild stocks in mixed-stock fisheries might proportionally increase. Increased harvest pressure triggered by larger aggregate run sizes might incidentally result in overharvest of less productive stocks within stock mixtures (Walters, 1988).

If successful, the YFP would be expected to produce significant numbers of returning spring chinook annually to the aggregate upper Columbia River run. Depending on several factors, these increases have the potential to alter current harvest regimes. Contributions of adult fish from other proposed supplementation programs currently are unknown. Consequently, it is impossible to project the cumulative impacts of the YFP with other proposed supplementation projects on Columbia River runs and fisheries.

Conceivably, the YFP and other regional supplementation projects could also result in positive cumulative benefits for some weaker stocks. Mixed-stock fisheries can be managed so as to protect weaker stocks. When stock-specific differences in run timing, geographic distribution, or other characteristics are known to exist, fisheries can be structured by regulatory measures (collectively termed "time-area-gear restrictions") to increase harvest pressure selectively on stronger stocks and to reduce pressure on weaker stocks. Such measures currently are applied to commercial and sport fisheries to provide additional protection to known weak stocks. For example, fixed ceiling fisheries such as those structured for chinook and coho in the ocean waters of Alaska and Canada under the Pacific Salmon Treaty do not respond to changes in total abundance of the aggregate. Cumulatively, successful supplementation production might lower the harvest rate on weak stocks due to a proportional dilution of weak stocks in the aggregate stock mixture.

If the YFP were unsuccessful for one or more stocks, and increases in harvest benefits were not realized, there would be no positive or negative harvest-related cumulative impact on existing Yakima and Columbia River stocks.

Estuary and Nearshore Habitat

It has been suggested that increases in certain runs could also result in anadromous fish populations which cumulatively tax the carrying capacity of the Columbia River estuary and nearshore marine habitats. Excessively large smolt populations could have adverse consequences for survival and for the ecology of the estuary generally. For this reason, the Council has identified the need to conduct a carrying-capacity study which will include estuary research (Columbia River Basin Fish and Wildlife Program Section 7.1A.2; 7.1A.1, 1994).

The Council has called for a preliminary evaluation of tributary, mainstem (including reservoirs), estuary, plume, nearshore ocean and marine salmon survival, ecology, carrying capacity and limiting factors. The evaluation would include analysis of existing data, identification of critical uncertainties and research needs, and estimates of incremental gains from improvements in each area.

The Council expects a draft carrying-capacity study plan based on critical uncertainties and research needs to be presented by December 1995, with a final plan due in spring of

1996. Currently, however, the means to obtain information on the cumulative impacts of supplementation projects on carrying capacity is unknown. The carrying-capacity study itself will be extraordinarily complex and is expected to be a long-term activity. In the meantime, information to conduct a more intensive cumulative impacts analysis of these issues is unavailable.

If the YFP were unsuccessful for one or more stocks, and increases in the production of either artificially produced or naturally produced juvenile salmonids emigrating from the Yakima River to the estuary were not realized, there would be no adverse cumulative impacts on the carrying capacity of the Columbia River estuary and nearshore habitat.

4.1.2.3 No Action Alternative

Impacts on Supplementation Knowledge

The No Action alternative would not allow fish managers to test the principles of supplementation in the Yakima basin. Knowledge about how supplementation can be used to reestablish naturally producing fish populations in both the Yakima basin and the Columbia River basin would not be gained. This lack could affect fish restoration and recovery goals throughout the Columbia River basin by delaying much-needed research into useful fish management tools at a time when populations are rapidly dwindling.

Production and Harvest Impacts

Without supplementation and the much larger outmigrations necessary to absorb large losses while still leaving a substantial number of survivors, the situation in the Yakima River would remain essentially as it is today. The Yakima River spring chinook would most likely remain at current population levels without achieving their production potential. That failure would have two causes: existing patterns of water management in the Yakima River Basin compromise rearing habitat throughout much of the mainstem Yakima River, and more important, they substantially depress smolt-to-smolt survival in the mainstem Yakima River below Sunnyside Dam. Providing better juvenile and adult passage through diversion dams would help, but recent Court decisions may guarantee that no more water than the present amount would be available for fish production. If the estimated current losses of outmigrating smolts are correct, predation would play a significant role in population dynamics. Small returns generate small outmigrations, which suffer proportionately high losses, thereby resulting in small returns and the perpetuation of the current, depressed cycle. In turn, low returns would continue to affect harvest levels for the terminal fishery.

Yakima River spring chinook would make no contribution to the Council's goal of increased production and associated harvest benefits from the Columbia Basin. Coho production, however, would continue at its present level under the No Action alternative. Constrained by passage mortality, the full natural spawning and rearing potential of spring chinook would not be realized in the Yakima River. The alternative of doing nothing would substantially delay critical learning about methods to increase naturally reproducing fish populations in the Columbia or Yakima Basins.

Genetic Impacts

Hatchery operations present some genetic risk. Consequently, the decision not to construct and operate YFP facilities would, by definition, eliminate certain potential genetic risks. Such a decision, however, would increase other risks. A population with a chronically low escapement because of habitat loss, harvest pressure, and passage impediment might be at substantial risk of severe genetic drift, inbreeding, or extinction. A carefully designed supplementation program could potentially rescue such a population. The Yakima chinook salmon and steelhead populations are at depressed levels, and recent years have seen a pronounced downward trend in the runs. It is unclear whether this is just a fluctuation or the start of a long-term decline.

Another concern is the effective population sizes of the substocks. A more complete picture of the genetic health of the substocks of the Yakima River Basin in terms of probable effective population size is still being developed. If research should show that the Yakima River substocks were not in immediate danger, and harvest management could be guaranteed to keep them out of danger, taking no action to supplement healthy stocks would be a viable alternative.

Under the No Action Alternative, all risks described earlier (as directly related to operation of the hatchery operation) would not exist, but neither would any of the potential benefits. The only likely improvements in production to be realized in the near future would result from the completion of the Phase II screening of irrigation canals and other habitat improvement work now underway.

Despite their depressed condition relative to historic levels, the spring chinook stocks in the Yakima basin appear to be genetically healthy. Procedures for estimation of effective population size are still being developed, but preliminary results indicate that the effective size of all three stocks is adequate for conservation of within-stock genetic diversity. There is no evidence to suggest that they are being affected by gene flow from other stocks. However, recent downward trends in abundance, if not reversed within the next 2 or 3 years, could put the stocks at risk of losing genetic diversity due to low effective size. As population size decreases, there is also a greater risk of extinction. Thus, without a reversal of current downward trends in abundance, the No Action alternative could pose more risk to the spring chinook than the supplementation alternative.

The only genetic risk associated with coho production is the risk to other species through ecological interactions. Coho production under the *U.S. v. Oregon* CRFMP will exist in the basin no matter which alternative is adopted, so this risk will always be present. Alternative 2, because it includes monitoring the ecological impacts of coho production, and thus allows for changes to reduce these interactions, therefore involves less risk than either Alternative 1 or the No Action alternative.

Species Interactions Impacts

There would be no increased risk from direct or indirect impacts, or impacts on long-term natural production on current populations of trout, steelhead, and salmon under the No Action Alternative.

Transfer of Disease

The risk of impact on salmonid populations from the introduction of non- indigenous strains of pathogens would not be increased under the No Action Alternative.

4.1.3 Other Aquatic Resources

It is highly unlikely that the proposed project would result in adverse impacts on other aquatic organisms. A detailed analysis of the potential for wastewater to enter the Yakima River from the hatchery and rearing facilities to enhance algal growth indicated that the resulting concentrations of nitrates and phosphates would not enhance algal production. Further, effects would be short-lived because of rapid dilution in the Yakima River.

Dominant invertebrates identified in the Yakima River include insects belonging to the orders Diptera and Trichoptera. The dipterans are mainly black flies, and the trichopterans are caddisflies. Both of these groups obtain their food by filter-feeding, removing suspended fine particulate organic matter (FPOM) from the water column. Because there is no indication that FPOM concentrations would be enhanced by the proposed action, there is no indication that these groups would be affected by project operations. Higher numbers of salmonids produced by the project could, however, result in increased predation of invertebrates used as food.

Given that it is unlikely that the lower trophic levels of the Yakima River aquatic ecosystem (algae and invertebrates) would be affected by project operations, it follows that there would be no reason to expect that overall ecosystem processes within the Yakima River would be altered by operation of facilities as part of the proposed project.

4.1.4 Vegetation Resources

4.1.4.1 Alternatives 1 and 2

YFP facilities would be located in a variety of habitat types, including those that support riparian and wetland plant communities, forested zones, and agricultural areas. Construction of the Cle Elum hatchery site would require clearing of approximately 6 ha (15 ac.) of vegetation for the acclimation site, the main hatchery facilities, the access road, the water intake structure, and the interpretive center facilities. Construction of the acclimation raceways and pipelines to deliver water to the raceways at the three acclimation sites would also destroy existing stands of vegetation. The total disturbed area would be approximately 0.4-0.8 ha (1-2 ac.) at each site. Surveys of the sites revealed that no unusual or rare habitat types would be affected as a result of these activities. Some of the proposed sites, especially along the Yakima River, have been previously disturbed or developed. Vegetation removal impacts would be the same for both Alternatives, since no additional facilities would be constructed under Alternative 2.

Impacts on wetlands are addressed under the **Floodplain/Wetlands Assessment** in Section 4.1.1.1, and impacts on special status plant species are addressed in Section 4.1.6.1.

4.1.4.2 No Action Alternative

There would be no potential impacts on vegetation under the No Action Alternative.

4.1.5 Wildlife

4.1.5.1 Alternatives 1 and 2

Construction of the Cle Elum hatchery facilities and acclimation site would affect wildlife at the site. Species observed using the area (see Section 3.4.1) would be temporarily displaced during the period of construction. Permanent loss of wildlife habitat would occur on 4-6 of 200 ha (10-15 of 500 ac.) at the site. However, the remaining acreage is proposed to be managed for wildlife mitigation for both the YFP and possible inclusion in the Columbia River Basin Fish and Wildlife Program. The facilities would be located more than 610 m (2000 ft.) away from the ponds and osprey nests at the northeast end of the site, and therefore would not impact them. The riparian area created by the constructed discharge channel to the oxbow system would increase the habitat available for riparian wildlife at the Cle Elum site.

The acclimation sites would be constructed in or immediately adjacent to disturbed areas that, in most cases, receive unregulated use by humans. About 1.2 ha (3 ac.) of potential wildlife habitat would be disturbed by construction at the three acclimation sites (about 0.4 ha (1 ac.) at each site). Because the acclimation sites would receive only seasonal use and low levels of human activity, potential operational impacts on wildlife would be relatively minor. Wildlife impacts resulting from Alternatives 1 and 2 would be the same. Impacts on special status wildlife species are addressed in Section 4.1.6, below.

4.1.5.2 No Action Alternative

There would be no potential impacts on wildlife under the No Action Alternative.

4.1.6 Threatened, Endangered, and Special Status Species

4.1.6.1 Alternatives 1 and 2

Federal agencies are required to consult regarding effects of proposed actions on listed threatened and endangered species under Section 7 of the Endangered Species Act. The NMFS is consulted regarding impacts to marine animals and anadromous fish, while the USFWS is consulted on all non-marine plants, animals, and resident fish.

Informal consultation with NMFS was initiated in December 1992, regarding project effects on listed Snake River chinook salmon. Issues that NMFS raised included potential interactions of YFP fish with listed Snake River salmon in the Columbia River corridor (competition, disease transmission, and predation); the potential for returning adult YFP fish to stray into the Snake River basin; and the potential for taking listed adult Snake River salmon while collecting broodstock for this project.

It is unlikely the listed Snake River salmon would be significantly affected by the proposed project. The best available information indicates that spring chinook have very low straying rates, so it is very unlikely they would stray into the Snake River basin. For the same reason, it is also very unlikely that adult Snake River salmon would be collected in the upper Yakima basin while collecting broodstock for the YFP. Interactions of YFP fish with listed Snake River salmon in the Columbia River corridor through competition, disease transmission, and predation are possible, but the relatively low numbers of upper Yakima spring chinook being added to the system would make the probability of these interactions occurring with any frequency very low.

NMFS is currently completing stock status assessments for chinook, sockeye, steelhead, and coho salmon throughout the ranges of these species. Chinook and summer steelhead in the Yakima River might be indirectly and adversely affected through competition, predation, or disease transmission from project fish. Since sockeye and coho are extinct in the Yakima River basin, there would be no adverse impact expected on them under the YFP. Possible indirect risks to sockeye and coho include interactions (competition) in the Columbia River corridor and straying of YFP coho into streams other than the Yakima River. Before the FEIS, BPA will complete consultation with NMFS on all currently-listed anadromous fish species that may be affected by the project. Subsequent listings may require additional consultation.

As discussed in Section 3.4.2, bull trout, a species for which the USFWS has determined listing was "warranted but precluded" under the ESA, exist in various parts of the Yakima River Basin. To the extent that the YFP leads to increased natural production of target species and their expanded use of available habitat, it is possible that spatial and temporal overlaps with bull trout will increase. Increased abundance and distribution of target species would heighten the probability that adverse competitive interactions with bull trout would occur. Proposed acclimation facilities have been sited to minimize the potential for adverse interactions, while still achieving natural production objectives for target species. If and when the USFWS should decide to list bull trout as a threatened or endangered species, the project managers would perform all appropriate environmental surveys and biological assessments.

In 1989, BPA prepared and submitted a BA to the USFWS, to evaluate potential effects on wintering bald eagles in the Yakima River Basin as a result of construction of proposed YFP central and satellite facilities. BPA determined in the BA that construction of these facilities would have no adverse effect on wintering bald eagles (BPA, 1990a).

Later, additional information was requested from the USFWS on the presence of Federally listed threatened and endangered species that may occur in the vicinity of the proposed acclimation sites. Six listed threatened or endangered species may be present--bald eagle, northern spotted owl, peregrine falcon, marbled murrelet, grizzly bear, and gray wolf. Consultation with the WDFW and the USFWS is ongoing, and a new BA, summarized below, will be submitted to USFWS for the following listed species prior to the final EIS.

- **Bald eagle.** Pacific Northwest Laboratories began surveys of wintering bald eagles in December 1991 for all project facilities. No nest sites were observed near any of the proposed acclimation or facility sites. Project activities would increase numbers of anadromous fish in the Yakima River Basin, a benefit in terms of increased prey base for wintering bald eagles. Thus, results indicate that there would be no adverse effect on the bald eagle as a result of either alternative. However, wintering bald eagles might be disturbed at the Clark Fork acclimation site, through increased human activity around project facilities.

- **Northern spotted owl.** The USFS and WDFW were contacted regarding the historic occurrence of spotted owls and the distribution of suitable spotted owl habitat in the vicinity of the acclimation sites. Historic accounts of spotted owls at the Keechelus site warranted a survey of that site. A one-year calling survey conducted by the Pacific Northwest Laboratories in 1993 did not elicit responses from owls. The Keechelus, Cle Elum, and Jack Creek sites occur within the 2.9- and 4.3-km (1.8- and 2.7-mi.) median home range for spotted owls (WDFW 1994). However, none of the proposed sites is located within suitable owl habitat or contains trees suitable for spotted owl nesting. The Keechelus and Jack Creek sites are proximal to suitable owl habitat; however, there is a very low probability that construction would affect owls at these sites because trees suitable for use by owls would be affected by site development. As a precaution, construction at these two sites would be timed outside the spotted owl breeding season (March 15 to August 31), if necessary, to minimize the potential for impact on spotted owls in the vicinity.

- **Peregrine falcon.** There are no suitable nesting sites (cliffs) for peregrine falcons near any of the project sites. Surveys for other types of habitats used by peregrine falcons will be conducted at the project sites, if necessary, prior to the Final EIS.

- **Marbled murrelet.** Surveys for marbled murrelets were not conducted at the project sites. Murrelets require old-growth habitat within 80 km (50 mi.) of saltwater. The Keechelus site may be on the margin of a known murrelet territory; however, there is a very low probability that construction would affect murrelets at these sites because no suitable trees used by murrelets would be affected. As a precaution, construction at the Keechelus site would be timed outside the murrelet breeding season (April 1 to September 15), if necessary, to minimize the potential for impact on murrelets in the vicinity.

- **Grizzly bear.** Surveys of grizzly bear habitat in the vicinity of the acclimation sites were conducted during spring 1992. No definitive sightings of grizzly bear have been reported in the vicinity of the sites. The home range of the grizzly bear sighting near Teanaway Butte in 1989 would overlap the Cle Elum and Jack Creek sites. However, characteristics essential to grizzly bear habitat (Craighead et al., 1982)--isolation, space, denning, and safety--would not be met within the Cle Elum site. Also, although riparian and upland vegetation would provide forage for grizzly bears at these two sites, neither of the sites is typified by species which constitute primary forage of grizzly bears (i.e., huckleberries, kinnickinnick, sedges) (Servheen, 1992). The potential for grizzly bears to use either of these two sites is likely limited.

- **Gray wolf.** Pacific Northwest Laboratories conducted surveys of gray wolf habitat in the vicinity of the proposed project facilities during spring 1992. USFS also conducted surveys in the vicinity of the Cle Elum site in 1989 and 1990. Responses were received during the USFS surveys in the vicinity of Matthews Creek, about 6.4 km (4 mi.) northwest of Jack Creek. An unconfirmed siting of a gray wolf was reported for the vicinity of the North Fork of the Teanaway River during 1992. One adult and two juvenile gray wolves were confirmed about 3.2 km (2 mi.) from the proposed Keechelus site during 1992. More recent surveys have not been completed. The construction of the facilities would only temporarily alter gray wolf habitat, and would not affect denning or wolf prey base.

Specific surveys for the Federal candidate species were not conducted at each site, however, during field reconnaissance none of the species or signs of them were observed. The proposed activities are not anticipated to affect Federal or state monitor or candidate species. If necessary, sites would be resurveyed prior to construction and/or a biologist would be on site to monitor construction of the facilities.

Surveys were conducted for Hoover's tauschia, a Federal candidate plant species, and for the state-listed threatened plant species at suitable sites during May and June 1992. None were found. Proposed activities are not anticipated to affect these species.

4.1.6.2 No Action Alternative

No adverse impacts are expected on threatened and endangered species under the No Action Alternative. However, there would be no potential benefits to bald eagles from increased foraging opportunities resulting from increased numbers of adult fish. Ongoing recovery planning for the listed species would continue, and proposed species would continue to be reviewed and listed as warranted.

4.1.7 Air Quality and Noise

4.1.7.1 Air Quality

Building the fish hatchery and satellite facilities proposed under either alternative would result in periodic short-term local increases in the vehicle exhaust emissions of vehicle exhaust associated with site clearing and excavation. Dust could also be generated. Site clearing would be minimized to reduce the potential for these impacts. Major earthmoving and heavy construction activities would be completed in 4 to 6 months. Completion of construction and the operation of facilities should have negligible effects on local air quality, and air quality standards would not be exceeded. No significant health-related air pollution problems are anticipated to result from construction activities.

Operation of the facilities proposed under either alternative would continue air pollutant emissions primarily associated with vehicle exhaust (carbon monoxide, volatile organic compounds, nitrogen oxides, sulfur oxides, and particulate matter). However, emissions would be minor, and no significant impacts on air quality of the surrounding region are anticipated.

There would be no potential impacts on air resources under the No Action Alternative.

4.1.7.2 Noise

The effect of Alternatives 1 and 2 on noise levels would be largely limited to the construction phase. The use of heavy equipment during site preparation and construction may temporarily produce elevated noise levels, but these would not affect residential areas. For most sites, construction impacts on wildlife would be minimal because of the lack of noise-sensitive species in the vicinity of the proposed sites. Noise effects during operation of the proposed facilities would be the result of occasional traffic to and from facilities, and from the operation of electrical pumps at some sites. Because activities at the proposed facilities would be low in intensity, these impacts would be minimal and not exceed State of Washington noise guidelines.

No noise impacts would result from the No Action Alternative.

4.1.8 Socioeconomics

An economic impact analysis was conducted in order to show the total employment and income impacts that would result from direct expenditures made during various stages of YFP development and operation. The study prepared as part of the Operating Plan for the project (Mack et al., 1989) was updated in 1995 (Mack and Robison, 1995) to reflect the changes made to the proposed project. Economic expenditures arising from project construction, operations and maintenance, monitoring and evaluation, and harvest were analyzed; impacts were then projected from 1996 to the project maturity year of 2010. Yakima spring chinook supplementation and evaluation comprised Alternative 1; coho monitoring and evaluation activities were added to Alternative 1 to comprise Alternative 2. This section reviews the analytic procedures, assumptions and findings of the impact analysis.

4.1.8.1 Analytical Procedures

The analysis used BPA cost estimates for project activities to estimate the employment and income impacts of both initial and subsequent rounds of spending (see Tables 4.3 and 4.4). For initial spending, models were developed that allocated direct expenditures by function for specific years.

Table 4.3 Estimates of Construction Costs for both Alternatives for the YFP (in thousands of dollars)

FACILITY	COST
Cle Elum Hatchery (upper Yakima spring chinook)	12800
Acclimation sites (upper Yakima spring chinook - 3 sites)	2500
Total construction Cost	**15300**
Engineering/Legal/Administration (25% of total)	3825
Land Acquisition	1450
Grand total cost	**20575**

Table 4.4 Annual Project Costs of the YFP (in thousands of dollars)

	Alternative 1	Alternative 2
Operations and Maintenance		
Labor	128	128
Transportation	12	12
Fish Food	76	76
Power	52	52
Supplies	12	12
Subtotal Operations and Maintenance	280	280
Monitoring and Evaluation	1500	2000
Total Annual Cost	1780	2280

The USFS's IMPLAN input-output economic model was used to estimate the secondary effects upon the economy when direct expenditures cause additional rounds of economic activity in an economy. The IMPLAN model also used the direct expenditures to estimate the induced impacts which would result when the project expenditures were respent in the study area. The sum of direct expenditures plus indirect impacts plus induced impacts equaled total impacts, which were measured as potential increases in jobs and income.

The total impacts were then added to a baseline model, a projected portrayal of the economy of the impact area from 1995 to 2010 as it would have developed without the project. The baseline model was developed around the county level projections made by the Regional Economic Information System, Bureau of Economic Analysis, U.S. Department of Commerce.

The designated two-county impact area was comprised of Yakima and Kittitas counties, since all structures and activities for the two alternatives would be situated within this area. Although some project expenditures and impacts would occur outside the study area, the vast majority would occur within it. Special consideration was made of the impacts upon the Yakama Reservation, an area comprising almost two-thirds of Yakima County. The YIN would be the Lead Agency for managing operations and maintenance as well as monitoring and evaluation activities. As the YIN is also expected to account for half of the harvest of fish from the project, it is appropriate to separate the effects on the Yakama Reservation from the overall effects on the Yakima-Kittitas County areas.

The modeling was also broken down by activities into construction, operations and maintenance, monitoring and evaluation, and harvest. Figure 4.1 shows how the individual activities fit into the time lines of the project lifetime.

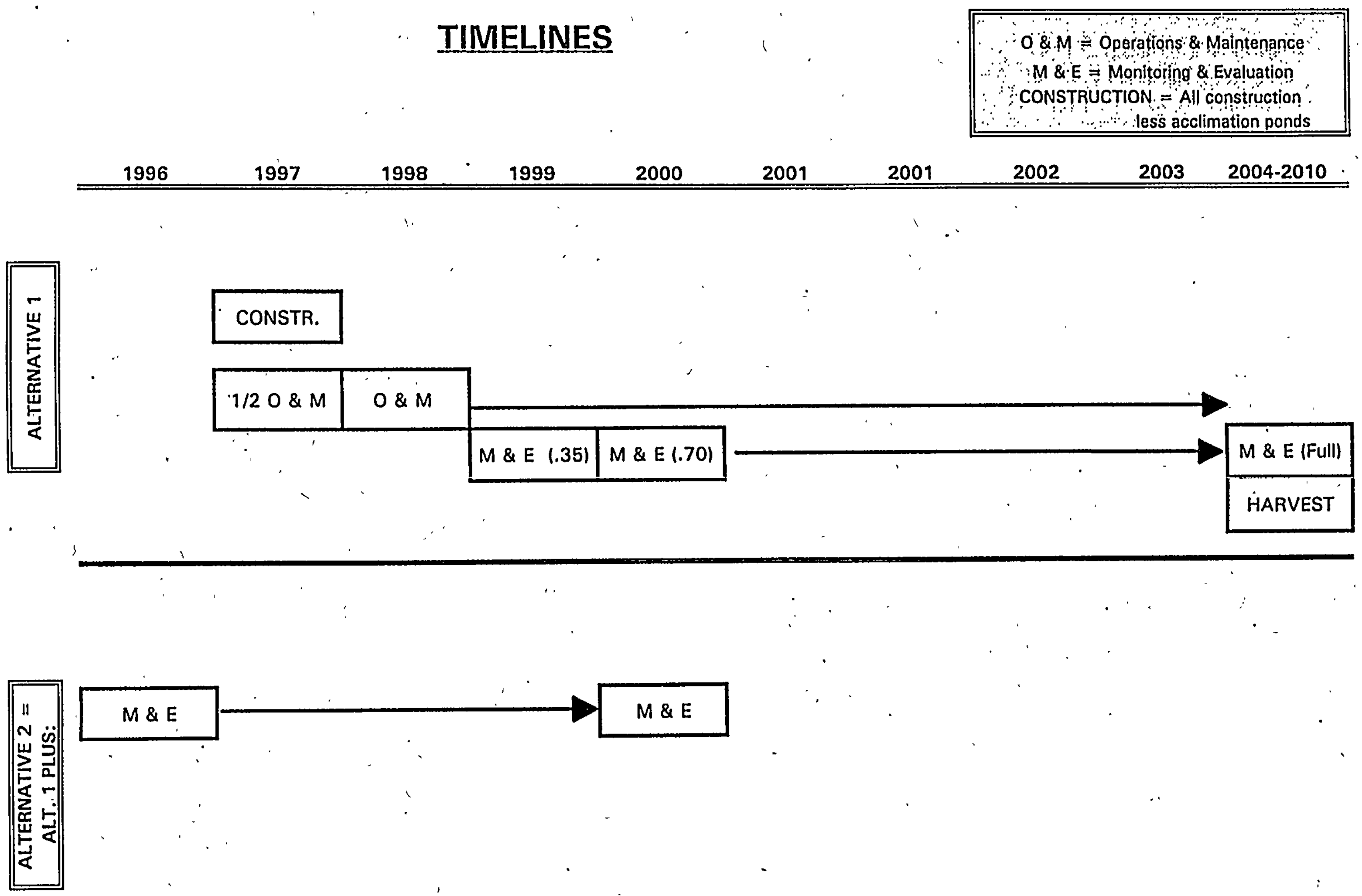

Figure 4.1 Timelines for Socioeconomic Study

4.1.8.2 Assumptions Behind Direct Expenditure Models

Construction

BPA was the primary source for construction costs in aggregate. Aggregated costs were broken down into 22 industrial sectors according to expenditures made on similar hatchery-related construction over the last decade. Twenty-five percent of total construction costs were allocated to Engineering, Legal and Administrative activities.

Local capacity factors were developed, based upon the scenario that the construction contract would be awarded to an out-of-area contractor. A 1-year construction period (June 1996 to May 1997) was assumed. Although some acclimation sites would be built later in 1997, their expenditures would be minor compared to the bulk of 1996 expenditures.

Operations and Maintenance

Detailed operations and maintenance expenditures were obtained from BPA and disaggregated into seven sectors based upon operations and maintenance expenditures of similar projects. It was assumed that operations and maintenance expenditures begin upon completion of construction. The YIN would be the lead agency for operations and maintenance of the facilities.

Monitoring and Evaluation

Aggregated monitoring and evaluation costs obtained from BPA and were broken down into line-item expenditures on a basis of cost allocations recorded in similar programs over the past decade. Historically, a significant portion of monitoring and evaluation contracts was issued to consultants residing outside the region. Accordingly, impacts were generated by these consultants' in-region expenditures plus the expenditures of in-region monitoring and evaluation staff and contractors. Monitoring and evaluation expenditures for Alternative 1 were assumed to begin in 1999, reach their maturity level by 2000, and continue through 2010. Monitoring and evaluation activity by in-region staff was assumed to displace consultant activities as the activities proceeded. For Alternative 2, monitoring and evaluation activities were assumed to begin in 1996 and continue through 2000.

Harvest Expenditures

The harvest model, which apportioned harvestable fish by harvest methods and then into expenditures, was based upon a number of assumptions: (1) a 50/50 Native American to recreational split; (2) an 80/20 recreational boat/ bank angler split; (3) catch rates of .19/.09/2.2 salmon per trip for boat/bank/native anglers, respectively; and (4) 50 percent of recreational anglers would come from outside the study region. Expenditures per trip was an eclectic compilation of findings from a number of parallel studies. It was assumed that the spring chinook harvest would begin in 2004. No coho harvest was attributed to the YFP.

4.1.8.3 Findings

Tables 4.5 and 4.6 summarize the annual results obtained by running the model under the previously listed assumptions. The baseline column of Table 4.5 portrays the employment levels with no additional fishery activities. Columns 4 and 5 show the absolute and percentage increases in employment that Alternative 1 and Alternative 2 activities would add to the baseline employment for the construction year (1996-1997) and the maturity year (2010). Table 4.6 portrays the same impacts in terms of baseline incomes and additional income.

Table 4.5 Summary of Annual Employment Impacts for Alternatives 1 and 2, for the two-County Impact Area

Year	Alternative	Baseline Employment	Change over Baseline	% Change over Baseline
1996-1997	1	119,245	386	0.32%
1996-1997	2	119,245	400	0.34%
2010	1	124,426	76	0.06%
2010	2	124, 426	76	0.06%

Table 4.6 Summary of Annual Income Impacts in Thousands of 1995 Dollars for Alternatives 1 and 2, for the two-County Impact Area

Year	Alternative	Baseline Employment	Change over Baseline	% Change over Baseline
1996-1997	1	5,164,534	10,686	0.21%
1996-1997	2	5,164,534	11,229	0.22%
2010	1	5,731,259	2,085	0.04%
2010	2	5,731,259	2,085	0.04%

In the construction year, Alternative 1 would generate annually $10,686,000 of additional earnings, and 386 new jobs. When coho monitoring and evaluation activities, concomitant with the spring chinook construction activities, are added to the impacts for the construction activities, the total construction year effects are 400 new jobs and $11,229 in additional annual income. Not shown in these summary tables are potential sub-sector impacts of the construction period. The sectors with the greatest impacts would be construction and services. Although the greatest income and employment effects ($3,837,000 and 145 jobs) would occur in the construction sector, the second greatest income and employment changes would accrue to the service sector in the form of $2,451,000 of new income and 105 additional jobs. Because the service sector requires more employment per dollar of output, more new jobs would be generated by the service sector per dollar of income.

Projected annual results for the 2004-2010 maturity period are also summarized in Tables 4.5 and 4.6. These total impacts are comprised of the impacts of O & M, monitoring and evaluation, and harvest expenditures. In 2004, the beginning of the maturity period, the project would produce annual impacts of $2,085,000 in income and 76 jobs. As compared to the construction period expenditures, maturity period expenditures have relatively more impact on the service and trade sectors.

Taken on a basis of the impact area as a whole, even the largest of these impacts (for the 1997 construction year) amount to a maximum of one-third of a percent of either total employment or total income for the area. However, the impacts upon the Native American population of the area are considerable. Table 4.7 details the estimated impacts upon the Native American population in the construction and the maturity period.

Table 4.7 Summary of Annual Income and Employment Impacts upon the Native American Population, in Jobs and Thousands of 1995 Dollars

Year	Employment	Income
1996-1997	26	$754,100
2010	34	$1,041,900

The considerable impacts upon Native American employment and income in the maturity period stem from the role of the YIN as Lead Agency in operations, maintenance, monitoring, and evaluation activities. In summary, the employment impacts upon this relatively small population (8420) and labor force (3886) are significant.

The study also indicates the following:

- The project would increase employment in an area that generally suffers from high unemployment and youth out-migration.
- The project would stimulate some entrepreneurial activities in the study area.
- There would be no construction boom and bust, but a slight increase in jobs and income relative to the size of the study area economy.
- The new jobs would bring a mixed quality of employment to the region: high-income employment would be associated with construction, operations and maintenance, and experimentation and monitoring, while lower income employment would stem from service sector and trade activities during the harvest period.
- The project would aid in the structural evolution of the study area's economy.

- Even during the construction phase, the impacts would represent less than 1% of total area employment and income; there would be less than a 3% change in these variables for the construction sector itself.
- Although the impacts would be small relative to the two-county study area, the impacts would be far more significant to the Yakama Indian Reservation, a sub-area of low incomes and high unemployment rates.

4.1.9 Recreation Resources

4.1.9.1 Alternatives 1 and 2

Wild Trout Fishery

Potential impacts on wild resident trout are discussed under in Section 4.11, under **Species Interactions**. Since it appears that the YFP might affect resident trout to some extent, it is likely that the wild trout fishery would also be affected. Potential impacts include reduced size, reduced catch rates, and reduced angler satisfaction.

The risk of impacts on the wild trout fishery (particularly in the upper Yakima River) would be similar for both alternatives, since no additional coho would be released under Alternative 2. Also, coho released under the current YIN program are being released only in the lower Yakima River, outside the primary area of the wild trout fishery. Successful supplementation of Upper Yakima spring chinook would increase the rate at which the natural carrying capacity of the river in areas of species overlap would be reached or exceeded. Consequently, the likelihood would increase of adverse ecological and genetic interactions that could affect positive attributes of the wild trout fishery.

The resident trout fishery in the upper Yakima River is managed under year-round catch-and-release and selective fishery regulations (retention of caught fish is prohibited; only artificial flies or lures with a barbless hook are allowed). If returns of YFP fish were to jeopardize this fishery seriously, additional resource protection measures might be applied. These might include closing areas now open to fishing, imposing restrictions or reducing the time periods open to angling. Project managers would use the YFP adaptive management process (see Section 2.2, Adaptive Management) to identify unforeseen and unacceptable adverse impacts to resident trout populations and associated fishery attributes. As a part of that process, potential adjustments in YFP objectives and strategies which might reduce such impacts to acceptable levels would be considered, and adjustments would be made as appropriate.

Although there is a risk of adverse impacts on the wild trout fishery from successful supplementation under the YFP, positive impacts on resident trout might occur. If successful supplementation results in increased abundance of spring chinook, it is possible that resident trout populations would benefit from the increased prey base afforded by increased abundance of chinook fry or smolts. To the extent that successful supple-mentation results in positive impacts on resident trout populations, the wild trout fishery might also benefit. Such benefits might include increased trout size and abundance, increased catch rates, and increased angler satisfaction.

Esthetics and Visual Resources

Since most of the project facility sites are located in natural-appearing settings, the facilities would alter the visual settings of the sites. Except for the Cle Elum hatchery, however, the facilities would be on a small scale, and several of them would be located near diversion dams, fish screens, and other man-made facilities. The Keechelus Dam site is located in a scenic highway corridor designated by the WDOT, but the site would be overshadowed by the dam and screened from the highway by trees. The Easton site options are also located in the scenic highway corridor, but both sites have been previously disturbed. The Easton gravel pond site is located next to the freeway, but has been highly disturbed by the asphalt batch plant and excavation of gravel, and is screened from the highway by trees. The Easton Dam site is surrounded by the diversion dam, fish screens, railroad, and a gravel access road. It is not visible from the freeway. The visual impacts of the sites would be mitigated by facility design, minimizing ground and plant disturbance during construction, and providing vegetative screening around the facilities.

Other Recreational Resources

The project facilities are not located near, nor would they affect, any National Trails, Wilderness areas, state-designated parks, or natural areas. The Cle Elum hatchery facility and Jack Creek acclimation site might displace some dispersed recreational and hunting use. The remaining sites identified for facilities currently have little or no recreational use.

BPA is discussing the possibility of allowing the Mountains to Sound Greenway Association to construct a trail that would cross the Cle Elum site on the south side of the river. The trail would connect the John Wayne Trail with a new trail to Roslyn.

Pump stations and outlet pipes on the banks of the river are the only in-river structures proposed as part of this project. Therefore, impacts on recreational boaters would be limited to minor, temporary construction activities.

Interpretive facilities are being planned for the Cle Elum site in conjunction with a group of interested agencies including the U.S. Department of Agriculture - Forest Service and the City of Cle Elum. The interpretive information would contribute to public education as to how the facilities work and their contribution to fishery resources. A public use policy for the undeveloped portions of the site would be initiated as a part of the wildlife management plan. Plans for minimizing impacts on recreational resources at the Jack Creek site would be developed in consultation with the landowners.

4.1.9.2 No Action Alternative

Potential impacts on the wild trout fishery from No Action would depend on management policies implemented in the Yakima River Basin. Recreational opportunities for anadromous sport fishing might be affected if the stocks continued to decline. Visual resources would not be affected, because no supplementation facilities would be built and operated.

4.1.10 Archaeological, Historical, and Cultural Resources

Archaeological, historical, and cultural resources are protected through a number of Federal regulations, including the National Historic Preservation Act, the Archaeological Resources Protection Act, and the American Indian Religious Freedom Act. (See Section 5.7.) These regulations safeguard historical and archaeological resources from damage or removal from Federal lands, and ensure that Federal activities do not impair access to Native American religious sites. In addition, the National Historic Preservation Act requires that the effects of any Federal or Federally assisted undertaking affecting cultural, historic or prehistoric resource be evaluated before project inception.

4.1.10.1 Alternatives 1 and 2

An analysis of potential impacts at the proposed facility sites for both alternatives resulted in the following conclusions:

- no impacts would occur on cultural resources at the Cle Elum, Easton, Jack Creek, or Clark Flat sites;
- the pony-truss bridge at the alternate Keechelus acclimation site is potentially eligible for inclusion in the NRHP. Should the need arise to exceed the posted tonnage (10 tons) or to replace or alter the bridge, a determination of eligibility for the NRHP would be prepared for the bridge, or alternative access would be explored.

If, after construction has started, BPA should discover the project would have an effect on a previously unidentified but eligible property, BPA would fulfill its responsibilities under 36 CFR 800 of the National Historic Preservation Act by suspending work in the area of the impact, consulting with the SHPO and other involved agencies to assess the significance of the resource, and developing mitigation measures if warranted. Should human remains be discovered, work would stop, and the SHPO and the YIN would be notified. If human remains are discovered on Federal or Indian land, work must be suspended for a minimum of 30 days, as required by the Native American Graves Protection Act (1991), and appropriate mitigation measures adopted.

4.1.10.2 No Action Alternative

No impacts on cultural resources are expected from the No Action Alternative.

4.1.11 Resource Management

The fisheries, land use, and water management actions described in Sections 3.9.1, 3.9.2, and 3.9.3 would not change under the YFP. The state and Federal fisheries agencies and the YIN are responsible for anadromous fish habitat protection. The authorities for habitat protection in the Yakima River Basin include the YIN Treaty-reserved rights, and state and Federal laws and regulations. The basic laws that govern protection of fisheries habitat are adopted by either the Washington state legislature or the US Congress. Existing laws and regulations dealing with habitat protection will not be modified by the YFP, nor will the YFP create new regulations.

4.1.11.1 Alternatives 1 and 2

Land Use Policies, Plans, and Procedures

Construction and operation of the proposed YFP facilities under either alternative would have minor impacts on existing land uses. Some impacts on dispersed recreation would occur at the Cle Elum and Jack Creek sites (see Section 4.1.9.1). Each acclimation site would use less than 0.8 ha (2 ac.) of land (including access roads). Consistency with local land use plans is addressed in Section 5.2, and farmlands are addressed in Section 5.10 of this EIS.

Solid Waste and Hazardous Materials

<u>Solid Waste</u>

Each YFP facility is anticipated to generate solid waste requiring disposal. For the purposes of this analysis, three types of solid waste were considered: refuse generated by the residences at the Cle Elum hatchery facility, refuse resulting from daily facility operations, and fish carcasses resulting from seasonal fish processing operations. The volume of waste generated by the residences would depend on the number of persons in each household, and could vary seasonally. Based on data from a number of rural counties in Washington State, a generation rate of between 1.8 and 2.7 kilograms (kg) (4 and 6 pounds (lb.)) per person per day can be used to estimate the amount of refuse generated. Actual refuse generation would be likely to vary somewhat from this estimate. The amount of solid waste generated by employees depends on the number of full-time equivalent (FTE) staff employed at each facility, and would vary seasonally with changing operations at the hatcheries. The amount of this waste could range from 2.7 to as much as 3.2 kg (3 to as much as 7 lb.) per day per FTE employed. It is anticipated that approximately 13.4 metric tons (14.8 short tons) of fish carcasses would be generated annually at the Cle Elum hatchery facility under either alternative.

Solid waste collection, transport, and disposal services are available for the Cle Elum hatchery facility from Waste Management of Ellensburg. Wastes would be transferred to a baling operation near Ellensburg and disposed of at a landfill

27 km (17 mi.) east of Ellensburg. For the disposal of fish carcasses, specific disposal arrangements would be required annually. Fish carcasses could also potentially be incorporated into local composting programs or used as fertilizer, rather than disposed of by conventional means. Contracts would be arranged with local solid waste disposal companies for disposal of the small amounts of wastes generated at the other project facilities.

Facility operation would also generate domestic sewage. Septic tanks and drainfields would be constructed for each residence and main buildings to dispose of domestic sewage. Contents of the septic tanks would be periodically pumped out by a licensed contractor and disposed of at a local sewage treatment plant. Routine facility operations would result in generation of fish feces and unconsumed fish food. Most of these fish wastes would settle to the bottom of the rearing tanks and raceways, with a small percentage remaining suspended and discharged. Through routine cleaning practices, waste products accumulating in rearing structures would be pumped to the facility settling basins. The basins would detain raceway cleaning effluent and allow fish wastes to settle out of the water column. Wastes that accumulate in the settling basins would undergo biological degradation, but may require periodic removal and disposal every 5 to 10 years. This waste material may be suitable for agricultural fertilizer, and could be offered to local farms or applied to facility land. It could also be placed in a certified landfill.

The project managers would develop and implement a recycling policy, which would clearly state the type and quantities of products to be procured by the program or facilities. In addition, source separation of recyclable products would be practiced onsite by using separate containers for aluminum, glass, paper, and other recyclable materials. The appropriate recycling or solid waste collection company would then be contacted for materials pickup.

Hazardous Materials and Waste

Normal facility operation under both alternatives might require the use of several chemicals classified as medicines for fish disease prevention and control. These substances include fish disease chemotherapeutants such as acetic acid, Diquat, Epsom salts, formalin (a saturated formaldehyde solution), iodophor (Betadine, Wescodyne, Argentyne), potassium permanganate, quaternary ammonium compounds, and sodium chloride and antibiotics such as oxytetracycline HCl (Terramycine) and oremetroprim (Romet). Several of these chemicals can be applied by a licensed operator only.

Tricaine methane sulfonate (MS-222), a fish anesthetic, and chlorine (sodium hypochlorite or HTH) also are likely to be used at project facilities. MS-222 is approved by the Food and Drug Administration (FDA) and is used primarily during transport of fish. MS-222 would be used in accordance with FDA requirements to calm fish and reduce stress during their transport from the central or satellite facility to the acclimation facility. Chlorine is likely to be used on a limited basis, primarily for disinfecting equipment.

Of the specific materials identified above, only formalin is considered a potentially dangerous waste. The formalin would probably be considered a listed hazardous waste as formaldehyde and classified as a U122, EHW (extremely hazardous waste) dangerous waste. Project facilities must comply with the dangerous waste generator requirements of WAC 173-303-070(8) if it becomes necessary to dispose of more than 1 kg (2.2 lb.) of formaldehyde at one time. Because the formalin is expected to be used up by the facility during operations, the facility is not expected to be a dangerous waste generator.

Because of their associated hazard, several of the compounds identified above are listed in 40 CFR 302 as requiring a report to be filed with the National Response Center within 24 hours if a spill above a certain amount (or reportable quantity) occurs. These compounds and their reportable quantities are listed below:

Compound	Reportable Quantity
acetic acid	2268 kg (5,000 lb.)
Diquat	453.6 kg (1,000 lb.)
formalin (formaldehyde)	45.4 kg (100 lb.)
potassium permanganate	45.4 kg (100 lb.)

The amount of these chemicals present at any of the facilities at any one time is expected to be below these reportable quantities, except for formalin.

Chemicals applied in project facilities would be handled, applied, and disposed of in accordance with FDA, EPA, and the WDOE regulations. Consequently, project managers do not anticipate adverse environmental effects from chemical use at project facilities.

Facility operations would not likely require the use of herbicides and pesticides for terrestrial applications. Mechanical eradication of nuisance species (for example, weeds, mice) is preferred; only in extreme cases would pesticides be used. If use of such a herbicide or pesticide were required at the facilities, a readily available EPA-approved product (for example, Monsanto's Roundup™) would be used. The use, storage, and disposal of these products and their containers would be in accordance with EPA or FDA regulations and the instructions on the product labels.

Limited use of lubricant oils and greases is expected to occur at the facilities. Use of these materials would be limited to maintenance of pumps and other moving equipment that might need to be lubricated periodically. These materials would be stored in an area such as a storage locker for flammable materials, away from the hatchery waters and storm drains. Maintenance of vehicles used by the facility would be contracted out and would not occur onsite. Thus, it is not expected that oil and/or grease would have an adverse effect at any of the facility sites.

4.1.11.2 No Action Alternative

Land use and resource management policies would not be expected to change in the Yakima River Basin as a result of the No Action Alternative. State and Federal fisheries agencies and the YIN are currently involved in implementation of several habitat protection laws and regulations. It should be noted that, while implementation of these laws and regulations may have been uneven over recent years, they pre-date the YFP and implementation will not be avoided if the YFP is not constructed. Fisheries habitat protection laws include the following: Water Resources Act of 1971, Revised Code of Washington (RCW) 90.54; Hydraulic Approval Act, RCW 75.20; Minimum Water Flows and Levels, RCW 90.22; RCW 90.03.247; and RCW 90.03.345. Federal laws which may apply include: Endangered Species Act of 1973; Clean Water Act; Fish and Wildlife Coordination Act; National Environmental Policy Act of 1969; and Section 10 of Rivers and Harbors Act of 1886.

Land uses at the proposed facility sites would not change under the No Action Alternative. The proposed facilities would not be built, and the sites would remain in their current condition unless developed in the future. No generation of solid or hazardous waste or use of hazardous materials would result under the No Action Alternative.

4.2 Mitigation Measures

4.2.1 Management of Biological and Ecological Risk

The biological and ecological effects of the YFP or any other supplementation program are a function not only of the direct hazard (e.g., straying, disease transmission, competition), but also of the entire risk management structure of the project. Key elements of the risk management structure are a monitoring program and an adaptive management process for responding to results from the monitoring. While an effective risk management structure cannot promise to fully contain all possible risks posed by a project, it would significantly reduce the intensity and duration of impacts.

The YFP has a well developed risk management structure, described in Section 2.2. The risk analyses presented in Section 4.1.2.1 describe the potential risks arising from operation of the project according to the objectives developed for the project. The monitoring plans described in Sections 2.3.3 and 2.4.3.2 will provide feedback for the adaptive management process.

4.2.2 Specific Mitigation Measures

The mitigation measures below have been identified by the various resource specialists working on this RDEIS; the impact analyses are based on implementation of these measures. If an action alternative should be selected for the YFP, BPA would detail in the Record of Decision which of these measures (and any additional measures suggested during the review of the RDEIS) would be implemented. BPA and the project managers would work with the regulating agencies and affected parties to develop detailed plans for implementing these or similar measures. All measures apply to both Alternatives 1 and 2, unless otherwise specified. See also discussions under regulatory compliance in Chapter 5.

- Water withdrawals from the Yakima River for the Cle Elum hatchery would be reduced during periods of river flow less than 350 cfs (9.8 m^3s).

- Surface water withdrawals would be nonconsumptive; water would be returned to the source stream or river after it flows through the facility. BPA or the project managers would apply for a permit for nonconsumptive appropriation of surface waters from the WDOE for each of the sites, and comply with the conditions of the permits.

- If the alternative Keechelus acclimation site were used, the possibility of using water piped directly from the reservoir would be explored to avoid further dewatering of the Yakima River during extreme low flow periods when the reservoir is being refilled.

- Project managers would implement measures to ensure that project facility construction and operation do not adversely affect surface or groundwater quality, including treatment of runoff from access roads and other impervious surfaces.

- County authorities and the Federal Emergency Management Agency would be contacted to ensure that any new construction would not alter floodplain characteristics or channel flow capacity. Certain design restrictions or limitations may apply. If facilities were located within the floodplain, they would be designed to withstand flooding. Construction impacts within the 100-year floodplain would be mitigated by ensuring that construction would not raise the expected level of the 100-year flood, and would include minimal use of impervious surfaces.

- The loss of 0.1 ha (0.24 ac.) of riparian wetland at the Cle Elum hatchery site would be mitigated by constructing 0.2 ha (0.54 ac. or 1,000 lineal feet) of outflow channel to the oxbow system with 0.14 ha (0.34 ac.) of fringing riparian emergent wetland, and by constructing an additional 0.06 ha (0.14 ac.) of isolated emergent wetland.

- To avoid impacts on wetlands at acclimation sites, delineations would be completed before final facility design, siting, construction, and operation. Information from delineation surveys would be used during final design to develop mitigation measures, if necessary, to ensure that the project would result in no net loss of wetlands. Review and concurrence through the Corps permit process would be completed as necessary before site development. Disturbance of wetlands and buffers from construction activities would be avoided whenever possible. If disturbance cannot be avoided, the area of disturbance would be minimized to the extent practicable. Upon completion of construction, excavated areas would be backfilled, and disturbed land restored to its previous condition wherever possible.

- The project managers will define or identify objectives for management of the key non-target species before the project is implemented, so that an effective monitoring plan can be developed and implemented.

- The possible introduction of non-indigenous strains of pathogenic organisms under either alternative would be minimized by stringent inspection and quarantine procedures.

- All phases of artificial propagation, fish transfers, and supplementation procedures for both Alternatives 1 and 2 would follow the fish health policy documented in *Policies and Procedures for Columbia Basin Anadromous Salmonid Hatcheries* (IHOT, 1994). Minimal use of surface water, rigorous sanitation, and use of disinfection procedures combined with optimum husbandry, isolation and quarantine practices, and a strong diagnostic and therapeutic program would be incorporated into the project operations.

- Specific recommendations for wildlife mitigation at the Cle Elum hatchery site have been prepared as a result of consultations with the WDFW (Renfrow, 1994) and the YIN, and would be reviewed for applicability and modified as necessary for implementation during site development. Mitigation plans for the net loss of riparian and other wildlife habitat at the acclimation sites would be developed and implemented in consultation with WDFW and YIN personnel. For the purposes of the YFP, and to be consistent with the Columbia River Basin Fish and Wildlife Program, wildlife mitigation is defined as achieving and sustaining the levels of habitat and species productivity for the habitat units lost as a result of the construction and operation of the YFP facilities and interpretive trails. Habitat Units, as defined under the Habitat Evaluation Procedure, will be the preferred unit of measurement for wildlife mitigation accounting. The mitigation obligation will be considered to be met only when the effects are fully addressed, i.e., when mitigation actually offsets the loss caused by a YFP facility.

- Any loss of unavoidable disturbance of riparian habitat would be compensated for by either acquisition or enhancement of other riparian habitat in the Yakima River basin.

- BPA would complete consultation with the NMFS and USFWS under Section 7 of the ESA before implementing the project.

- Construction at the Jack Creek and Keechelus sites would be timed outside the spotted owl breeding season (March 15 to August 31), if necessary, to minimize the potential for impact on spotted owls in the vicinity.

- Surveys for peregrine falcons would be conducted before construction at the project facility sites.

- As necessary, the acclimation sites would be resurveyed for special status species before construction and/or a biologist would be on site to monitor construction of the facilities.

- Site clearing would be minimized to reduce the potential for air quality impacts during construction due to dust and vehicle exhaust.

- The visual impacts from the sites would be mitigated by minimizing ground and plant disturbance during construction, and providing vegetative screening around the facilities.

- Interpretive information has been proposed for the Cle Elum site to help the public understand how the facilities work and their contribution to fishery resources. A public use policy for the undeveloped portions of the site might be developed as a part of the wildlife management plan. Plans for minimizing impacts on recreational resources at the Jack Creek site would be developed with the landowners.

- The pony-truss bridge at the Keechelus Dam site is potentially eligible for inclusion in the NRHP. Should the need arise to exceed the posted tonnage (10 tons) or to replace or alter the bridge, a determination of eligibility for the NRHP would be prepared for the bridge. Alternative access might be investigated.

- The project managers would develop and implement a recycling policy, which would clearly state the type and quantities of products to be procured by the program or facilities. In addition, source separation of recyclable products would be practiced onsite by using separate containers for aluminum, glass, paper, and other recyclable materials. The appropriate recycling or solid waste collection company would then be contacted for materials pickup.

- Chemicals applied in project facilities would be handled, applied, and disposed of in accordance with FDA, EPA, and WDOE regulations.

- Where possible, an attempt would be made to locate facilities out of the 60-m (200-ft.) State shoreline area of the Yakima and North Fork Teanaway Rivers. The following measures would be taken, when practicable, to assure consistency with the Kittitas County's Shoreline Master Plan.

    1. Location of structures within the identified shoreline would be avoided if possible. If locations within the shoreline area could not be avoided, BPA would consult with the appropriate state and local agencies to determine the best placement of the structure.
    2. In shoreline areas, disturbed land would be restored as closely as possible to pre-project contours and replanted with native and local species. However, there might be locations where site topography would require near-bank disruption. A restoration and monitoring plan would be prepared before shoreline areas were disturbed.
    3. Erosion control measures would be implemented within the 60-m (200 ft.) shoreline area.

- Construction equipment exhausts would meet applicable regulatory requirements. Any fugitive dust caused by construction would be mitigated by water sprinkling, as necessary.

4.3. Unavoidable Adverse Effects

Implementation of the YFP as proposed under Alternatives 1 or 2 in this RDEIS would result in the unavoidable adverse effects discussed below.

Dewatering of the Yakima River below Keechelus Dam would occur if this alternative site were chosen, minimum flow agreements for protection of fishery resources were not maintained, and alternative water sources were not found for the raceways at this acclimation site. Some construction activities would unavoidably violate State water quality standards on a short-term basis as erosion from the construction site entered nearby water bodies. Construction of pipelines and other facilities would disturb floodplains and small amounts of riparian habitat. Small amounts of wetlands would be lost, but would be mitigated through replacement.

Construction of the facilities for the YFP would result in the destruction of approximately 8.5 ha (21 acres) of vegetation and wildlife habitat, including potential habitat of two endangered species: grizzly bear and gray wolf. However, there is no known use of the habitat by grizzly bears or wolves. Some disturbance of wintering bald eagles at the Clark Flat acclimation site would result from increased human activity in the vicinity of project facilities.

The project would increase the likelihood of ecological and genetic interactions that could affect positive attributes of the wild trout fishery. The facilities would alter the visual settings of the sites. Some impacts on dispersed recreation would occur at the Cle Elum and Jack Creek sites. Each YFP facility is anticipated to generate solid waste requiring disposal.

The following biological risks to fish have been identified for the project. While an effective risk management structure would greatly minimize these risks, it cannot promise to fully avoid all possible adverse effects that might result from implementing the project. Therefore, these risks are included here. The project managers believe that, with the implementation of the risk management structure outlined in Section 2.2, the benefits of the YFP would greatly outweigh the potential adverse effects of these risks. The Upper Yakima spring chinook program poses genetic risks to all three spring chinook stocks in the basin. The amount and effect of straying of Upper Yakima hatchery fish on other stocks cannot be predicted and could genetically affect the other stocks, both in the Yakima River Basin and in other basins. Spring chinook produced from the YFP would compete with pre-existing naturally produced fishes, particularly spring chinook salmon and perhaps rainbow and steelhead trout. The specific outcome of this competition is largely unpredictable at this time, but it is reasonable to expect that growth, abundance, and/or distribution of affected stocks would be altered to some extent. The likelihood or outcome of interactions between fish produced by the YFP and wild and native non-anadromous fish is unknown. The fish produced by the YFP pose a low degree of risk to existing stocks through the potential for transfer of disease. The increased number of YFP fish available for harvest might result in increased harvest of unsupplemented wild stocks. The cumulative impact of the YFP and other supplementation projects on the carrying capacity of estuary and nearshore habitat is unknown.

4.4. Relationship of Short-Term Uses and Long-Term Productivity

One of the goals of the YFP is to increase the long-term productivity of anadromous fish in the Yakima River Basin and, ultimately, in the Columbia River Basin, by providing knowledge about the use and application of supplementation theories. In the short term, the YFP would cause relatively minor impacts on water quality, quantity, vegetation and wildlife habitat, wetlands, and possibly the wild trout fishery. Yakima River Basin fisheries could also be negatively affected by genetic and ecological interactions that could result from implementation of the project. However, the commitment of the project managers and BPA to the use of the adaptive management process, including systematic risk assessment and monitoring, should minimize long-term genetic and ecological impacts. In fact, implementing the YFP through an adaptive management process may result in less impact on the long-term productivity than the No Action alternative, especially if the current decline in anadromous fish populations should continue.

4.5. Irreversible and Irretrievable Commitments of Resources

The YFP would result in the irreversible and irretrievable commitment of the materials needed for the construction of the facilities, although some of the materials would be recyclable after they complete their useful lives. Fuel used to construct and operate the project would not be renewable. Depletion of groundwater resources might occur, depending on the rate of recharge of the aquifer being used to provide water for the project. However, the most significant commitment of resources would be that of the genetic resources of the wild and native Yakima River Basin spring chinook stocks. The genetic makeup of the three stocks, especially the Upper Yakima stock, could be irreversibly and irretrievably altered by the implementation of the project. While all practicable means to minimize this impact would be taken by the project managers, there is no way to eliminate this risk totally. The project managers and BPA, as a first priority, will consider the risks of this commitment in making decisions on this project.

5. ENVIRONMENTAL RULES, REGULATIONS, AND PERMITS

This chapter discusses laws, regulations, and permits that may apply to the Yakima Fisheries Project. Regulatory citations are in parentheses. As lead Federal agency for the EIS, BPA would take the lead role, as appropriate, in acquiring all necessary permits.

5.1 Environmental Policy

The proposed project would be developed in a manner consistent with the National Environmental Policy Act, following the "Regulations of Implementing the Procedural Provisions of the National Environmental Policy Act." These rules were issued by the President's Council on Environmental Quality. It would also be consistent with the Department of Energy National Environmental Policy Act Implementing Procedures (10 CFR 1021).

5.2 State, Areawide, and Local Plan and Program Consistency

No unresolvable conflicts with state, areawide, or local plans are anticipated. The project would be coordinated with State and local government agencies to ensure that all applicable requirements are met.

5.2.1 State and Areawide Clearinghouses

BPA will distribute the RDEIS to the Washington clearinghouse for State and local agency review and consultation, as required by Executive Order 12372. The clearinghouse will be notified when the RDEIS is ready for review, and clearinghouse comments will be addressed in the FEIS. The clearinghouse will also be informed of the availability of the FEIS and the Record of Decision.

5.2.2 Local Plans

BPA's proposed activities would be located in areas covered by the 1993 Kittitas County Comprehensive Plan. The comprehensive plan is a declaration of policies, and as such, contains no regulations or minimum standards.

The Cle Elum hatchery site, acclimation site, caretakers' residences, most of the wells and water transmission pipelines, and access roads are located in an area designated as *Forest Multiple Use* on the Upper Kittitas County Comprehensive Plan Map. The purpose of this designation is to protect and conserve natural resources, provide appropriate areas for residential and recreational development, and promote development in harmony with the natural environment. The pump station, one or more wells, and portions of one or more water transmission pipelines are located in an area designated *Floodplain*. The purpose of the floodplain designation is to minimize flood damage, reduce the need for flood control structures, assist the unhindered flow of flood waters, and limit costs of recovery from flooding.

The acclimation sites have the following Comprehensive Plan designations:

Easton acclimation site	
Gravel Pond siting option	Forest Multiple Use
Easton Dam siting option	Forest Multiple Use
Jack Creek acclimation site	Forest Resource/Forest Multiple Use
Clark Flat acclimation site	Open Range
Cle Elum acclimation site	Forest Multiple Use/Floodplain
Keechelus acclimation site	Forest Multiple Use

The purpose of the Forest Resource designation is to focus on the importance of sustained yield forestry and associated forest values including watershed, wildlife, mining and recreation. The open range (rangeland) designation objective is to follow a policy of encouraging low intensity uses and activities on range lands. Where heavier land uses can be supported, such uses might be allowed following environmental review.

5.2.3 Zoning

Current zoning and comprehensive plan designations are not always consistent with each other. Work underway for the Washington Growth Management Act would correct that.

The proposed and alternative YFP facilities would be located within the following Kittitas County zoning districts:

Cle Elum hatchery site	Forest and Range
Easton acclimation site	
Gravel Pond siting option	Forest and Range
Easton Dam siting option	Rural - 3
Jack Creek acclimation site	Commercial Forest
Clark Flat acclimation site	Agricultural (A20)
Cle Elum acclimation site	Forest and Range
Keechelus acclimation site	Commercial Forest

Fish hatcheries or aquaculture facilities are not addressed in the Kittitas County Zoning Code as either permitted or conditional uses under any of the county's zone designations. BPA and its consultants have and would continue to coordinate the proposed actions with the County planning department to address any zoning concerns.

5.3 Water Quality and Water Appropriation

Several regulatory requirements apply to water quality, water appropriation, and to work in stream beds and on shorelines.

5.3.1 Water Appropriation

BPA would secure permits from the Washington Department of Ecology as required for the nonconsumptive appropriation of river water required for the YFP (RCW 90.03). Permits would also be secured from the WDOE for the appropriation of groundwater in amounts over 18,927 liters (5,000 gallons) per day (WAC 173-160). The necessary notifications for water-well drilling (WAC 173-160) would be provided.

5.3.2 Permits for Discharges Into Waters of the United States

The Clean Water Act (CWA) regulates discharges into waters of the United States. (See Section 5.3.3 for compliance with section 404 of the CWA (33 U.S.C. 1344)).

BPA would acquire National Pollutant Discharge Elimination System (NPDES) permits from EPA, Region 10, as required, for the point discharge of any pollutant regulated under the CWA (33 USC 1251 et seq.) to the Yakima River or its tributaries from YFP facilities. Under Section 401 of the CWA, a Federal permit to conduct an activity that results in discharges into navigable waters is issued only after the affected State certifies that existing water quality standards would not be violated if the permit were issued. Some construction activities would unavoidably violate state water quality standards (particularly the turbidity criteria) on a short-term basis. In such cases, a Water Quality Modification may be required by the WDOE (Chapter 90.48 RCW, Chapters 173-201; 173-222 WAC).

Section 402 of the CWA authorizes storm water discharges associated with industrial activities under the NPDES. For the State of Washington, the EPA, Region 10, has a general permit (# WA-R-10-000F) authorizing Federal facilities to discharge storm waters from construction activities disturbing land of 2 or more ha (5 or more ac.) into waters of the U.S., in accordance with various set conditions. BPA would comply with the appropriate conditions for this project at all sites meeting this criterion, such as issuing a Notice of Intent to obtain coverage under the EPA general permit and preparing a Storm Water Pollution Prevention (SWPP) Plan.

The SWPP Plan helps ensure that erosion control measures would be implemented and maintained during construction. The SWPP Plan would address Best Management Practices for stabilization practices, structure practices, stormwater management, and other controls.

5.3.3 U.S. Army Corps of Engineers Permits for the Discharge of Dredged or Fill Material

Minor amounts of dredged or fill material may be discharged to the Yakima River, its tributaries, or wetlands during construction or operation of the YFP. These activities would most likely be authorized by Corps nationwide permits (number 14 for access roads and number 7 for intake and outlet structures) under CWA Section 404 (33 CFR 320-330). As in the case of NPDES permits, certification (that the discharge would not violate State water quality standards) is required from the State of Washington. Other conditions may apply to the nationwide permits.

5.3.4 State Permits for Work in Stream Beds

Hydraulic project approval from the WDFW would be obtained to construct any form of hydraulic project or perform other work that would use, divert, obstruct, or change the natural flow of the Yakima River or its tributaries (RCW 75.20.100, WAC 220-110). The WDFW would also require that water-diversion devices be equipped with a fish screen to prevent fish from entering the diversion device (RCW 75.20, Chapter 77.16 WAC).

5.3.5 Coastal Management Program Consistency

The Coastal Zone Management Act of 1972 requires that Federal actions directly affecting the coastal zone be undertaken in a manner consistent, to the maximum extent possible, with the State's coastal zone management program. Washington's coastal zone management program is implemented through the provisions of the State Shorelines Management Act, including shoreline management programs developed/administered by the counties. The Coastal Zone Act Reauthorization Amendments of 1990 also require that proposed Federal facilities fully comply with Federal consistency requirements as determined by and through consultation with a designated coastal zone management agency.

BPA and the WDOE have a Memorandum of Agreement (MOA) that provides a process for State and local review of BPA projects in and directly affecting shoreline areas in the State. BPA would fully meet its obligations under the MOA, but no permit would be required.

The State's Shoreline Management Act (Chapter 90.58 RCW) identifies "Shorelines of Statewide Significance" and "Shorelines of the State" near the proposed project. In addition, the Kittitas County Shoreline Master Plan regulates development in areas 60m (200 ft.) landward of the Ordinary High Water Mark of the Yakima and North Fork Teanaway Rivers, including the floodway and associated wetlands. Facilities at the Cle Elum hatchery and all of the acclimation sites may be located within the 60m (200 ft.) jurisdictional area on the Yakima River and North Fork Teanaway River for the Shoreline Management Act and Shoreline Master Plan.

The Cle Elum hatchery would have an intake structure and pump station located at river mile 184.7 and an outfall structure located at river mile 183.3. In addition, the oxbow system at the Cle Elum hatchery site is considered to be an associated wetland of the Yakima River, so the discharge from the constructed outflow channel would be located in the shoreline zone. The portions of the Cle Elum hatchery site that fall under the jurisdiction of the Kittitas County Shoreline Master Plan are designated Conservancy Environment. Aquaculture (including fish hatcheries) is a permitted use in the Conservancy Environment, provided operation does not involve major construction or other activities that would substantially change the character of the area.

Actual structure locations for the acclimation facilities would not be finally determined until the detailed design stage of project development (after the final EIS). Where possible, BPA would attempt to locate structures out of the 60-m (200-ft.) jurisdictional area. Also, BPA would take the following measures, when practicable, to assure consistency with the county's Shoreline Master Plan.

1. Location of structures within the identified shoreline would be avoided if possible. If locations within the shoreline area could not be avoided, BPA would consult with the appropriate state and local agencies to determine the best placement of the structure.
2. In shoreline areas, disturbed land would be restored as closely as possible to pre-project contours and replanted with native and local species. However, there might be locations where site topography would require bank disruption. A restoration and monitoring plan would be prepared before shoreline areas were disturbed.
3. Erosion control measures would be implemented within the 60-m (200 ft.) shoreline area. (See Section 4.2, **Mitigation**.)

5.3.6 U.S. Army Corps of Engineers Permits for Structures or Work in Navigable Waters

Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. 403) requires permits for structures potentially affecting navigation on waters of the United States. The Rivers and Harbors Act requires the applicant to prevent the obstruction or alteration of a navigable water without the specific authorization from the Corps. The Corps has identified navigable waterways and issues permits for actions affecting them (33 CFR 322). This project would not require any structures in a navigable waterway because the Yakima River and its tributaries above the city of West Richland are not classified as navigable waters according to the Corps definition in 33 CFR 329.

5.4 Recreation Resources - Wild and Scenic Rivers, National Trails, Wilderness Areas, Parks

A review of the Wild and Scenic River inventory of listed and proposed rivers (16 U.S.C. Sec 1273 (b)) shows no rivers or portions of rivers qualifying for Wild, Scenic, or Recreation River status within the study area. The Pacific Crest National Scenic Trail, inventoried in the National Trail System (16 U.S.C. Sec. 1242-1245), passes within several miles of the Keechelus and Easton acclimation sites, but these sites would not be visible from the trail. No designated wilderness or parks are located near the facility sites.

5.5 Permits for Rights-of-Way on Public Lands

BPA would secure necessary use permits from the USBR for the Keechelus and Easton Dam acclimation sites. A use permit may be required for the Easton Gravel pond site from the WDOT.

5.6 River-Bottom Leases

Leases of the state-owned aquatic lands are administered by the Washington Department of Natural Resources. If necessary, a lease to use these public lands would be issued by the Department's Aquatic Lands Division (Chapter 79.90 RCW, Chapter 332.30 WAC).

5.7 Heritage Conservation

Federal historic and cultural preservation acts include the National Historic Preservation Act (16 USC 470-470w-6), the Archaeological Resources Protection Act (16 USC 470aa-470ll), the Archaeological and Historic Preservation Act (16 USC 469-469c); the American Antiquities Act (16 USC 431-433), and the American Indian Religious Freedom Act (42 USC 1996).

5.7.1 Current Status

The National Historic Preservation Act requires that Federal agencies review the consequences of an activity on property that may be listed on the National Register of Historic Places (NRHP) or eligible for listing. The State Historic Preservation Officer (SHPO) of Washington has been contacted regarding the presence of properties currently listed in the NRHP. At this time, no previously identified NRHP properties are located within BPA's area of potential effect. However, historic and previously reported, potentially eligible NRHP properties are known to exist in the vicinity of the Keechelus site (see Section 3.8). Surveys have been completed at all sites, and no other historic or prehistoric resources were discovered. Historic or prehistoric sites identified have been inventoried on the appropriate Washington State Cultural Resource Inventory Form, and Determinations of Eligibility have been prepared for potential NRHP properties. The Washington SHPO has been consulted for findings of effect to the resources in question.

and has concurred regarding their eligibility. BPA has also consulted with the YIN to ensure that none of the project activities would affect sites that have religious or cultural significance to them. The YIN is a proponent of this project, and a cooperating agency for the preparation of this EIS.

5.7.2 Discovery Situations

If, during construction, previously unidentified cultural resources are identified which would be adversely affected by the proposed project, BPA would follow the procedures set forth in the following regulations, laws, and guidelines: Section 106 (36 CFR Part 800) of the National Historic Preservation Act of 1966, as amended (16 U.S.C. Section 470); the National Environmental Policy Act of 1969 (42 U.S.C. Sections 4321-4327); the American Indian Religious Freedom Act of 1978 (PL 95-341); the Archaeological Resources Protection Act of 1979 (16 U.S.C. 470a-470m); and the Native American Graves Protection and Repatriation Act of 1990 (PL 101-601).

1. To the maximum extent possible, BPA would redirect work so that it would not affect the resource. Other work or work in areas that would not affect the resource may continue.

2. BPA would immediately obtain from BPA's contract cultural resource specialist an evaluation of significance for the site and determination of potential impacts on eligible properties.

3. BPA would immediately initiate consultation with the Washington SHPO and other Federal/state agencies that may be involved in the project regarding the eligibility of the site to meet specific NRHP Criteria. Such consultation would be initiated by telephone or in person, and corroborated with written documentation.

4. If the SHPO and BPA both agree that the site is not eligible, BPA would document this decision and construction may proceed.

5. If BPA, the SHPO, or both consider the site NRHP-eligible, that determination shall be documented and BPA would proceed with protection and mitigation. BPA would further consult with SHPO on the determination of effect as follows:

    a. If BPA and SHPO agree that there would be no effect, construction may proceed.

    b. If BPA, SHPO, or both consider that the project would affect an eligible property, they would confer to identify appropriate mitigation measures. Recommended mitigation measures would then be provided to the ACHP.

    c. If the ACHP agrees with the proposed mitigation, then a Memorandum of Agreement addressing mitigation of the affected resource would be drafted, and the project may proceed.

5.8 Threatened and Endangered Species

The Endangered Species Act requires that Federal agencies review the consequences of an activity on threatened and endangered species and the ecosystem on which these species depend; it also gives review authority to USFWS and NMFS. In their letter of October 7, 1994, the USFWS listed the bald eagle (*Haliaeetus leucocephalus*), Northern spotted owl (*Strix occidentalis caurina*), gray wolf (*Canis lupus*), grizzly bear (*Ursus arctos = U. a. horribiliis*), marbled murrelet (*Brachyramphus marmoratus marmoratus*) and Peregrine falcon (*Falco peregrinus*) as the threatened and endangered species in the area. A Biological Assessment will be prepared and submitted to the USFWS during the review of this Revised DEIS. It will be included as Appendix D of the Final EIS. NMFS will be consulted regarding impacts on any listed anadromous fish species. While none of the listed species are present in the Yakima River Basin, several species in the basin are under review for listing.

Should any changes that might affect a species occur to the proposal, or if any other species known to occur in the close vicinity of the project becomes officially listed before completion of the project, BPA would reevaluate its activities to ensure that its actions do not "jeopardize the continued existence of any endangered species or threatened species," and are in compliance with Section 7(a) of the Endangered Species Act.

State-listed special status species will be addressed under the SEPA guidelines. The State program and SEPA guidelines were developed to improve quality and consistency in and validate methods for evaluating impacts of development on wildlife. The SEPA document is being prepared for submission prior to the Final EIS along with the Biological Assessment for Federal threatened and endangered species.

5.9 Fish and Wildlife Conservation

Provisions of the Pacific Northwest Electric Power Planning and Conservation Act (16 U.S.C. 839 *et seq.*) are intended to protect, mitigate, and enhance fish and wildlife of the Columbia River and its tributaries. This project is proposed as a part of the Columbia River Basin Fish and Wildlife Program to fulfill these obligations.

The Fish and Wildlife Conservation Act of 1980 (16 U.S.C. 2901 *et seq.*) encourages Federal agencies to conserve and to promote conservation of nongame fish and wildlife species and their habitats. Measures proposed to mitigate potential impacts on wildlife and on vegetation do this to the maximum extent possible within BPA's statutory responsibility.

The Fish and Wildlife Coordination Act (16 U.S.C. 661 et seq.) requires that Federal agencies consult with the USFWS whenever an agency plans to conduct, license, or permit an activity involving the impoundment, diversion, deepening, control, or modification of a stream or body of water. BPA is coordinating potential changes in bodies of water with the USFWS to ensure species protection as required by this act by providing the USFWS with a copy of this RDEIS.

5.10 Farmlands

Section 154 (a, b) of the Farmland Protection Policy Act requires BPA to identify and quantify adverse impacts of the proposed action on farmlands. The location and areal extent of Prime and other important farmlands as designated by the Soil Conservation Service (SCS) were obtained from SCS soils surveys for the Kittitas County area. The Clark Flat and Easton Dam acclimation sites are the only project sites that would affect potentially prime farmland soils. However, since these sites are not irrigated, they are not considered to be Prime farmland (Gentry, pers. comm., 1995). Approximately 0.8 ha (2 ac.) of land would be affected by construction at each site. No unique or other designated (i.e., statewide or local) important farmlands would be affected.

5.11 Floodplains/Wetlands

Both floodplains and wetlands are found in the project area. These are specially protected resources. For complete assessment of their significance and of impacts, see the floodplain/wetlands assessment under Section 4.1.1. This assessment constitutes the Federal review required by 10 CFR 1022 and Executive Orders 11988 and 11990. A statement of finding with respect to floodplains will be included in the final EIS.

Wetlands, frequently flooded areas, and riparian habitat are all designated as environmentally sensitive "critical areas" under the Kittitas County Interim Critical Areas Development Ordinance. The ordinance establishes a "zero net loss of natural wetland functions and values" approach to regulating wetlands. Wetland buffer widths and replacement ratios are designated. Frequently flooded areas are defined as the 100-year floodplain, and are protected by a "no net loss of floodplain storage" concept for new construction. Structures must be floodproofed. Riparian habitat buffers are also designated; for the Yakima River they are 12.2 to 61 m (40 to 200 ft.) from the Ordinary High Water Mark. Riparian buffers are to be retained in their natural condition; however, uses that do not cause a significant adverse impact on the habitat may be allowed in the buffer (subject to approval by the Director of the Planning Department). These requirements would be met for the YFP.

5.12 Energy Conservation and Pollution Control

5.12.1 Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)

FIFRA provides for the registering of pesticides and regulates their use to ensure that unreasonable environmental impact does not result. Herbicides (a kind of pesticide that kills plants) would be used for the YFP only in a very limited fashion and under controlled circumstances. Herbicides would be used to control weeds at project facilities, to control noxious weeds, and to maintain landscaping at various facilities. If herbicides were applied, the use, storage, and disposal of these products and their containers would be in accordance with EPA or FDA regulations and the instructions on the product labels. Herbicide containers would be disposed of according to Resource Conservation and Recovery Act (RCRA) standards.

5.12.2 Resource Conservation and Recovery Act (RCRA)

This act is intended to bring about:

- the recovery of useful materials which are often needlessly buried in landfills;
- the recovery of solid fuel, oil, and gas that can be converted into energy; and
- environmentally safe disposal of non-recoverable waste residues, particularly those which are toxic or hazardous.

See the discussion of these topics in Section 4.1.11 of the EIS. BPA does not anticipate that any hazardous wastes, as defined by RCRA (42 USC 6901 et seq.), would be generated by the YFP. However, any such wastes that might be generated would be manifested, packaged, and shipped offsite for disposal under the appropriate regulations (40 CFR 260-268, 40 CFR 270-272, WAC 173-303).

5.12.3 Comprehensive Environmental Response, Compensation and Liability Act (CERCLA)

CERCLA was enacted and is generally employed primarily to address past contamination from past activities at inactive sites; however, it can also be used to address active sites with current releases of hazardous substances.

BPA assesses existing fee-owned properties and property planned for acquisition in order to determine the likelihood that hazardous substances may be present. All of the sites proposed for acquisition under this project have undergone an Environmental Land Audit; potential for contamination was discovered only at the Easton Gravel ponds site. If this site were selected for an acclimation site, the extent of contamination would be assessed and, if necessary, cleaned up before construction is started.

5.12.4 Energy Conservation at Federal Facilities

It is the policy of BPA to set an example in the Pacific Northwest for energy-efficient construction. All of BPA's new construction will use thermal conservation measures based on regional cost-effectiveness as well as on life-cycle costing within the region's three climatic zones. BPA will exceed the requirements of the latest version of BPA's Energy Smart Design (Commercial Model Conservation Standards) or the DOE mandatory standards for Federal facilities for individual building components of the YFP, whichever is more stringent.

5.12.5 Noise Control Act

WDOE regulates maximum environmental noise levels (WAC 173-60). Allowable levels depend on land use of the source and receiving property. Noise levels associated with the YFP are discussed in section 4.1.7.2. Given the low level of noise expected to be generated and the lack of nearby sensitive receivers, State noise levels would not be exceeded.

5.12.6 Safe Drinking Water Act

The Safe Drinking Water Act (42 U.S.C. sec 300f *et. seq.*) is designed to protect the quality of public drinking water and its sources. In the State of Washington, the Department of Health is responsible for implementing the rules and regulations of the Act (WAC 246-290). This project would not affect any Sole Source Aquifers or other critical aquifers, or require an underground injection well.

5.12.7 Clean Air Act

Neither construction nor operation of the YFP would result in significant air emissions that would require air quality permits under the Clean Air Act (42 USC 7401 et seq.). Construction equipment exhausts would meet applicable regulatory requirements. Any fugitive dust caused by construction would be mitigated by water sprinkling.

Chapter 6.0

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Chapter 7.0

Preparers and Reviewers of the Environmental Impact Statement

This chapter lists and presents credentials for those who prepared and reviewed this EIS.

The original DEIS (November, 1992) was prepared by staff of the Pacific Northwest Laboratory (PNL), which is operated for the U.S. Department of Energy by Battelle Memorial Institute under Contract DE-AC0676RLO 1830. Subsequent revisions were made by a group of consultants and BPA staff. Listed below are people who contributed to writing and reviewing both the original and revised DEIS, the areas in which they contributed, and their qualifications.

The revised environmental impact statement underwent a series of reviews before it was published. Reviewers included staff of the Bonneville Power Administration, members of the Yakama Indian Nation, the Washington Department of Fish and Wildlife, and various consultants to the Yakima Fisheries Project.

Table 7.1. EIS Contributors and Reviewers

Name, Affiliation	EIS Responsibility	Qualifications
Jan A. Aarts CH2M Hill	Permitting	Master of Urban Planning; 12 years experience in urban and environmental planning
David M. Anderson PNL	Socioeconomics, PNL	M.S. in forest economics; 10 years experience with environmental issues
Randall S. Anderson Anderson & Associates	Technical writing, comment analysis	M.S. in Natural Resource Management; 12 years experience in environmental research and technical writing, consultant to BPA since 1990
Robert J. Austin BPA	Project management	M.S. in biology; 17 years experience in fishery biology
Craig Busack WDFW	Genetics	Ph.D.; 10 years experience in fish genetics research
Natalie A. Cadoret PNL	Cultural Resources	B.S. in geology; 13 years experience in cultural resource evaluation
James C. Chatters PNL	Archaeology, Historic, and Cultural Resources	Ph.D. in anthropology; 25 years experience in cultural resource evaluation and management

Colbert E. Cushing PNL	Aquatic Ecology	Ph.D. in biology (limnology) 31 years expenence in aquatic ecology research
Mark Danley BPA	Public Involvement Specialist	M.S. in forestry; 8 years experience in public involvement coordination
Dennis D. Dauble PNL	EIS Management, Fisheries, Water Quality	Ph.D. in fisheries; 18 years experience in fisheries research
David E. Fast YIN	Fisheries biology, Science/Technical Advisory Committee	Ph.D. in fisheries sciences; 18 years experience in fisheries management
Richard E. Fitzner PNL	Wildlife	Ph.D. in zoology; 22 years experience in wildlife research
Carlene Fleskes BPA	Public Utility Assistant	3 years experience in environmental compliance activities and public involvement
Robert Gatton CH2M Hill	Engineering aspects	M.S. in water resources engineering/M.S. management; 20 years experience in water resources and fisheries engineering
Lauren Gaylord CH2MHill	Solid and hazardous waste	M.S. in urban planning; 5 years experience in water resources and fisheries engineering
David R. Geist PNL	Fisheries	M.S. in biology; 7 years experience in fisheries research and management
Jeff Gislason BPA	Project Manager	Ph.D. in fisheries; 15 years of experience in fisheries research and management
Robert Hagar Hatchery Operations Consulting	Fish Culture, Facility Operations	B.S. in fisheries; 32 years experience in fishery biology and fish culture
Lee Harrell NMFS	Fish health aspects	Doctor of Veterinary Medicine/M.S. in fisheries biology; 28 years experience in fisheries veterinary medicine and fish health research

Donald Heinle CH2M Hill	Water Quality	Ph.D. in zoology; 26 years experience in aquatic ecology and water quality
Craig Holstine Eastern Washington University	Archaeology, historic, and cultural resources	MA in history; 15 years experience in resource management and history
Karin A. Hoover PNL	Water Quality	M.S. in geological sciences; 6 years experience in water-related research
Charles (Bill) Hopley WDFW	Fisheries biology, Science/Technical Advisory Committee	B.S. and M.S. in Fisheries Science; 19 years experience in hatchery production programming and evaluations, harvest management, and supplementation research
William Koss WDFW	Project direction and management	M.S. in forest economics; 18 years experience in natural resource management, policy, and administration
Steven Leider WDFW	Species interactions; Project direction and management	B.S. in fisheries; 19 years experience in fisheries research
Susan Lewis CH2M Hill	Surface water hydrology	M.S. in water resources; 5 years experience in fisheries research
Regina E. Lundgren PNL	Technical Communications	BA in scientific and technical communications; 7 years experience in risk commnunication
Duane A. Neitzel PNL	Adaptive Management	M.S. in zoology; 20 years experience in fisheries and limnology
Richard S. Mack Central Washington University	Socioeconomic study	Ph.D. in economics; 25 years experience in regional economics
Rosy Mazaika PNL	Wildlife Biology	M.S. in wildlife ecology; 7 years experience in wildlife research and management
Katherine B. Miller	Recreation, PNL	M.S. in marine affairs; 4 years experience in environmental compliance

Lars Mobrand Mobrand Biometrics	Project planning	Ph.D. in biomathematics; 12 years experience in fisheries research
Judith H. Montgomery	Technical writing and editing	Ph.D. in American Literature; 15 years of experience in writing and editing environmental documents
Emmett B. Moore PNL	Regulations and Permits	Ph.D. in physical chemistry; 36 years experience in government regulations and project management
Marvin E. Nelson BPA	Project Management	B.S. in mechanical engineering; 25 years experience in engineering and management, 16 years experience in research and management
Patrick Oshie YIN	Tribal law	J.D., U. of Washington; 15 years experience in working with tribal, state, and other governments in natural resources
Steve Parker YIN	Harvest management	B.S. in fisheries; 10 years experience in harvest management
Todd Pearsons WDFW	Species interactions	PhD in fisheries science; 10 years experience in fish research
Lloyd Phinney Phinney Fish Consultants	Project management	B.S. in fisheries science; 35 years experience in fish habitat and fisheries management
William H. Rickard PNL	Vegetation	Ph.D. in botany; 42 years experience in ecosystem research
Kirk Robinson BPA	Engineering	M.S. in Civil Engineering; 14 years of experience in project engineering and management
Melvin Sampson YIN	Project direction and management	
Tom Scribner YIN	Anadromous fisheries	M.S. in fisheries; 14 years experience in fisheries research

Harry Senn Fish Management Consultants	Fish culturing	B.S. in biology; 35 years experience in fish culture practice
Lonna G. (Jodi) Stroklund BPA	Fish biology, contract management	B.S. in biology; 10 years experience teaching biology, 8 years COTR, 3 years fishery biologist
Robert L. Tuck Eco Northwest	Water issues	B.S. in biology; 14 years experience in fisheries research and management
Tom Vogel BPA	Fisheries Biology	B.S. Fisheries
Richard W. Wallace PNL	Land Use, Geology	Ph.D. in hydrogeology; 20 years experience in geology and hydrology research
Kevin Ward BPA	EIS Development	B.S. in Resource Management; 11 years experience in NEPA/ environmental coordination
Bruce D. Watson YIN	Habitat enhancement	B.S. in fisheries biology; 20 years experience in fisheries management
Nancy H. Weintraub BPA	Technical writing and editing, NEPA compliance coordinator	M.S. in zoology; 16 years experience in NEPA compliance and aquatic ecology

Chapter 8.0

Agencies, Organizations, and Individuals to Whom This Environmental Impact Statement Was Sent

This chapter lists those to whom the draft EIS was sent. Additional businesses, organizations, and individuals will be sent copies of the RDEIS as they request it.

Federal/Regional Agencies

Northwest Power Planning Council
Portland, Oregon

Pacific Northwest Utilities Conference Committee
Portland, Oregon

U.S. Department of Agriculture Forest Service
Wenatchee National Forest, Washington

U.S. Department of Commerce/National Oceanic and Atmospheric Administration/
National Marine Fisheries Service
Seattle, Pasco, and Manchester, Washington/Portland, Oregon

U.S. Department of the Interior, Washington, DC

U.S. Department of the Interior/Bureau of Reclamation
Boise, Idaho/Yakima, Washington

U.S. Department of the Interior/Fish and Wildlife Service
Vancouver, Olympia, and Moses Lake, Washington

U.S. Department of the Interior/Environmental Protection Agency, Washington, DC

U.S. Department of the Interior/Environmental Protection Agency, Regional Office, Seattle, WA

State Agencies

State of Idaho

Department of Fish and Game

State of Oregon

Department of Fish and Wildlife

State of Washington

Department of Agriculture
Department of Community Development
Department of Ecology
Department of Ecology, Water Resources
Department of Fish and Wildlife
Eastern Washington State College, Bonneville Cultural Resources Group
Washington Sea Grant
Washington State University
Central Washington University

Tribal Agencies

Yakama Indian Nation
Fisheries Resources Management Program
Toppenish, Washington

Yakama Indian Nation
Law and Order Committee
Toppenish, Washington

Yakama Indian Nation Confederated Tribes
Tribal Council, Fish and Wildlife Committee
Toppenish, Washington

Local Agencies
City of Cle Elum, Mayor's Office
City of Yakima, Assistant City Manager
Cle Elum Chamber of Commerce
County of Kittitas Board of Commissioners
County of Kittitas Department of Planning
County of Yakima Department of Planning
Douglas County PUD No. 1
Ellensburg Water Company Board of Directors
Halverson and Applecate, Ellensburg Water Company
Roza Irrigation District
Sunnyside Valley Irrigation District
Yakima River Basin Association of Irrigation Districts

Organizations and Businesses

Burke and Sons Herefords
Cle Elum, Washington

Cascade Irrigation District
Ellensburg, Washington

CH2M Hill Northwest, Inc.
Bellevue, Washington

Chinook Engineering
Mukilteo, Washington

Clark Skamania Flyfishers Association
Vancouver, Washington

Federation of Fly Flshers
Seattle, Washington

Fiander Enterprises, Inc.
Harrah, Washington

Fisheries Resource Management
Granger, Washington

Hickey Engineering Sales, Inc.
Bellevue, Washington

Mobrand Biometrics, Inc.
Vashon, Washington

Northwest Rivcrs Council
Seattle, Washington

Oregon Step Coalition
Bandon, Oregon

Oregon Trout
Portland, Oregon

Pacific Northwest Laboratory
Richland, Washington

Pentec Environmental
Edmonds, Washington

Royal Coachman Outfitting Company
Renton, Washington

R. W. Beck and Associates
Seattle, Washington

Trout Unlimited
Yakima, Washington

Washington Cattlemen's Association
Ellensburg, Washington

Washington State Council of the Federation of Flyfishermen
Seattle, Washington

Washington Fly Fishing Club
Redmond, Washington

Washington Water Resources Association
Yakima, Washington

Yakima River Alliance
Seattle, Washington

Yakima Valley Canal Company
Yakima, Washington

Libraries, State and Federal Congressional Staff, And Private Individuals

GLOSSARY

This appendix contains a list of acronyms, abbreviations, and technical terms used in this EIS. Words that would be defined in a desk-size dictionary (for example, the College Edition of the American Heritage Dictionary) are not included.

Acronyms and Abbreviations

AHS	Archaeological and Historical Services
BPA	Bonneville Power Administration
BLM	Bureau of Land Management
CEA	Comprehensive Environmental Analysis of Anadromous Fish Production
CFR	Code of Federal Regulations
CWA	Clean Water Act
cfs	cubic feet per second
Corps	U.S. Army Corps of Engineers
CRFMP	Columbia River Fish Management Plan
dBA	decibels (A-weighted)
DEIS	Draft Environmental Impact Statement
EA	Environmental Assessment
EDTPM	Ecosystem Diagnostic and Treatment Planning Model
EIS	Environmental Impact Statement
FDA	U.S. Food and Drug Administration
FONSI	Finding of No Significant Impact
gpm	gallons per minute
ha	hectares
HTH	sodium hypochlorite
m^3/s	cubic meters per second
mg/L	milligrams per liter
MOU	Memorandum of Understanding
MS-222	tricaine methane sulfonate
NEPA	National Environmental Policy Act
NIT	new innovative treatment (one of the experimental treatments for the project)
NMFS	National Marine Fisheries Service
NOI	Notice of Intent
Northwest Power Act	Pacific Northwest Electric Power Planning and Conservation Act of 1980 (Northwest Power Act).
NPPC	Northwest Power Planning Council
NRHP	National Register of Historic Places
NTU	nephelometric turbidity units
OCT	optimal conventional treatment (one of the experimental treatments for the project)

ORV	off-road vehicle
RASP	Regional Assessement of Supplementation Project
RCW	Revised Code of Washington
RDEIS	Revised Draft Environmental Impact Statement
SEPA	State Environmental Policy Act
SHPO	State Historic Preservation Office
STAC	Science/Technical Advisory Committee
TSS	total suspended solids
USBR	Bureau of Reclamation
USC	U.S. Code of Regulations
USDOE	U.S. Department of Energy
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WDFW	Washington Department of Fish and Wildlife (formerly consisted of Washington Department of Fisheries and Washington Department of Wildlife; the two agencies have now merged)
WDOE	Washington Department of Ecology
WDOT	Washington Department of Transportation
YFP	Yakima Fisheries Project
YKFP	Yakima/Klickitat Fisheries Project
YIN	Yakama Indian Nation

Technical Terms

100-year floodplain. That portion of a river valley adjacent to the stream channel which is covered with water when the stream overflows its banks during a 100-year flood event. A 100-year flood event is one that has a 1 in 100 chance of happening in any 1 year.

acclimation site. Sites at which young fish are held in artificial ponds to allow them to imprint so that they return to that place to spawn.

acclimation. Allowing fish to adjust to environmental variables. Older hatchery practices resulted in high mortalities because the young fish were released directly from the hatchery, without a chance for them to adjust to the natural stream environment. Acclimation is a process which is used to allow the fish to gradually adjust to a more natural environment and imprint on the area in which the acclimation site is located, rather than on the hatchery, so that the fish will return to the area to spawn.

acre-feet. Quantity of water (43,560 cubic feet) that would cover 1 acre to a depth of 1 foot.

adaptation. Genetic change over generations through natural selection that results in a population better suited to its environment.

aggregate. Multiple fish stocks within a species or race.

anadromous. Fishes that migrate from fresh to salt water when young, spend the majority of their adult life in the ocean, and then return to their ancestral drainage to spawn.

ancestral drainage. Basin in which fish spawned, historically.

biomass. Total weight of organisms per unit volume.

broodstock. Fish that will be spawned to create hatchery stock.

carrying capacity. The average maximum level of a particular population sustainable within an ecosystem over a long period.

central facility. Fish culture facility used for incubation and rearing of salmon and steelhead.

density-dependent mortality. Predation on fish that varies depending upon their density. It is theorized that predators ignore prey species that are rare, and begin to prey on them only when they reach a certain density.

domestication selection. Natural selection for traits which affect survival and reproduction in a human-controlled environment.

donor stock. Specific stock from which broodstock are chosen.

fingerling. Juvenile salmonid; usually refers to pre-smolt fish.

floodway. A river channel active only during a flood.

fry. Juvenile salmonid life stage following absorption of yolk sac.

imprinting. The physiological and behavioral process by which migrating fish assimilate environmental cues to aid their return to their stream of origin as adults.

kelt. Spawned-out adult.

long-term genetic fitness. A measure of the ability of a population to survive natural selection over a number of generations.

maximum sustainable yield. The maximum harvest rate at which a population can remain viable over an extended period of time.

native populations. Populations of fish that have adapted to a particular habitat and that have spawned naturally in that habitat over many generations.

naturally-spawning populations. Populations of fish that spawn in the natural habitat as opposed to being spawned through a hatchery program. They may be offspring of fish spawned in either natural or hatchery environments.

new innovative treatment. A treatment that incubates, rears, and acclimates spring chinook salmon using natural-like environments (e.g., natural cover, substrate, in-water structure) to produce fish that mimic attributes of naturally produced spring chinook salmon.

optimal conventional treatment. A treatment that incubates, rears, and acclimates salmonids using optimal conventional fish-culture methods derived from artificial propagation experiences within the Columbia River Basin.

pH. The symbol for the chemical measurement of the acidity or alkalinity of a solution.

population. A group of individuals of a species living in a certain area.

presmolt. Juvenile salmonid before undergoing metamorphosis into saltwater fish.

predation. The harm, destruction, or consumption of a prey organism by an animal predator.

production. Number of individuals produced from natural environment or fish culture facilities.

programmatic EIS. An EIS that addresses a program, or a broad range of actions, rather than a specific project or proposal.

race. A group of individuals within a species, forming a permanent variety; a particular breed.

raceway. Holding area or rearing facility for juvenile or adult salmonids in a hatchery.

redd. A salmon nest.

reproduction. The process of forming new individuals of a species by sexual or nonsexual methods.

riparian. Growing on or living on banks of streams and rivers.

residualism. When anadromous juveniles do not outmigrate to the ocean and instead remain in freshwater for extended periods. In some cases, they may become resident fish, and never outmigrate to the ocean.

run timing. The distinct period during which a population of anadromous fish passes through or returns to a specific location.

salmonid. Belonging to the family salmonidae, i.e., salmon, trout, steelhead, whitefish.

satellite facility. Fish culture facility used for rearing and acclimation of juvenile salmon or holding of adult broodstock.

smolt. Juvenile salmonid undergoing metamorphosis into a saltwater fish, usually during the downstream migration period.

species. A group of interbreeding individuals not interbreeding with another such group; similar, and related species are grouped into a genus.

status-indexed fishery. A fishery based upon harvest policy that determines the rate of harvest on the basis of the strength of all run components.

stock. A distinct management or genetic unit of fish.

subordination. To put the item referenced behind something else, in terms of importance.

supplementation. The use of artificial propagation in the attempt to maintain or increase natural production while maintaining the long-term fitness of the target population, and while keeping the ecological and genetic impacts on nontarget populations within specified limits. **(Regional Assessment of Supplementation Projects definition)**

terminal fishery - A fishery that occurs in a terminal area, such as a tributary, where the stocks of fish have been disaggregated so that the harvest is considered to be on a single identified stock rather than on mixed stocks of fish; fishery conducted near or in the natal stream as anadromous fish return to their point of origin.

terminal harvest rate. The proportion of a migratory population harvested in a terminal fishery.

trapping facility. Facility used to trap and handle juvenile or adult salmonids during downstream or upstream migration period.

wild population. Genetically unique populations of fish that have maintained reproduction successfully without supplementation from hatcheries.

within population variability. The quantity and variety of alleles, chromosomes, and arrangement of genes on the chromosomes that are present in populations.

INDEX

APPENDICES

Appendix A: Comments on Draft EIS and Responses

Appendix B: 1995 Planning Status Report Volume 3 Yakima Spring Chinook Salmon

Appendix C: Glossary of Species Scientific Names

Appendix D: Endangered Species Consultation

Appendix E: Harvest Management

APPENDIX A

COMMENTS AND RESPONSES

Yakima Fisheries Project
Draft Environmental Impact Statement
(October, 1992 Draft)

Bonneville Power Administration

Washington Department of Fish and Wildlife

Yakama Indian Nation

TABLE OF CONTENTS

SUMMARY

The original Draft Environmental Impact Statement (DEIS) for the Yakima Fisheries Project (YFP) was released for public and agency review in October 1992. Information letters and copies of the DEIS were distributed to elected officials, government agencies, tribal organizations, associations, businesses, individuals, and public libraries. Six public meetings were also held throughout the region (Richland, Yakima, Portland (2 meetings), Bellevue, and Ellensburg) to facilitate review of the document and solicit oral comments. The comment period closed on December 28, 1992.

Bonneville Power Administration received 102 comment letters and phone calls from individuals, groups, and agencies during the comment period. In addition, more than 300 people attended the public meetings, with many individuals providing oral comments about the project.

Many comments received during the public comment period were similar to those raised in earlier project forums. Four issues in particular received extensive comment: (1) project purpose and need, (2) potential impacts on water rights and claims, (3) the genetic risks to the existing wild fish populations, and (4) potential impacts on the resident trout fishery above Roza Dam. Commentors also provided remarks on the EIS process, the project alternatives selected for EIS analysis, and the potential impacts on other ecological resources, including threatened or endangered species. An overview of the major issues and comments follows.

EIS Process. In general, many commentors believed that the DEIS was premature, given the number of ongoing studies and amount of missing project information. Several requested that the EIS be revised and reissued in draft form when additional project information was available. Some reviewers also felt that this EIS should have been tiered to an EIS analysis of other fishery enhancement efforts, both in and outside the Yakima Basin.

Project Purpose and Need. Most comments in this section questioned why supplementation is needed in the Yakima Basin. Many reviewers suggested that the project should focus on improving habitat and instream water flows, rather than on supplementation. Others questioned the project's experimental goals and project size needed to meet those goals. Several commentors believed the DEIS placed too much emphasis on the experimental objectives of the project. They believed the EIS should stress the important mitigation aspects of the project, including the restoration of lost harvest opportunities.

Management and Coordination. Several reviewers requested additional information regarding the project's management structure. Commentors also questioned whether the project had been adequately coordinated with local landowners and appropriate Federal, State and local agencies.

EIS Alternatives. Many commentors thought that the DEIS failed to explore all reasonable alternatives for the project. Some stated that nonsupplementation alternatives (e.g., habitat and passage improvements) should have been included in the analysis. Others suggested that the EIS evaluate smaller (truly experimental) supplementation activities, including an alternative that involves only one fish stock.

Preferred Alternative. Some reviewers were concerned that a preferred project alternative was not identified in the DEIS. Commentors asked for additional public comment opportunities, including the chance to comment on the preferred project alternative.

Proposed Fish Stocks, Numbers and Areas. There were a wide range of comments relating to the fish stocks and locations proposed for supplementation. Several reviewers questioned how reintroduction of coho and summer chinook could be considered supplementation as these stocks no longer exist in the Yakima Basin. Others asked why sockeye were not included in this project.

Genetic Risks. The potential impact on genetic resources continued to be a project concern. Many reviewers thought the DEIS lacked sufficient detail and analysis regarding this important issue. Of particular concern were the genetic implications of broodstock collection strategies and fish-rearing operations. There were also concerns over the feasibility of the proposed genetic refuges.

Species Interactions. Most comments in this category focused on the project's potential impact on the resident trout fishery above Roza Dam. Reviewers questioned how the project could proceed when the species interaction studies were still underway. Other comments addressed the need to expand research to cover bull trout, cutthroat trout, and other less aggressive species.

Water Rights and Claims. Although the project was designed to be water-neutral, many commentors believed that the project would take water rights and interfere with current water rights adjudication. One particular concern was what would happen when adult fish return and spawn in areas where there are currently few fish, if any. Many commentors wanted to know who would decide whether it would be the fish or farmer who would get the water in a water-short year. Several reviewers advocated that the project establish a procedure to deal with these conflicts that will inevitably arise when supplemented fish stray into areas where water management problems exist. Commentors also urged that additional water storage be built in the basin before this project proceed.

Threatened and Endangered Species. Recent actions to protect several Snake River salmon runs under the Federal Endangered Species Act (ESA) have escalated concerns over this project. Commentors expressed concern that the project could negatively affect the ESA-listed stocks. Some commentors also thought that the project could result in some ESA listings in the Yakima Basin, which would lead to the confiscation of land and water rights. Additional comments in this category identified the need for more analysis regarding the project's impact on bald eagles.

Adaptive Management. Reviewers requested additional details on the project's monitoring plans and on how adaptive management would be implemented. Some individuals were also interested in what criteria would be used to determine whether this "experiment" were a success or failure.

Fish Harvests. Commentors asked for more information regarding who would be harvesting the fish produced from this project. Several reviewers also questioned how nontarget fish populations would be protected from overharvest if the project succeeded in rebuilding fish runs.

COMMENTS AND RESPONSES
Yakima Fisheries Project
Draft Environmental Impact Statement

INTRODUCTION

This report summarizes and addresses comments submitted on the 1992 Draft Environmental Impact Statement (DEIS) for the Yakima Fisheries Project (YFP). The DEIS was officially released for public and agency review in October 1992. Informational letters announcing document availability were sent to more than 2,000 elected officials, government agencies, groups, businesses, and individuals. Six public meetings were also held throughout the region (Richland, Yakima, Portland (2 meetings), Bellevue and Ellensburg) to facilitate review of the document and to solicit oral comments. The comment period closed on December 28, 1992.

Bonneville Power Administration (BPA) received 102 comment letters and phone calls from individuals, groups and agencies during the comment period. In addition, more than 300 people attended the public meetings, with many individuals providing oral comments about the project. A record was kept by an official recorder at each of the public meetings, and meeting transcripts were prepared for analysis.

Identifying the issues and comments was a two-step process. First, meeting transcripts and letters were reviewed by project team members. Comments were identified, coded by topic, and organized into a computerized, comment matrix. Second, the matrix was used to summarize and consolidate comments addressing similar issues. Several comment letters provided extensive comments referencing specific statements in the DEIS, or provided numerous editorial suggestions. To facilitate the comment review and development of responses, these comments were not entered into the computer matrix. All comments, however, were reviewed and used in preparing the Revised DEIS.

The issues presented in this report are organized by topic areas similar to the comment matrix described above. Following each issue, BPA provides a response with additional information about the issue and/or indicates how the EIS has been revised in response to the comments received. Some responses reference additional project documents or related studies. Complete citations for these references are found in the References section of the Revised DEIS (Section 8).

Because of the decision to issue a Revised DEIS, no attempt was made to include, or to respond to, every individual comment. Rather, this report is intended to identify major issues/ concerns and to illustrate the range of opinions expressed. Please note that **all** comments received on the original DEIS were considered in developing the Revised DEIS. With the release of the Revised DEIS, the public may again provide comments on the project. BPA will consider and provide responses to any new comments received on the Revised DEIS when developing the Final EIS. Copies of the comment letters, the comment matrix, and meeting transcripts are not included in this report because of their large size. These documents are available by request. Questions on this report should be addressed to Ms. Nancy Weintraub - ECN, Bonneville Power Administration, P.O. Box 3621, Portland, OR 97208; telephone (503) 230-5373.

APPENDIX A
COMMENT SUMMARY

The comments below are numbered for easy reference. Comments were sometimes moved or grouped together (because they addressed the same subject and were best addressed in one place). The initial identifying numbers for each comment may therefore appear out of order.

A - EIS PROCESS/GENERAL COMMENTS

1. Distribution of EIS. Concerned about the lack of effort to get this document to the public and the short amount of time available for public review before the public meetings. Hope that when the Final EIS is released, there will be more time available for public review.

Response: We acknowledge that some people may not have had much time for DEIS review before the public meetings. This was not intentional. The meetings were set up several months before publication, in order to get meeting space and provide adequate announcement regarding the document availability (the Council of Environmental Quality (CEQ) requires public notice of the DEIS 15 days before the public meetings). However, with the Revised DEIS, the public now has an additional opportunity to review and provide comments. An agency may *request* comments on a Final EIS before the decision is made, but this is not required. A 30-day no-action period is required after the Final EIS is completed and before the Record of Decision is signed.

7. Draft EIS is Premature. There are still a number of ongoing studies and much of the project information is incomplete. In addition, the DEIS does not consider anywhere near the full range of logical alternatives for a rational fisheries project for the Yakima River Basin and does not analyze anywhere near the full range of ecological consequences of the alternatives that are proposed. In short, this DEIS is premature—it must be withdrawn and reissued in draft form when the defects are cured and when planning for the project has proceeded to the point where its effects can be meaningfully evaluated.

Response: (1) After reviewing the public comments, BPA and the project managers decided to revise the proposal and issue a Revised DEIS, with a revised and clarified purpose and need discussion, different alternatives, information not available during development of the original draft, additional analysis, and expanded discussion of possible project impacts. (2) The RDEIS evaluates two action alternatives and a No Action alternative. The action alternatives meet the project purpose and need as identified in the EIS: to gain knowledge about supplementation and how it can be used to restore naturally spawning fish populations while maintaining the long-term genetic fitness of the fish population and keeping adverse ecological interactions within acceptable limits. Other alternatives considered (but eliminated from further discussion in this EIS) included various types of habitat improvements, increasing instream flows, and improving water quality. These alternatives would not meet the project's purpose or need. Some of them are, however, being pursued in other forums. For additional information, see responses in **Section C** below and **Issue # 188.**

8. <u>NEPA Compliance Regarding Incomplete Information</u>. The DEIS fails to deal with uncertainty as required by CEQ requirements. There is a great deal of uncertainty relating to the effects of the Yakima Project, none of which is made clear in the DEIS.

Response: Section 1502.22 of the National Environmental Policy Act (NEPA) regulations indicates that when an agency is evaluating reasonably foreseeable significant adverse effects on the human environment, and there is incomplete or unavailable information, the agency shall always make clear that such information is lacking. The DEIS has been revised to help clarify where information is incomplete or unavailable.

9. <u>Inadequate Impact Analysis</u>. The DEIS does not provide a legally sufficient basis for decision-making because it fails to discuss adequately the risks of the project and the alternatives. Among the impacts that are not addressed adequately are the following:

1. "Resolvable Uncertainties" and "Unresolvable Uncertainties" listed in the October 1992 Project Status Report
2. Genetic risks generally
3. Broodstock collection
4. Cumulative impacts
5. Impact on funding for habitat improvement
6. Risk of poor smolt-to-smolt and smolt-to-adult survival rates
7. Domestication selection
8. Effective population size
9. Control releases of experimental hatchery fish
10. Risks to steelhead populations due to uncertainties regarding population structure
11. Monitoring methodologies
12. Failure to analyze scientific literature
13. Effects on coho donor stocks
14. Failure to discuss other supplementation projects
15. Funding risk
16. Risks of coho program.

Response: The DEIS has been revised to include additional information and references where available. Specific responses to many of these issues are found under appropriate subject headings below.

11. <u>Programmatic EIS</u>. A programmatic EIS should be completed for the operation of Columbia River fish hatcheries to define the proper role for supplementation and fish hatcheries in general.

Response: The U.S. Fish and Wildlife Service (UWFWS) is presently leading this type of effort. The Comprehensive Environmental Analysis of Anadromous Fish Production EIS addresses the cumulative impacts of all Columbia Basin salmon and steelhead fish hatcheries on wild and naturally spawning salmon and steelhead stocks. The Yakima Fisheries Project will be evaluated along with all other artificial propagation and supplementation facilities; however, the YFP is moving forward concurrently with that analysis (see discussion in Section 1.5).

13. Scientific Objectivity and Integrity. BPA has failed to insure the scientific integrity of the discussions and analysis in the DEIS. The authors have failed to make consistent statements in the EIS, let alone cite the literature that supports those statements. The DEIS in many instances fails to specify methodologies. Moreover, the refusal to acknowledge the literature that suggests that supplementation has been unsuccessful compromises the scientific integrity of the entire DEIS.

Response: The DEIS has been reviewed and revised to help improve overall consistency. The document has also been revised to include additional information and references where appropriate. See the response to **Issue # 37** for a discussion of literature that suggests supplementation may be unsuccessful.

17. Relationship Between the EIS Process and Adaptive Management. How does BPA propose to reconcile the constraints on project design imposed by the EIS process with the concept of adaptive management? Adaptive management encourages modifications as new information or thinking indicates that modifications are warranted, whereas the EIS process apparently limits the range of design options to the few alternatives shown in the EIS document. What happens in the event that new information or thinking suggests that an option not shown in the EIS is the preferred alternative?

Response: The NEPA process does have mechanisms to adapt to changing conditions. YFP has adopted a strategy to address the concept of adaptive management at the program level as it applies to the YFP, with specific proposals to supplement upper Yakima spring chinook and study the feasibility of establishing a naturally spawning coho population. The adaptive management process is an iterative process, and requirements for additional NEPA coverage will be reviewed as the project adapts and changes. Supplemental environmental documentation can be tiered to this EIS as changes and additions are proposed.

B - PROPOSED ACTION (GENERAL)

24. Relationship to Yakima Enhancement Project. The relationship of the YFP to the Yakima Enhancement Project is shown in Figure 1.1 but little is said about the status of the other three phases (habitat, passage, and water enhancement). Since the other portions of the Yakima Enhancement Project are so closely related to the YFP, more information would be helpful in the Final EIS.

Response: The Yakima Enhancement Project, as presented in the EIS, was intended to provide a framework to identify all the potential activities that could be implemented in the Yakima Basin. These activities are not proposed as part of this project and are not being funded by BPA at this time. This issue has been clarified in the RDEIS. Additional information regarding habitat and water enhancement activities is presented in Section C below, and **Issue/Response # 27.**

B01 - PROJECT PURPOSE AND NEED

25. **Relationship to Klickitat Project**. Did you drop the Klickitat portion of the project?

Response: The Klickitat portion of the project was deferred in 1990 to provide additional project planning time and to allow for emphasis on the Yakima phase. The preliminary design report for the Klickitat River will be available for public review, when it is completed. Work in the Klickitat Basin would complement work in the Yakima Basin.

27. **Project Purpose and Need**. [*Many commentors expressed concerns about the stated project purpose and need. Generally, commentors indicated that efforts should be directed towards other fish enhancement measures, not towards supplementation. Their comments are summarized below. Additional comments recommending that nonsupplementation alternatives should be included in the EIS are summarized in **Section C**.*]

(a) The purpose of and need for the proposed action must be fully explicated and analyzed. The DEIS does not address reasons why stocks were depleted. It should address the root causes for declining populations of anadromous salmonids in the Yakima Basin; and identify various habitat/flow improvement opportunities (with associated costs and expected benefits). Then true solutions can be developed to treat the causes and it will also be possible to see how this project will address the causes. Unless the basic causes for declines are addressed, neither wild nor hatchery salmonids can prosper in the Yakima Basin and wild salmonids will never be able to return to levels even approximating former abundance and diversity.

(b) It appears that the underlying motive of the project's promoters is to use supplementation. Rather than having technique (supplementation) be the goal, the more sensible goal is "to increase the abundance of naturally reproducing salmonids." The means of doing this should be impartially explained in the EIS, not stated as a given. The best means of accomplishing the sensible goal will probably turn out to be a combination of habitat restoration, improvement of instream flows, and harvest control.

The DEIS fails to explore all reasonable alternatives and has ruled out nonsupplementation alternatives because they would "not accomplish the supplementation research objective to reintroduce stocks that no longer inhabit the basin." The DEIS does not make the case that this is a reasonable, defensible or even the only objective for the project. The EIS should evaluate a full range of possible alternatives, not just supplementation. Suggested alternatives include 1) fish passage improvements at mainstem Columbia River dams and on Yakima Basin rivers,

2) additional harvest restrictions, 3) habitat improvements, including acquisition of riparian corridors, 4) providing additional instream flows, and 5) improving water quality.

(c) The focus should be on improving habitat, in-stream flows and water quality, not on supplementation.

(d) Supplementation of wild stocks is <u>needed</u> but not <u>only</u> supplementation. This avoids the questions of destruction of natural runs caused by water diversion, damming, agricultural runoff, and timber over-harvests. You are attempting to treat symptoms only.

(e) The case is not adequately made in the EIS that stocks will not recover if the hatchery system is not built (i.e., if habitat were improved, harvest controlled, and instream flows improved, the hatchery system would not be needed). The EIS should contain information from the field of conservation biology that would bear on the question of the re-colonization process or the critical numbers needed for self-sustaining fish populations. Does artificial production really have to be done at all?

(f) Is the purpose of this project to improve fish runs, or test supplementation? The flaw is in the choice of target goals for the YFP which should be to restore the natural production of anadromous fish resources of the Yakima River Basin, not to test supplementation. With restoration of natural production as the goal, supplementation could be one experimental approach to be included among EIS alternatives for the YFP

(g) I am surprised how much this Draft EIS sounds like a sales pitch. The reader is led to believe that the Yakima Fisheries Project's experimental facilities are necessary to gather meaningful data which will be used to restore natural fish runs. However, the Yakima Enhancement Project also includes improvements in habitat, passage and water enhancement. It will be impossible to discern which portion of the Yakima Enhancement Project is actually improving anadromous fish runs. It would seem logical to do as much habitat restoration as possible with the project funding before any more hatcheries are built.

(h) The next DEIS should adequately address the questions of 1) why it makes ecological and economic sense to try to rebuild fish spawning runs by "releasing artificially propagated fish into natural streams" (p. ii) if the habitat of those streams is now so bad that the runs do not exist or would not restore themselves there naturally, or if the Yakima River system habitat is indeed good enough to support the envisaged fish spawning runs (which should also be analyzed in the EIS), then 2) why an ongoing program of artificial propagation is needed for "supplementation" rather than natural recolonization or just an initial year or several years of inoculation, involving use of existing hatcheries or temporary (relatively inexpensive) hatcheries.

Response: The RDEIS includes information on why runs have declined or become extinct in the basin (Sections 1.3 and 3.3.1). Purpose and need have been revised to explain that at this time we are proposing to test supplementation as *one* technique that could be used to help restore fish to the Yakima River Basin. We acknowledge that supplementation would not eliminate the need to pursue other conservation and enhancement measures (see Sections 1.4 and 3.9).

The project purpose is to test supplementation principles, as well as improve fish runs. This will mean trying new and innovative treatments to increase abundance of naturally reproducing salmonids. Activities such as passage improvements are currently being completed throughout the basin. Other activities are being coordinated with this project, but are not necessarily funded as part of this project.

The Yakima Enhancement Project was used in the DEIS to refer to *several* different activities that could be taken in the Yakima Basin. Habitat, passage, and water enhancement activities do not meet the project need and are not proposed under the Yakima Fisheries Project. The nonsupplementation alternatives suggested in the comments above are all valid alternatives for increasing the numbers of fish in the Yakima River Basin. Many of these activities have been proposed for the basin as part of the Yakima Subbasin Plan (YIN 1990), and some actions are already underway through other efforts and programs. Although the nonsupplementation alternative could provide fishery benefits, these activities would not accomplish supplementation research objectives or help reintroduce stocks that no longer inhabit the basin. Because they would not meet the project's need or purposes, these proposed alternatives were eliminated from detailed study as alternatives to the proposed action (see further discussion in Section 2.6).

Existing wild stocks are being considered and risks are being evaluated (see the interactions portion of the EIS). The current proposal has also been scaled back from the number of stocks proposed for supplementation in the original DEIS. If additional improvements are made in the future, there could be additional benefits to resident fish, wild and native fish and supplemented fish. These additional improvements are being pursued concurrently with this proposal.

Based on information available at this time, it is thought that the supplementation approach will help enhance stocks in the Yakima Basin as well as provide important information about new techniques that can be used elsewhere in the region. The DEIS has been revised to provide additional information regarding this issue in section 1.2.

Section 7.4K of the Council's Fish and Wildlife Program identifies various goals for this project. Two of these goals are to 1) increase production of anadromous fish, and 2) learn from this project. As stated in the Fish and Wildlife Program, much is still unknown about the impact of hatchery-produced fish on wild populations. The design and management of the Yakima production facilities will allow fish and wildlife agencies and tribes to learn more about these impacts and to identify the best methods for carrying out hatchery production and supplementation of natural production. In today's environment, we must look at innovative treatments, including supplementation. Consequently, the National Marine Fisheries Service, in its Proposed Recovery Plan for Snake River Salmon (NMFS 1995), proposes development of management programs involving artificial propagation and supplementation to support recovery of listed Snake River salmon.

Natural re-colonization of fish stocks takes many years. Any increase possible under existing conditions would be very slow. Supplementation can be used as a tool to increase natural production, but this approach needs to be tested and evaluated.

28. Feasibility of Testing Supplementation. Any investment in spring chinook supplementation research could fail to yield the needed answers, because the Yakima subbasin is probably not in the chronically underseeded condition assumed in the YFP plan. Any test of supplementation as a means of providing increased natural production in the Yakima Basin is doomed to the same constraints presently affecting naturally producing stocks in the Yakima Basin. Existing habitat constraints must first be addressed. Only then can natural production of the salmonid resources likely be restored through a number of management strategies, one of which could be supplementation, but including more thoroughly tested conservation strategies as well.

Response: If, as these comments imply, all targeted Yakima stocks are subject to a substantial degree of density-dependent limitation, supplementation would indeed be impossible. However, a special case of density-dependent limitation *can* be overcome by supplementation. This case occurs when production of a population is limited by intense predation: the consumption rates of a large predator population increase very rapidly as prey density increases, continuing until the net number of surviving outmigrants is driven down to a level that induces the predator to switch to alternative prey. The prey population can overcome the limitation only by producing such a large number of outmigrants that the predators reach maximum consumption rates and their impact is reduced. YFP planners consider the northern squawfish and other predators in the lower Yakima as having a high likelihood of limiting salmonid populations, creating the situation described above (see Sections 2.2.3 and 4.1.2.1 of the RDEIS).

Conversely, if the low abundance of existing Yakima stocks is attributable to density-*independent* limiting factors, such as smolt mortality at mainstem dams, then sustained supplementation with high-quality smolts clearly would increase natural production. Larger returns would result because the same smolt-to-adult survival rate would be applied to a larger number of outmigrants.

The evidence for non-predatory, density-dependent limitation in the Yakima is subject to interpretation. Egg-to-smolt survival for spring chinook is inversely correlated with brood-year egg deposition and positively correlated with outmigration abundance (Fast et al. 1991). This might indicate significant density-dependent limitation, an influence of predators, the unfortunate coincidence of several large returns with a severe drought and very poor rearing conditions, or something else entirely. A preliminary limiting factors analysis (an updated spring chinook natural production objectives) has been conducted, but a report has not yet been completed. Based on this preliminary analysis, the critical habitat enhancement opportunities to increase natural production of Yakima stocks were identified[1]. These or similar activities are not yet deemed necessary to address the purpose of the project, evaluation of supplementation, but may be addressed in the future to benefit natural production issues.

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[1] YFP Natural Environment Team, August, 1992. "Preliminary habitat enhancement opportunities in the Yakima River basin: a description of assumptions, strategies, and recommendations."

30. **Relationship to Other Supplementation Efforts.** The EIS should analyze why, in the light of the existing hatchery and supplementation programs in the Columbia River Basin, this project is needed for the stated purpose of "testing" the strategy of supplementation. The EIS should also identify what has been learned from previous supplementation projects and how this project will improve upon their results. It must also discuss whether any of the previous supplementation projects have damaged wild stocks in any way.

Response: The RDEIS includes additional details regarding the relationship between this project and other supplementation efforts in the region (Section 2.6). The experimental features of this project would exceed features of other existing or proposed supplementation efforts in the Columbia Basin, and provide the information that cannot be gained through these other efforts. "Testing" supplementation is thus needed for the following reasons:

- The YFP supplementation strategy goes further than past projects in attempting to raise fish with attributes similar to those of wild and native fish.
- The Yakima Basin offers good logistics, monitoring, and experimental design opportunities that are unique.
- The new supplementation methods proposed for testing in the Yakima River Basin are designed to be adaptable to many other hatchery facilities in the Basin, increasing its potential applicability.
- Evaluation of the potential impacts of the new techniques proposed for the YFP is part of the project's main experimental goal.

See also response to **Issue # 37.**

33. **Production and Harvest Objectives.** The DEIS de-emphasizes the role of the YFP as a tool for restoring the salmon runs historically present in the Yakima Basin. The purpose and need for this project do not relate solely to environmental objectives, but also to production and harvest objectives. The EIS should state these objectives clearly.

Response: The importance of harvest was supported in the DEIS and has been discussed in all previous project documents. As noted on page 2.1 of the original DEIS, "The Yakima Fisheries Project (YFP) is designed to test the assumption that supplementation can be used to increase anadromous fish production and improve harvest opportunities while maintaining genetic resources" (emphasis added). The Revised DEIS has continued this emphasis on "maintaining genetic resources" while providing additional acknowledgment of harvest objectives.

37. Hatchery Effectiveness. We find it strange that this hatchery project proceeds in light of all of the scientific evidence about hatcheries and their effectiveness.

Some scientists with global perspective on the need to conserve the Columbia River's wild salmon see the proposed fish hatcheries as hopelessly outdated. Two recent articles in Conservation Biology can help you understand the need to abandon this costly and dangerous proposal. Nils Ryman and Linda Laikra (Conservation Biology 5 (3):325-329) explain how supportive breeding (supplementation) if "successful" will decrease the genetically effective population size. Gary K. Meffe (Conservation Biology 6(3) 350-354) states that "Salmonid management based largely on hatchery production, with no overt and large-scale ecosystem-level recovery program, is doomed to failure." The only proponents of the current proposals are State, Federal and tribal agencies who will obtain millions of Federal dollars for implementation.

Response: There is considerable regional debate focused on hatcheries and their future use. Although there is evidence that past hatchery programs have been ineffective for some purposes, *there is little scientific research to indicate that supplementation as proposed by this project would be ineffective*. One problem has been that much of the "scientific evidence" about hatcheries is often broadly applied to all artificial production, including supplementation. Another problem is that projects have not always been accurately evaluated on a scientific basis. One often-misrepresented summary of scientific evidence is the BPA-funded Miller Report, which reviewed 316 hatchery projects. The vast majority of the projects was dismissed as not meeting the definition of supplementation. However, these projects are often grouped as "failed supplementation" projects, when in fact many of them produced adult returns. Other projects were not evaluated on any scientific basis, so success or failure could not be measured. One purpose of the Yakima Fisheries Project is to test scientifically whether controlled supplementation can produce adult returns while maintaining the genetic integrity of the stock.

Previous hatchery programs have had limited success in the Yakima Basin. However, these small-scale research efforts primarily involved the release of out-of-basin spring chinook stocks (Leavenworth Hatchery) to test whether acclimation could increase adult returns. (Survival of the acclimated fish was twice that of the unacclimated releases.) The Yakima Fisheries Project would expand on this research, using stocks adapted to the basin and reared under more natural conditions.

The Ryman-Laikra paper referenced above has received a great deal of attention from the geneticists associated with this project. It is true that a bad project can seriously depress effective population size. However, a project with good return rates, and one using a program of regularly cycling naturally spawning fish though the hatchery, will have a negligible impact on effective population size. If this project succeeds as planned, effective size will actually increase over the preexisting situation.

42. Selection of the Yakima Basin. The DEIS does not adequately justify the selection of the Yakima River Basin for experimental supplementation purposes. Why isn't this project being implemented in an area with fewer dams and/or no important trout fishery? The Final EIS should describe the rationale for selecting the Yakima Basin, including a comparative summary of any other alternative experimental watersheds which were previously analyzed. Existing Columbia Basin hatchery facilities should be reviewed for their ability to test the stated study hypotheses.

Response: The Council's 1982 Fish and Wildlife Program identified the Yakima River Basin as one of the areas within the Columbia River Basin with the greatest potential for anadromous fish production. The Council adopted the Yakima River Basin measures, as proposed by the fish and wildlife agencies and tribes, to (1) mitigate hydroelectric impacts in the basin and (2) provide off-site enhancement to compensate for fish and wildlife losses caused by hydroelectric project development and operations throughout the Columbia River Basin.

After reviewing public comments on the DEIS, the project managers and BPA considered an alternative involving supplementation research at existing facilities outside the Yakima Basin. Although we found that there is some opportunity to conduct comparable supplementation research outside the Yakima Basin, that alternative would not meet several important purposes of the proposed action and would not be consistent with the Council's Fish and Wildlife Program. Additional information can be found in Section 2.6 of the Revised DEIS.

49. <u>Basin-Wide Hatchery Policy</u>. No integrated plan or policy is in place for hatcheries or other artificial propagation efforts in the Columbia River Basin. The Yakima Project should only be considered after regional development and implementation of a basin-wide hatchery policy.

Response: A comprehensive approach to policies and procedures for production facilities in the Columbia River Basin has been developed and adopted by Federal and state agencies and tribes (IHOT, 1994). Where applicable, the YFP would be developed and implemented consistent with these policies and procedures. It should be noted, however, that the YFP is proposing to test supplementation, which is different than a traditional hatchery system.

51. <u>Project Size</u>. The scale of the project seems totally inappropriate as an experiment. If an experiment is to be performed, at admitted risk to existing wild stocks, then it should be done on a smaller scale to test the technology first. The EIS must provide more discussion of the research project to be done and the appropriate scale of the project.

Response: The DEIS has been revised and now proposes supplementation on only one Yakima River stock—upper Yakima spring chinook. A second alternative would add a coho reintroduction feasibility study as well.

Project scale is an important issue. However, the project's purposes include increasing harvest opportunities. Generally, the proposed strategies have been based upon a set of assumptions regarding production capacity of the natural environment and performance of supplementation fish. If these assumptions are correct, the project objectives will be met. Since some of the assumptions are subject to uncertainty, the project as a whole will be designed and conducted as an experiment. Small-scale studies are often ineffective because the outcome of experiments of this kind are subject to great statistical variability. In summary, given the project's stated purpose, to test supplementation and increase natural production and harvest benefits, the project is of the smallest size that is expected to best achieve all purposes.

B02 - MANAGEMENT AND COORDINATION

55. Coordination with SOR. Is there any analysis being conducted in conjunction with the System Operations Review (SOR) and what impact will the current SOR alternatives have on this project?

Response: No analysis is being conducted in conjunction with SOR ; however, the current alternatives being considered under the SOR will likely increase the survival of juvenile fish and returning adults in the Yakima River Basin.

56. Coordination with County Government. Have there been any efforts to coordinate planning efforts with county planning offices on issues of growth management, water quality and shoreline management?

Response: The project has been coordinated with Benton, Franklin, Kittitas and Yakima counties since the YFP Management Plan was developed in 1987. Water quality information has been coordinated with the Environmental Protection Agency and Washington Department of Ecology. This coordination would continue throughout the life of the project. All project activities and permits would be in compliance with county requirements.

57. Management Structure. What is the authority and management structure of the Yakima Enhancement Project? The Final EIS should list those parties responsible for 1) funding of the construction, operation, and maintenance of experimental facilities for anadromous fish; 2) development of and the carrying out of restoration activities; and 3) gathering of information on supplementation techniques.

Response: The DEIS has been revised to provide more information on the YFP management structure and on "adaptive management" (see Sections 2.2 and 2.2.3; Figure 2.3). Generally, BPA is proposing to fund the construction, operation, and maintenance of most of the YFP facilities. Development of plans for fish supplementation would be directed by the Policy Group. Plans would be carried out and experimental information would be gathered by the Yakama Indian Nation (YIN) as the lead managing agency, the Washington Department of Fish and Wildlife (WDFW), and others as needed.

58. Coordination with Landowners. The National Cattlemen's Association, other groups and other individuals have asked for several years that any proposed activity by the Northwest Power Planning Council, the BPA, or other governmental entity in any of the tributaries to or in the mainstream of the Yakima River be discussed with each of the landowners and water rights owners in each area. This has not been done. These are private property rights you are proposing to impact and you have the legal obligation to consult with and acquire the permission from these persons before you proceed.

Response: Federal law requires that BPA obtain permission in writing before entering private property. This has been done for each proposed site; a file is kept in BPA's Branch of Lands identifying the landowners who have been contacted. Individual landowners will be contacted and their permission obtained before any project activities take place on their property. With respect to water right owners, as discussed in Section 4.1.1.1 of the RDEIS, the YFP would not cause increased demands for instream flows in addition to those currently being sought, nor would the project cause water rights to be taken from irrigators.

59. Coordination with NMFS. Proposed actions are not consistent with the policy developed by the National Marine Fisheries Service (NMFS) regarding fish hatcheries for anadromous fish. NMFS should be named as a cooperating agency for the project, especially since they are experimenting with sockeye salmon in the upper basin. The impact statement should cover all fish stocking activities, regardless of the agency involved.

Response: The NMFS draft Policy on the Role of Hatcheries has not yet been adopted; however, the project will be consistent with the Interagency Hatchery Operations Team's *Policies and Procedures for Columbia Basin Anadromous Salmonid Hatcheries* (IHOT 1994). NMFS has been involved in research funded by BPA that pertains directly to the YFP. They will also be consulted on the impacts to listed threatened and endangered anadromous fish species. This EIS does not analyze the impacts of all fish stocking activities in the Yakima River Basin, but it does discuss them. The cumulative impacts of this proposed project with the existing hatchery and supplementation projects in the Columbia River Basin are also discussed in Section 4.1.2.2.

B03 - PUBLIC INVOLVEMENT

63. Public Education. The plan lacks an essential emphasis on public education. Public awareness programs are essential in gaining cooperation toward promoting conservation and must be included.

Response: The project managers are responsible for the development and coordination of public education and awareness programs associated with the YFP. Currently, the project managers are considering the development and construction of visitor facilities at the Cle Elum hatchery. Public education and awareness issues have played an important role in the planning process for these facilities. As proposed, the visitor facilities will include interpretive exhibits. The managers expect that these exhibits will contribute to the public's education and awareness of supplementation and fishery issues in the Yakima River basin. These programs are referenced in the RDEIS. Additional public education and awareness opportunities may be identified and implemented in the future.

B04 - DECISION-MAKING PROCESS

64. Selection of the Preferred Alternative. What process will be used to select the preferred alternative and could the final alternative be a combination of the proposed alternatives? Who will make the final decision on this project?

Response: A preferred alternative is identified in the Revised DEIS that resulted from the long-term planning process, as well as through input from the public, agencies, and other groups, and is now subject to public review and comment. Selection of the final alternative will be a joint decision among BPA and the project managers after considering public input on the EIS; BPA's Administrator would sign the Record of Decision.

B05 - SCHEDULE AND TIMING

66. Project Commitment. What is your length of commitment to make sure this project will work?

Response: It is difficult to assign a specific duration for a project being managed using an adaptive management policy. under the project's adaptive management process, which has been described in greater detail in the RDEIS, it is expected that the systematic monitoring and evaluation of objectives and related activities would provide information for the project managers, BPA, and the Council to review and assess the project's progress toward meeting its stated objectives, consistent with the council's Fish and Wildlife Program. These parties would be responsible for determining whether the project were successful in achieving its objectives, and would identify and direct any appropriate actions. It is not possible to know at this time what project features will and will not work as desired.

67. Remaining Project Schedule. What is the schedule for the remaining EIS process and how long would it be before any facilities are actually built?

Response: The decision to develop a Revised DEIS has added time to the project schedule. Once the Final EIS is completed and the Record of Decision is signed (proposed for early 1996), the project could begin construction.

69. Incremental Implementation. Because of the potential risks associated with biological and physical uncertainties, and potential conflicts with the existing water management system, the project should be developed in increments as the project demonstrates success and conflicts are resolved.

Response: The DEIS has been revised and now includes only two action alternatives. Alternative 1 proposes supplementation testing on only one stock—upper Yakima spring chinook. Alternative 2 proposes a coho reintroduction feasibility study, in addition to the spring chinook supplementation activities. Any future supplementation of additional stocks would be implemented on a stock-by-stock basis, based on fully developed supplementation plans for each distinct stock, and following any appropriate NEPA compliance activities (e.g., supplemental EIS).

B06 - COSTS AND FUNDING

70. **Project Costs**. How much money has been spent on this project to date and who has paid for it? What are the costs associated with the various proposed alternatives?

Response: To date, about $40 million has been spent by BPA on the YFP. See Section 4.1.8 (Socioeconomics) for a discussion of estimated costs associated with the new alternatives. Construction costs of the two alternatives are the same, estimated at $20.575 million; annual operating costs are estimated to be $1.78 million for Alternative 1 and $2.28 million for Alternative 2.

71. **Impact on Electrical Rates.** Concerned about increasing utility rates as part of BPA's Fish and Wildlife Program activities. BPA should study the project's effect on future electrical rates.

Response: BPA's Fish and Wildlife Program (under which the YFP activities have been and would continue to be funded) is funded through utility rates. However, BPA's Fish and Wildlife Program expenditures are only a relatively small part of the BPA budget and many other factors in addition to Fish and Wildlife Program costs, such as ESA-related flow/spill requirements and BPA operational costs, influence utility rates. BPA is implementing Agency-wide cost control strategies to keep its electrical rates competitive in today's market. On April 25, Administrator Randy Hardy announced that the executive committee had identified $228 million out of a goal of $250 million in cuts to keep BPA competitive (BPA This Week, May 1, 1995). In addition, the Fish and Wildlife Program budget has been capped at $83 million in fiscal years 1995 and 1996.

74. **Costs Associated with Experimentation.** Concerned about the costs associated with experimentation because it would seem that there are unlimited possibilities. Need to look at what is reasonable and what is not.

Response: The purpose of experimentation is to improve opportunities for future success, not just to gain new knowledge. Therefore, experimentation plays an important role in helping to develop new strategies that may be more cost-effective. The adaptive management process for the project, through the uncertainty resolution process, would provide a focus and a logical sequence for the research (see the discussion in Section 2.2, and Figure 2.1 of the RDEIS). Evaluation costs would be associated with the project's stated objectives, strategies, and assumptions. The managers are committed to managing costs by focusing on uncertainties that are critical to evaluating the project's success in achieving its objectives.

C - PROJECT ALTERNATIVES AND OPERATIONS (GENERAL)

79. **Project Fate Under No Action.** What happens if the No Action alternative is selected? Will all project activities stop?

Response: If the No Action alternative were selected, BPA-funded activities associated with this project would substantially change or cease. The resource management agencies would continue appropriate activities as part of their management responsibilities.

84. **Smaller-Scale Alternatives.** The DEIS has not identified all reasonable alternatives. The EIS should evaluate smaller (truly experimental) supplementation activities including an alternative that involves only one stock. This approach would help resolve some of the current uncertainties without major risks to wild stocks and without major capital expenditures. The project could then be expanded if study results demonstrated that the project worked.

Response: The DEIS has been revised and now includes an alternative that would involve supplementation testing on only one Yakima River stock—upper Yakima spring chinook. The number of fish released has also been reduced (from 125,000 to 810,000). For additional information, see response to issue **Project Size** above, under **Issue # 51.**

88. **Inadequacy of No-Action Discussion.** The DEIS contains inadequate discussion of the No Action alternative. The statement of the No Action alternative is internally inconsistent (compare the statement that without the project, the fisheries program would be "unchanged," with the statement that some salmon and steelhead populations would increase). The statement admits that with habitat improvements and harvest restrictions, "some" runs would increase. Moreover, the authors only surmise that such increases would be at a slower rate than with the project. Thus, the authors admittedly do not purport to know whether or not the runs might increase at the same rate with habitat improvements and no project, as they would with the project.

Response: The DEIS has been revised to include an expanded discussion of the No Action alternative (see Sections 2.5 and 4.1.2.3). Given existing research, it is reasonable to expect that increases in salmon and steelhead populations would occur faster with supplementation than without; it may not be possible to prove. There are some consequences under the No Action alternative that can be expected with a greater degree of certainty. For example, nothing would be learned about the conditions and determinants of supplementation in the Yakima River system; implementation of that part of the Council's Fish and Program which instructs BPA to fund construction of an anadromous fish hatchery in the Yakima River Basin would be indefinitely delayed. No Action would also restrict opportunities for achieving the goal of mitigating the impacts of hydroelectric projects on salmon resources of the Columbia River Basin.

C01 - PROPOSED FISH STOCKS, NUMBERS AND AREAS

90. Fish Enhancement Below Horn Rapids Dam. Why is most of the project emphasis on the upper portion of the basin with no facilities located below Horn Rapids Dam? If fish runs rebuild and fishing pressure increases, it could be risky to the existing naturally spawning fall chinook populations in the lower river which have not been enhanced.

Response: Supplementation of fall chinook stocks is not included in the proposed alternatives. Fall chinook in the lower river is healthier than upper Yakima spring chinook, and less planning emphasis has been placed on fall chinook to include them in YFP at this time. Natural production objective modeling and planning for these stocks may be developed and proposed in the future, but they would be subject to additional environmental analysis. The coho reintroduction feasibility study proposed under Alternative 2 would address predation by coho on fall chinook stocks.

93. Sockeye. Weren't sockeye historically a major fish run in the Yakima Basin? Why are there no plans to reintroduce sockeye at this time?

Response: The estimated historical abundance of sockeye in the Yakima system is 200,000 fish. Sockeye were included in the project's early planning phase, and NMFS is exploring the feasibility of getting juvenile sockeye to emigrate from Cle Elum Reservoir. In 1990, however, the Council expressed concerns over the potential impact of the sockeye reintroduction on (1) the overall project, (2) the existing fish populations, and (3) water storage and delivery. The Council directed BPA, fishery management agencies and the YIN to review with them and the public any proposed reintroduction of sockeye salmon into the Yakima Subbasin. No decision can be made on the construction of sockeye facilities until the feasibility study is completed (expected in December 1996).

94. Selection of Acclimation Sites. Who determines the process for selecting project activities and locations? For example, why are there no sites on Ahtanum Creek? The Final EIS should address how the sites were selected.

Response: The candidate acclimation sites were selected based on biological criteria specified by the managers. These criteria specify that the location should be adjacent to appropriate spawning habitat, that there must be adequate flow for fish migration, and that the water supply must encourage imprinting and homing to the desired spawning location. Section 2.3.4 of the RDEIS discusses selection of the acclimation sites. No sites are located on Ahtanum Creek because it is not a spring chinook spawning creek.

95. **Feasibility of Taneum Creek.** The project has proposed summer steelhead acclimation ponds on Taneum Creek. How will this work when a portion of the stream goes dry in the summer and water is muddy during the spring?

Response: The Revised DEIS does not include any supplementation of summer steelhead at this time. The lower portion of Taneum Creek does experience periodic instream flow problems, particularly in the summer and early fall. However, the acclimation ponds would generally be in use between March and May, when water flows are normally higher. Despite periodic flow problems on the lower Taneum, there are more than 16 kilometers (10 miles) of suitable steelhead habitat above this area. Steelhead are known to successfully spawn and rear in streams that are naturally intermittent for a portion of the year. Adult steelhead typically migrate into tributary streams to spawn in the winter and early spring (when flows in the lower Taneum are adequate to provide for fish migration). Juvenile steelhead typically move out of tributary rearing areas in the late winter and spring, a time of adequate migration flows. Steelhead can thus use a considerable portion of Taneum Creek for spawning and rearing. A certain amount of sediment is normal during the spring runoff, even under undisturbed conditions. This is not harmful to anadromous fish, provided that the sediment amount is not excessive.

96. **Opposed to Cowiche Creek Plans.** Are there any alternatives, besides no action, which would preclude building facilities on Cowiche Creek? Opposed to the construction of steelhead rearing ponds on Cowiche Creek for the following reasons: 1) fish culture would damage the water quality; 2) introduction of steelhead would result in fishing restrictions and probably eliminate native trout; 3) construction, maintenance, viewing and use of man-made ponds will result in significant increase in traffic over unsafe roads; 4) the proposed development is not consistent with zoning or character of the neighborhood; and 5) the development would detract from the beauty of Cowiche Creek.

Response: The DEIS has been revised and now includes only two action alternatives. These alternatives would not include any facilities on Cowiche Creek.

98. **Reintroduction of Coho and Summer Chinook.** The DEIS describes reintroduction of coho and summer chinook into the Yakima Basin as supplementation. How can coho and summer chinook be supplemented when they no longer exist in the basin? This is not supplementation, and it should not be considered as a part of supplementation strategies. Reintroduction of salmon stocks that have gone extinct is of proven difficulty, and the strategy and risks for such reintroductions should be addressed differently than the supplementation strategies.

Response: It is true that wild coho no longer exist in the basin and that any naturally spawning coho are considered the result of hatchery outplantings. The initial emphasis on coho is to provide harvest opportunity in the Yakima River. Coho plantings occur annually as part of the Columbia River Fish Management Plan (CRFMP). Inclusion of coho in the YFP Project is, in part, an effort to coordinate those plants with other project activities. Alternative 2 in the Revised DEIS includes a study of the feasibility of re-establishing natural coho production as an objective.

The Revised DEIS does not currently include any proposed actions for summer chinook supplementation. Historically, Yakima summer chinook were present and are assumed to have represented a genetically distinct stock in the Yakima River basin; however, it is not certain whether they continue to exist in the Yakima Basin. The long-term YFP goal for Yakima summer chinook is to establish and supplement a naturally spawning stock (increasing natural production while maintaining the long-term fitness of the target population, and keeping the ecological and genetic impacts on nontarget populations within specified limits). The stock would be a derivation of the suspected remnant, locally adapted stock, or a donor stock from a source outside the basin that has not yet been identified.

100. Genetic Refuge Concept. The concept of "genetic refuge" is irrational from the standpoint of both fishery management and genetic resource management. By proposing to supplement certain substocks and not others under the "genetic refuge" concept, BPA risks increasing the imbalance in the relative productivities of substocks within the basin. This condition describes the dilemma of hatchery/wild stock management that the supplementation concept is meant to avoid. All identified substocks of a designated stock complex, such as spring chinook, fall chinook, and steelhead should be supplemented at similar levels to maintain the equilibrium in substock productivity. This strategy will produce more fish, preserve genetic stock integrity if that is a major consideration, and simplify both the implementation of supplementation plans and management of adults that are produced.

Three drainages (Marion Drain, Satus Creek, and American River) have been identified as having genetically distinct substocks and would be managed as genetic refuges (Section 4.2.1.1). According to the DEIS, these would not be supplemented and structures would be installed to deny access to marked hatchery fish or other substocks to these tributaries. How would this be accomplished and what about second generation non-native adults?

It is possible that the fall chinook spawning in Marion Drain may have been planted there. A check of planting records from hatcheries that have used Snake River fall chinook for broodstock may be appropriate.

Response: The original DEIS erroneously portrayed Marion Drain as a genetic refuge. This fall chinook stock would not be subject to supplementation. Only Satus Creek and American River were actually proposed to be managed as genetic refuges. The Revised DEIS does not include the "genetic refuge" concept as presented in the original DEIS.

Regarding the origin of the Marion Drain stock, we have tracked down every available lead indicating that Marion Drain fish were introduced. The only hatchery fall chinook known to have been planted there were from the Kalama River hatchery in the mid-1970s. The Kalama stock is genetically quite distinct from the Marion Drain stock, so it is unlikely these fish were the ancestors of the Marion Drain fish. Eyewitnesses observed fall chinook in the drain in the 1930s and there are eyewitness accounts of adult chinook trapped at Celilo being planted into the drain by a farm worker in the 1930s as well. Whether these fish produced any offspring is unknown, but based on the available information, it is currently believed that the Marion Drain population probably represents original Yakima fall chinook salmon.

103. Manastash Creek Feasibility. Manastash Creek is cited as a candidate for construction of upstream passage improvements to increase rearing and spawning habitat access (DEIS p. 2.18). This habitat access proposal also includes measure to increase instream flows in tributaries such as Manastash Creek (DEIS p. 2.19). Yet Manastash Creek is dry in a mile-long portion of its lower reach much of the year. Question whether Manastash Creek should be a candidate for anadromous fish enhancement because of these problems.

Response: No acclimation facilities are proposed on Manastash Creek. The Manastash Creek measures were included in the EIS to provide an overview of some of the habitat improvement opportunities identified in the basin. While these habitat improvements could benefit anadromous fish stocks, they are not part of the YFP proposal.

104. Keechelus-to-Easton Acclimation Sites. The acclimation sites in the Keechelus-to-Easton reach should not be constructed until sources of water can be identified and allocated to meet the needs of the additional fish.

Response: Project facilities are not proposed above Easton Dam at this time due to these concerns. Although the Keechelus Dam site has been identified as an alternative acclimation site, it was not selected as a preferred site for this reason, and would not be used until the water issue is resolved. The issue of water needs for additional fish are also addressed in **Issues # 214 and 222,** below.

105. Opportunities for Enhancement. Marion Drain, with some improvements, could provide some significant spawning habitat. Fish enhancement activities in Toppenish Creek may not be very successful because of poor water quality and flows. Satus Creek and Logy Creek have potential for enhancement and may have remnant runs.

Response: These streams and their salmonid populations are being reviewed for potential fish enhancement activities. However, none are a part of this RDEIS proposal.

C02 - PROJECT FACILITIES

106. Contingency Plans for Project Facilities. Is there an alternative plan for the project facilities if supplementation does not work?

Response: No, there is not.

109. **Public Comment on Acclimation Sites.** Is this the only time the public can comment on the proposed location of the acclimation sites?

Response: No. Comments will be obtained during review of this RDEIS. Before acclimation sites can be constructed, individual landowners will be contacted and the exact location for each site will be identified and agreed upon.

110. **Site Acquisitions.** Has BPA already approached landowners regarding purchase or lease of proposed acclimation sites? Does BPA have the power of eminent domain and will facilities be built on private land against the wishes of the landowner? Who will negotiate with the landowners and in whose name will the title be held? How will the price be determined for leasing or acquiring land?

Response: Each landowner has been contacted, and permission to enter property has been received for all acclimation sites to date. BPA does have the power of eminent domain, but strongly prefers to avoid exercising this right, especially on Fish and Wildlife Program activities. If at all possible, BPA would not build facilities on private land against the wishes of the landowner. Negotiations with landowners will be conducted by BPA's Real Estate Section. BPA offers fair market value for any land rights it acquires.

113. **Hatchery Design.** Hatchery facility design has already been somewhat finalized and the plans look very much like a traditional hatchery. Is there flexibility in the construction of these facilities that will accommodate new and innovative rearing strategies?

Response: The final design of the facilities has not been completed. In the preliminary design, several features were included to allow for flexibility and to provide for the ability to incorporate innovative rearing strategies as the project evolves through the adaptive management process. An important goal of this project is to identify new rearing techniques that can be used elsewhere by retrofitting existing hatcheries. Therefore, it is important the YFP use rearing vessels that are not unique, so that the technology can be applied to existing facilities. The designs look like traditional hatcheries because the project requires a large number of ponds for the experimental design. The experimental design requires a controlled environment with a number of duplicate facilities so that the experiments can be replicated (repeated with consistent results).

119. **Design of Acclimation Ponds.** The DEIS lacks sufficient detail on design of the acclimation ponds. The acclimation sites are described in general terms with graphics that make these look like small holding ponds. More thought and research should go into design of the acclimation ponds to better simulate the natural environment to which these fish will be soon exposed. The ponds should have irregular-shaped banks with peninsulas, some steep drop-offs, woody debris, shoreline vegetation and deep water. The EIS should provide a more detailed sketch to strengthen this concept. It would also help to show typical detail of spawning areas as related to the acclimation ponds.

Response: The current design for acclimation facilities is similar to raceway design so that innovative rearing strategies can be carried out consistent with early rearing in the hatchery and can be adapted to existing rearing facilities in the Columbia River basin.

120. **Use of Existing Facilities.** The operations of existing hatcheries in the Columbia Basin are presently being reevaluated in light of possible adverse effects on wild populations. Some of the hatcheries could be modified and reprogrammed to provide fish for supplementation. The DEIS did not examine the potential for using existing hatcheries for egg incubation and juvenile rearing. If feasible, this approach could eliminate the need for the central facilities currently planned for this project. The Final EIS should provide a discussion of this possibility and the reasons for and/or against its effectiveness.

Response: The facilities proposed for the YFP are specifically designed to meet the experimental needs of this project. (Use of the existing hatcheries would not meet the second purpose of the YFP, supplementation of fish stocks in the Yakima River basin.) There are currently very few facilities in the Yakima Basin that could be used for the project purposes (see Section 2.6). Much of what is being discussed for application to other sites in the Columbia Basin originated from the planning and design of the YFP. It is the goal of the YFP to assess the viability of these new techniques and to make them available to the rest of the Columbia Basin.

C03 - MONITORING AND EVALUATION

125. **Monitoring Plan Details.** The proposal lacks a clearly defined monitoring plan. Given the importance of monitoring to the adaptive management approach, the DEIS must discuss monitoring procedures and contingency plans in detail and identify any limitations on the ability of project managers to identify undesirable changes in response variables. In particular, the EIS must discuss whether monitoring methodologies exist which will allow for real-time adjustments to project operations.

To detect individual and population level effects, a monitoring plan including Quality Assurance/ Quality Control plan, baseline genetic data, genetic monitoring procedures, monitoring duration, contingency plans as well as a monitoring strategy for non-genetic impacts must be developed. The Final EIS should include a peer-reviewed monitoring plan.

Response: A preliminary monitoring plan, including the elements listed, has been developed for the proposed project (see Section 2.3.3). The Project Annual Review, Project Management, and Risk Analysis processes (Sections 2.2.1.3, 2.2.3, and 2.3.2) are the mechanisms proposed to identify and correct undesirable results. Peer review is included.

126. Monitoring Outside the Yakima Basin. Will test populations be monitored after they leave the Yakima Basin? How will you know if these fish reach the estuary safely?

Response: Monitoring of marked fish will occur at McNary Dam, in the ocean and in-river fisheries, and adult returns to the Yakima Basin. However, the fate of Yakima Basin fish that do not return to the basin will not be specifically known.

127. Implementation of Adaptive Management. The Final EIS should describe how adaptive management would be implemented. A technical oversight committee should be formed with oversight/compliance responsibilities. If the Yakima Project is touted as a research study, then it should be designed as such. All components typical of a research proposal and scope of work should be provided for peer and public review.

Response: Section 2.2 of the RDEIS details adaptive management and how it is proposed for implementation. The project has been carefully designed with special attention to research needs. Section 2.2.2 specifically addresses the mechanisms proposed for policy definition and expression for the project.

C04 - PROJECT OPERATIONS/BROODSTOCK SELECTION/FISH REARING

130. Broodstock Selection. Additional information is needed on strategies for broodstock selection (i.e., expected number of adult returns, percentage of run collected, locations, how selections will be made).

Response: The RDEIS has been revised to include additional information regarding broodstock selection strategies and other pertinent guidelines designed to control and reduce genetic risks. It also includes recent modeling results which address natural production objectives and population dynamics. (See the discussions in section 2.3.1 of the RDEIS.) Project geneticists have developed various project documents that deal with these issues. One of these, the Genetic Hatchery Guidelines, deals specifically with the points made in this comment. The project will operate under a hatchery operations manual that will provide protocols for broodstock selection.

132. Expected Fish Survival. What chance of success does the project have? What percentage of smolts will survive the downstream migration to the ocean? What is the expected smolt-to-adult survival for this project?

Response: The probability of project success cannot be rigorously quantified.. However, several common-sense "rules" can provide some perspective. For example, the egg-to-smolt survival for many species and races is roughly ten times higher in a hatchery than in nature. Therefore, if the reproductive successes (smolts per spawner) of wild and hatchery-reared fish are equivalent, the smolt-to-adult survival of hatchery fish need be only slightly better than 1/10th the wild rate for natural production to increase (the survival rate of conventional hatchery reared fish is currently assumed to be 10% of the survival rate of naturally reared fish).

The NMFS has collected empirical data suggesting that the use of naturalistic rearing should help to improve this relative survival rate greatly. Project planners have set a goal of achieving at least 50 percent relative smolt to adult survival of hatchery fish compared to their wild counterparts. Relative reproductive success is harder to predict. However, the figure should be relatively high if the proposed Genetic Hatchery Guidelines are rigorously applied, and any differences in behavior or ecological interactions between hatchery and wild fish are small.

Downstream Survival: The best existing estimates (System Planning Model database) of wild smolt survival from the upper reaches of the Yakima Basin to a point below Bonneville Dam are as follows: upper Yakima spring chinook (26 percent), Naches spring chinook (33 percent), upper Yakima steelhead (25 percent), Naches steelhead (24 percent), Marion Drain fall chinook (13 percent), and lower Yakima mainstem fall chinook (27 percent). There are data indicating that at least half of the losses occur within the Yakima basin. Limited data indicate that the relative survival of conventionally reared spring chinook smolts to John Day Dam might be about 50 percent of the wild rate (Fast et al. 1991).

If this figure is accurate, and if it applies to the relative hatchery/wild survival of all species/races to a point below Bonneville, then the survival of conventionally reared hatchery smolts to the "upper estuary" might range from 6 to 17 percent. Because the YFP smolts will be reared under more natural conditions, they should fare better than conventionally reared hatchery fish. There is no way to predict, however, how much better this might be.

Smolt-to-Adult Survival: We cannot make rigorous estimates of the smolt-to-adult survival rates for experimentally reared fish that have not yet been produced. Survival for conventionally reared spring chinook (rough, worst-case scenarios for the project) are as follows. The mean smolt-to-adult survival rate (expressed as return to subbasin plus mainstem Columbia catches) for all spring chinook released as smolts is 0.12 percent (range of 0.02 to 0.31 percent). This compares to a mean survival for wild spring chinook of about 1.9 percent (range 0.9 to 3.0 percent; Fast et al. 1991). Note that the figures for hatchery survival are for fish reared under conventional conditions and, in many cases, without the benefit of pre-release acclimation. Our goal is to attain 50 percent of the wild fish rate. For spring chinook, this would be 0.95 percent—an 8-fold increase over existing performance.

135. Steelhead Collection. Will an entire run of fish (upper Yakima steelhead) be put at risk by collection of the majority of the returning adults for broodstock purposes? With a remnant run of 50 to 80 summer steelhead returning each year to the Yakima River above Roza Dam, it does not seem appropriate to take most or all of these fish into a hatchery and forgo any natural production. With hatchery smolt-to-adult survival of less than 0.05% and survival of wild smolts approximately 10 times that figure, it makes no sense to impose our artificial mate selection and rearing schemes to possibly not even get back as many fish as we collect for broodstock. I would recommend that upper Yakima River steelhead not be collected for broodstock until such time that it has been demonstrated that the project is capable of increasing adult returns (based on an evaluation ten years after the first releases of hatchery fish).

Response: The Revised DEIS does not include any proposed actions for steelhead supplementation at this time.

137. **Spring Chinook Collection.** Care must be taken to not overharvest wild stocks for broodstock collection. The proposed upper limit of 50 percent is too high and should be reduced to 20 percent or less.

Response: We agree that care not to overharvest is important; we are acutely aware of the need to balance brood collection and wild escapement. Project planners have developed genetic hatchery guidelines to help with these issues. The 50-percent rule was adopted based on an analysis of the some existing genetics research (i.e., the Ryman and Laikre equation). However, before we implement any brood collection protocol, we will thoroughly analyze the level of impact and the degree of risk.

138. **Use of Non-local Stocks.** The use of non-local stocks is inappropriate. The DEIS contemplates the use of imported broodstock for certain populations, including chinook populations (pages 1.7, 2.2-2.4). Importation of broodstock defeats the purpose of a "supplementation" program. A program that uses imported broodstock does not seek to supplement *existing* stocks but to introduce new stocks. Given the potential for interbreeding within the basin, no chinook or steelhead from other populations should be introduced.

Response: Of the two action alternatives, Alternative 1 proposes supplementation testing on only one stock—upper Yakima spring chinook—with broodstock to be collected only from existing upper Yakima spring chinook stock. Alternative 2 proposes, in addition, a coho reintroduction study. Non-local stocks are necessary for coho because the wild stocks no longer exist within the Yakima system. The coho reintroduction program already exists in the Yakima River basin under the *U.S. v Oregon* program.

141. **Predator Avoidance.** Please detail how juvenile salmonids will be taught to avoid predators and forage for food (p. 1.2, para. 2). Nobody has much of an idea how to do such things, despite some previous attempts. Why couldn't a small temporary pilot project be used to solve such key problems before launching into the huge Yakima project? The project should be postponed until these problems are solved.

Response: A number of recent studies have been conducted regarding predator avoidance and foraging in fish. Some of these studies (e.g., by Oregon State University's Bori Olla) have had good success in training these behaviors. These techniques (or a modification of these techniques) will be applied to increase the survival of fish released through this project. Large-scale studies will be necessary to quantify the differences between different treatments proposed for the project. Related small-scale studies may also be planned. The project managers are reviewing ongoing research conducted elsewhere and are considering making these studies a part of the New Innovative Treatment (NIT).

145. Supplementation vs. Traditional Hatchery Practices. EIS is not clear on the difference between standard hatchery practices and supplementation. The summary plays up the biologically appropriate practices and innovations that will be used, but these seem like practices that should be standard in all hatcheries. If not, other hatcheries should adopt this model.

Response: The EIS has been revised to include additional information on the differences between traditional hatchery practices and the proposed supplementation practices (see Table 1.1). One project purpose is to test scientifically whether the NIT will increase survival of the supplementation fish over those reared under standard hatchery practices. If these rearing methods are superior, they will be adopted in standard hatchery programs.

D - POTENTIAL PROJECT IMPACTS AND CONSTRAINTS (GENERAL)

153. Cumulative Impacts. The DEIS is inadequate because it fails to analyze the cumulative impacts of the project on the entire Columbia River Basin and the Yakima Basin itself. The EIS must discuss the impacts of the project when added to the impacts of all existing, proposed and foreseeable supplementation releases throughout the Columbia River Basin, plus all existing, proposed and foreseeable releases from traditional production hatcheries. Such cumulative impacts would include, at a minimum, gene migration through straying, overharvest of wild stocks in mixed stock fisheries, effects on potentially endangered or threatened stocks and disease transmission.

The Final EIS should also present an analysis of cumulative impacts to water quality, wildlife, wetlands, riparian areas, and recreation resources in the river basin/watershed. Consideration of these impacts together with those of any past, present, and reasonably foreseeable future actions (i.e., forestry, mining, road construction) is warranted.

Response: The EIS has been revised and now includes an analysis of the cumulative impacts that would likely be caused by the proposed action (*see* Section 4.1.2.2). This includes any known present and future actions that are related to the proposed project. Some of the cumulative effects for the entire Columbia River Basin are also being covered in other forums. For example, the USFWS is presently leading the Comprehensive Environmental Analysis of Anadromous Fish Production (CEA) which will address the cumulative impacts of all Columbia Basin fish hatcheries on wild and naturally spawning stocks. The YFP will be evaluated in the CEA effort along with all other artificial propagation and supplementation facilities.

154. Inadequate Discussion of Risks. The DEIS does not discuss adequately the risks of the three-stock and five-stock alternatives. The fact that the risk of these alternatives are less than the seven-stock alternative says nothing about whether the five- or three-stock alternatives are justified in light of the potential project benefits, particularly since BPA has not put forth a preferred alternative. In addition to stating how the alternatives reduce risks as compared with the seven-stock alternative, the DEIS must clearly disclose which risks would remain if one of the alternatives is chosen.

Response: After considering public comments on the DEIS, BPA and the project managers concluded that the original stock options no longer present a logical set of alternatives. Consequently, the DEIS was revised to include only two action alternatives, proposing the supplementation of upper Yakima spring chinook without or with a coho reintroduction feasibility study. The Revised DEIS also identifies the preferred alternative and provides a greater level of detail regarding the expected risks and benefits of the various alternatives (see Section 4.1.2.1). See also **Issues # 170, 174, 175.**

156. Unresolvable Uncertainties. "Resolvable Uncertainties" and "Unresolvable Uncertainties" listed in the October 1992 Project Status Report have not been adequately addressed. Information concerning the status of genetic and natural production monitoring programs, for example, is "essential to a reasoned choice among alternatives" and must be provided in the EIS. The EIS must discuss "any adverse environmental effects which cannot be avoided should the proposal be implemented" (40 CFR 1502.16). In this regard, the EIS must list and discuss every unresolvable uncertainty listed in the Project Status Report.

Response: The Spring Chinook chapter of the Project Status Report for 1995, which contains the lists of resolvable and unresolvable uncertainties, has been revised and is appended to the Revised DEIS (Appendix B). Information on the genetic and natural production monitoring programs has been added. An Uncertainty Resolution Plan has also been developed and is discussed in the EIS. The risk analysis for the project (Section 4.1.2.1) addresses the risks that could result from the implementation of the project.

D01 - GENETIC RESOURCES

157. Broodstock Selection Effects. The EIS does not adequately address impacts associated with broodstock collection and lacks sufficient detail on broodstock collection limits needed to insure maintenance of natural or wild populations. The EIS states that up to 50 percent of returning adult salmon and steelhead will be taken for broodstock. This represents a substantial increase from the guidelines in the preliminary design report and the Power Planning Council's Staff Issue Paper 90-9. Have geneticists determined that a higher broodstock percentage will not increase risks to the native populations, or do the new guidelines simply reflect the agency's realization that poor survival rates make egg robbing necessary?

Response: Earlier project documents reflected a policy of taking no more than 20 percent of the wild escapement for hatchery spawners; the RDEIS states that less than 50 percent may be taken. This change was made after considering a recent Ryman/Laikre paper which identified a number of factors that must be considered in developing guidelines on the taking of natural fish. Under some circumstances, taking 20 percent may actually have a more severe genetic impact than taking 50 percent. Each broodstock operation in the program needs to be considered separately, and in some cases, 20 percent may be appropriate. Great care and caution will be taken in prudently assessing the broodstock take. See also **Issue # 130.**

159. Expanded Discussion of Fish Genetics Needed. Would like to see more detail on fish genetics and ecology in the Final EIS. The current documentation is very thin in these areas and there is very little evidence presented for the statements that are made.

Response: The Draft EIS did not reflect the high level of attention being paid to genetics and ecology in YFP planning. The Revised DEIS now includes additional details regarding these important topics (see especially Section 4.1.2.1).

161. Detection of Domestication Selection. The EIS should give specifics regarding how domestication selection could be detected (p. 4.7). If the survival of natural spawning fish decreases because of domestication, how would it be detected? How would it be separated or distinguished from declining survival due to habitat degradation, or oceanic survival changes?

Response: Monitoring designs for detection of domestication selection are currently being developed. Although plans are not complete at this point, it appears that this type of genetic impact will be difficult and expensive to monitor at reasonable levels of statistical power. An overall outline of the project monitoring program is included in the Revised DEIS in Section 2.3.3.

162. Avoidance of Domestication Selection. The EIS fails to provide an adequate discussion of plans to address the intractable problem of domestication selection in hatcheries. The EIS must disclose the fact that the project managers have no idea whether the envisioned innovations in feeding techniques, stream cover design, and predator conditioning will work. It must also explicitly state that no studies have ever demonstrated that humans can teach four-inch fish to survive in the wild.

Response: It is not yet clear just how intractable a problem domestication selection is. Project geneticists are spending much time on this topic; these efforts are reflected in the genetic hatchery guidelines and monitoring plans developed for the project. The Revised DEIS provides more information on genetic risk in general (Section 4.1.2.1). As for project management having no idea whether envisioned innovations in hatchery operations will work, preliminary research on some of these innovations has yielded very encouraging results (NMFS, D. Maynard unpublished data reported at March, 1995 Project Annual Review), but it is true that uncertainty remains. See also **Issue # 141**.

168. Genetic Risk Assessment. Recommend that the results of the level II genetic risk assessment and the hatchery genetic guidelines being developed be included in the Final EIS.

Response: The level II genetic risk assessment and hatchery genetic guidelines are available. Material from these documents has been incorporated into the Revised DEIS in section 4.1.2.1.

170. Inadequate Risk Assessment. The DEIS does not adequately address genetic risks. As stated on page 4.5 of the DEIS, no genetic monitoring plan exists for project, nor have the project managers finalized a set of hatchery management guidelines. The detailed operational assessment mentioned on page 4.5 of the DEIS must be completed and incorporated into and discussed in EIS before a reasoned decision can be made regarding the merits of the project. The DEIS also fails to discuss reasons for and significance of changes between the 1990 Genetic Risk Assessment and the Draft EIS (e.g., percentage of broodstock collected).

The EIS for hatchery supplementation of anadromous salmonids in the Yakima Basin does not critically address the genetic risks to conspecific target and nontarget subpopulations. Hatchery supplementation should be postponed in the Yakima Basin until a specific plan is devised to protect unique genotypes of nontarget subpopulations from broodstock "mining," from interbreeding with target subpopulations and from mixed-stock fishery exploitation. Should hatchery supplementation be implemented, hatchery production should be limited to upper Yakima River spring chinook and Naches River steelhead to minimize the "mining" of broodstock from nontarget subpopulations and interbreeding of stray hatchery fish with nontarget subpopulations. Only the "two stock supplementation plan" recommended in this assessment will minimize risk of extinction of all three nontarget subpopulations.

Response: Genetic risks, including a discussion of the genetic monitoring plan and hatchery genetic guidelines, are presented in greater detail in the Revised DEIS (see Section 4.1.2.1; also **Issue # 154, above**). An explanation for the change in broodstock collection policy is also presented in the Revised DEIS (see also **Issue # 157,** above). It should be noted that project planning and related research have been underway for a number of years. There are few, if any, cases of a hatchery program based on so much genetic research and planning. It is true that much is still unknown about supplementation. However, the basic premise of this project is that the best way to learn about supplementation is to supplement carefully, and to monitor the results equally carefully, adapting the program to new information so that the resource is not damaged.

174. Risks to Steelhead. The DEIS fails to adequately address the risks to steelhead populations due to uncertainties regarding population structure.

Response: The DEIS has been revised and does not propose any steelhead supplementation activities at this time. Steelhead stock identification work associated with this project has lagged chinook work. It appears, at present, that there are probably no more than three steelhead stocks in the basin. Our current planning recognizes this situation.

175. Risks to Coho Donor Stocks. The DEIS fails to adequately address the project impacts on coho donor stocks. The DEIS must discuss whether egg robbing will affect lower river stocks and whether the costs of coho facilities are justified in relation to the minuscule returns that can be expected.

Response: The transfer of coho salmon as described in the RDEIS has been occurring since 1987 under the requirements of the CRFMP. No increased transfers would occur as a result of the proposed activity, and the transfers will continue whether the YFP is initiated or not. The donor stocks for the YIN coho program are hatchery fish from Cascade Hatchery (not wild runs of lower river coho), made available under the CRFMP. Availability of eggs/fish is coordinated within the context of that program, and there are currently excess fish available under the program. Therefore, since no additional stock or fish would be used for the YFP, there should be no impact on donor stocks. No facilities are proposed for coho under the revised alternatives in the RDEIS.

181. <u>Subpopulation Identification</u>. The DEIS states that the potential genetic impacts would be reduced through the "identification and separate culturing of distinct subpopulations." Information regarding past and on-going studies related to subpopulation identification should be provided. The Final EIS should describe subpopulation identification procedures during broodstock collection. Although the DEIS does describe the importance of maintaining viable subpopulations, it does not provide a detailed plan as to how this might be accomplished.

Response: The EIS has been revised to include information on this issue, as well as information regarding hatchery genetic guidelines, genetic monitoring plans, and the genetic risk assessment (see Section 4.1.2.1).

D02 - SPECIES INTERACTIONS

183. <u>General Concerns</u>. Several commentors expressed general concerns over the possible impacts on the resident trout population. Comments addressing specific species interaction issues are detailed in the categories that follow.

Response: A discussion of literature, information, and research results on species interactions is presented in Section 4.1.2.1 of the Revised DEIS.

184. <u>Predator Control</u>. Have questions regarding instream predation on smolts been answered? The DEIS lacks sufficient detail on predator control in the lower Yakima River. The project should have a detailed plan for predator control and at least some outline of this plan should be included in the Final EIS.

There is a doctoral thesis at the University of Washington library titled "The Effect of Predator-Avoidance Conditioning on the Post-Release Survival of Artificially Propagated Salmonids" by Richard B. Thompson (1966). This study indicates that pre-smolts can be trained to be aware of and to avoid predatory fish. [399]

Response: Instream mortality is known to occur in the mainstem Yakima River, and predation is one of the potential sources of this mortality. The potential impact of predation has been a major concern of project planners; predator control activities are not inconsistent with the goals of the YFP and could benefit natural production of target species. Project planners feel control is not required to meet the stated purpose and need for the project. However, studies are being designed to examine the role of predation on survival of target species.

Thank you for the suggested reference on predator-avoidance conditioning. The application of predator-avoidance training, as exemplified by this reference, is one option being considered by YFP scientists.

185. Impacts on Wild Cutthroat and Bull Trout. The EIS should examine the possible impacts on wild cutthroat, bull trout, and species that are less aggressive than the species to be supplemented. It should also study interactions in small streams such as Cowiche Creek, as opposed to a larger stream such as the Yakima.

Response: Fish species such as bull trout and cutthroat trout exist in the Yakima Basin. The management agencies are interested in minimizing risks to these species posed by YFP activities. Studies of species interactions above Roza Dam have described risks of the YFP to non-target species such as bull trout. These studies have been conducted in mainstem areas as well as the smaller streams within the Teanaway River drainage. (See Section 4.1.2.1 of the Revised DEIS.)

187. Discussion of Species Interactions is Inadequate. The discussion of species interaction is very inadequate. The problems are presented, but solutions are usually not presented. Are we supposed to trust that "adaptive management" will solve all of the problems?

We do not believe that adequate concern has been expressed in the DEIS regarding the totality of effects of this project on the "blue-ribbon" trout fishery above Roza Dam. Evaluation of these effects must be increased, at least biologically and socioeconomically. The numbers given in the DEIS of "angler-trips" in this stretch of the river do not appear to be up-to-date nor large enough.

The DEIS must address the interactive process between newly released or residualized hatchery fish with wild fish of the same species. The DEIS must include specific strategies to avoid harmful consequences for re-building and/or existing wild stocks especially since it is known that introduction of hatchery fish into the wild is stressful to wild fish.

Response: A summary of species interactions information and research is presented in Section 4.1.2.1 of the Revised DEIS. Information presented is based on the best data available at this time.

Specific strategies used to minimize or avoid harmful interactions are part of the basic operational protocol for the project, and will receive considerable review via project monitoring and evaluation. Examples of strategies include, but are not limited to, the following: minimizing the occurrence of residuals, location of acclimation/release sites in areas where overlap with species of concern would be minimized, and production of fish that are not overly aggressive compared with their wild counterparts. These strategies may be accomplished by rearing of fish at low densities, utilization of innovative natural feeding regimes, production of smolts rather than pre-smolts, acclimation and volitional release, and final rearing at locations dispersed widely throughout an area rather than from a single point as done conventionally.

188. **More Results Needed Before Proceeding.** How can you proceed with the project when the species interaction studies are still underway? Results of this research must be considered when the choice of a preferred alternative is made. It would appear to be beneficial that the studies be completed prior to construction of the hatcheries.

Response: Proceeding with the YFP without the apparent safety of all risks being clearly resolved beforehand is consistent with the adaptive management philosophy embraced by the project managers and the Council. Using adaptive management, the managers intend to proceed cautiously, acknowledging and carefully identifying and assessing known risks (biological, economic, and other). Moreover, adaptive management requires extensive monitoring and evaluation of critically uncertain aspects of the project to resolve questions and take appropriate management action when changes need to be made.

Results from the species interactions research have been used in developing the preferred alternative. As additional information becomes available, it will be used to manage risks to trout populations and other species of concern above Roza Dam and elsewhere in the Yakima River basin. (See Section 4.1.2.1 of the Revised DEIS.)

189. **Mitigation for Impacts.** If there are impacts to the trout fishery after this project is implemented, will there be any way to mitigate the impacts or will the trout program be dropped?

Response: Maintaining a quality trout fishery is an important priority for the management entities involved with this project. Consistent with the YFP goals, the managers will use existing management review and regulation procedures to respond to any positive or negative changes in the trout population and its fisheries. See the discussion in section 4.1.9.1 of the RDEIS.

190. **Discussion of Research Results Lacking.** Although species interaction research is underway, little has been included in the DEIS. More information regarding this research should be included in the Final EIS. What are the experimental designs? What are the data collection methods? What has been learned to date? What were the results of the recent steelhead releases in the Teanaway River?

Response: See Section 4.1.2.1 of the Revised DEIS. Also, much new information can be found in the series of annual reports that were cited in the RDEIS (Hindman et al., 1991; McMichael et al., 1992, Pearsons et al., 1993, 1994).

195. Beneficial Impacts. I support the project and believe that trout and salmon would be beneficial to both.

It is implied on page 4.21 that there would be a potential benefit to rainbow trout populations resulting from an increased prey base (naturally produced juvenile steelhead from supplemented populations). The resident trout do not currently feed on juvenile steelhead to any significant degree and there is no indication that the existing food base is inadequate to support current populations. Hence, there would not be any negative effect if that "increased prey base" were not available.

Response: Thank you for your support. It is not clear to what extent food may be limiting for different life history stages of each supplemented species. It is true that there is no evidence to suggest that the existing food supply is inadequate to support current populations. However, there is also no evidence to indicate that increased natural production would not benefit from increased food availability. Steelhead are not currently proposed to be supplemented as part of this program.

182. Interbreeding Between Hatchery Steelhead and Resident Trout. Hatchery-reared steelhead have been shown to residualize at high rates in the species interactions research thus far. A large percentage of these residual hatchery steelhead are sexually mature males capable of spawning with resident trout. With a high degree of overlap in spawning timing and locations, the genetic implications are great. Has research been done on what effects interbreeding between hatchery steelhead and resident trout might have on the resident trout population?

Response: The Revised DEIS does not propose any steelhead supplementation activities at this time. The extent of opportunistic interbreeding between rainbow trout and steelhead is unknown. Studies of this phenomenon are very difficult to conduct, because, aside from the anadromous behavior, there is no way to distinguish between the two life-history forms. There is some promising work being conducted to solve these problems, so serious work on rainbow-steelhead genetic interactions may be possible within a few years.

197. Competition During Spawning. As noted on page 3.22, summer steelhead spawn from late February through mid-May. It is indicated on page 3.24 that "March is the peak spawning time for resident rainbow trout in the Upper Yakima River Basin." Accordingly, there would be direct competition between summer steelhead and resident rainbow trout for optimum spawning areas and increased genetic risk to the trout. These issues are only addressed in the DEIS in the negative (i.e., under the three-stock alternative, these risks would be eliminated) while the potential impact on resident trout are not addressed.

Response: The DEIS has been revised and does not propose any steelhead supplementation activities at this time. Spawning competition occurs naturally in salmonid populations. It is likely that mating between steelhead and resident rainbow trout would occur, since there is no evidence that reproductive isolation would occur if the two forms were spawning in the same area at the same time. However, the extent to which steelhead and rainbow trout might be spatially isolated is currently unclear.

198. Residualism. The DEIS seems to try to justify residualism. For example, page 4.9 states that "Residualism of hatchery steelhead would increase angling opportunities for anglers seeking to harvest trout." Residualism presents many problems, not just some hatchery "trout" to harvest. It could compromise the excellent wild trout fishery as well as remaining wild runs of anadromous fish. The EIS should address specific strategies for handling this problem.

Response: Steelhead are not proposed to be supplemented under the YFP at this time. The YFP does not intend to produce residual steelhead, and operational protocols will reflect strategies to minimize their occurrence. Residualism in hatchery steelhead is a problem common to conventional hatchery programs. It appears to be a highly variable occurrence in time and space, and appears to be strongly related to smolt size thresholds and aspects of smolt quality. The intent of the YFP is to minimize adverse ecological interactions, including those related to residualism. This would be accomplished by applying a wide variety of approaches, such as smolt quality criteria and volitional release strategies (see **Issue # 187**, above). Monitoring and evaluation plans will be used to ascertain whether residualism goals are met.

201. Intraspecific Conflicts. The DEIS has largely ignored the intraspecific (same species) conflict that will be created by the project, particularly between newly released (or residualized) hatchery fish and wild fish of the same species. The hatchery-versus-wild fish behavioral interactions, whether between the fish of same or different species, are almost completely neglected. This is a major oversight of the EIS, and needs to be addressed.

Response: An expanded discussion of intraspecific conflicts is provided in the Revised DEIS (see Section 4.1.2.1). See also **Issue # 187**, above.

202. Behavioral Interactions. The DEIS mentions only three categories of behavioral interaction: competition, predation and altering migratory behavior. A fourth and probably very important adverse category is maladaptive disruptive behavior of hatchery fish. A paper by Robert Bachman (Transactions of the American Fisheries Society, 1984) describes how pointless, aberrant activity by newly-stocked hatchery fish throws the established social system of wild fish into chaos, interfering with feeding and causing abnormally high energy consumption, with resultant increased death rates among both wild and hatchery fish. The EIS should analyze the effects of this disruptive behavior.

Response: The DEIS addressed the general issue of competition, which was intended to encompasses the mechanisms involved in disruptive behavior. Disruptive behavior results from maladaptive social behavior and energetic expense, and can lead to unintended interactions. Disruptive behavior and its relationship to the YFP are discussed further in the Revised DEIS (see Section 4.1.2.1).

204. Restoration of Natural Balance. With respect to interspecific interactions, it is important to point out that the existing composition and abundance of species in the Yakima Basin does not resemble the assemblage that was present prior to development in the Yakima and Columbia basins. This project seeks to restore the natural balance of species that existed in ancestral times.

Response: Rebuilding natural populations of anadromous salmon is a primary goal of the Council's Fish and Wildlife Program. It is not clear to what extent that Program, and the specific objectives of the YFP, would lead to a combination of species similar to what existed previously. The RDEIS includes programs for only two species.

205. Research on Cowiche Creek Lacking. Predation, competition for food and diseases associated with supplementation will extinguish the native trout population and possibly the native steelhead. Page 43 of the Environmental Assessment states that " . . . competition and predation factors will depend on the extent that the carrying capacity of the river is filled with each species." Project research for the South Fork Cowiche Creek is inadequate to proceed with the proposed project.

Response: Since no supplementation activities are proposed for steelhead stocks or Cowiche Creek under the RDEIS alternatives, detailed information on the physical and biological characteristics of Cowiche Creek is not presented, and no plans exist to obtain more specific information at this time.

209. Predation on Wild Fry. The DEIS has not adequately addressed the impacts of predation of wild fry by yearling hatchery fish. It is possible that large releases of hatchery fish may actually eliminate wild fish.

Response: Predation is one of the major categories of species interactions. The potential for predation of yearling hatchery fish on wild fry is a major project concern. Literature review and field studies have been undertaken to assess the risks of this occurrence. Details on field studies in the Yakima River exploring predatory tendencies of yearling hatchery steelhead can be found in the Revised DEIS. Based on the results of these and other studies, it is unlikely that predation by hatchery salmonids on their wild counterparts will eliminate the wild populations. It is anticipated that coho would be the most likely hatchery-produced predator of wild fish. The current Alternative 2 proposal includes a coho predation study.

210. Pied-Piper Effect. The DEIS has not adequately discussed the problems associated with the Pied Piper effect—how the release of large numbers of hatchery fish will prematurely draw wild salmon and steelhead downstream with them. Specific strategies to prevent displacement and premature migration of native fish should be presented.

Response: The risk of migratory alterations due to the Pied-Piper effect exists, but should be moderated by YFP standard rearing methods. Rearing practices would include low-density rearing, acclimation of fish in geographically dispersed areas, and the use of volitional release from the pond sites. These methods should have considerably different impacts on pre-existing populations compared to point-source releases from hatcheries or transport trucks as practiced by conventional hatcheries. The EIS has been revised and now contains additional information regarding these issues (see Section 4.1.2.1). Migration timing of hatchery and wild fish will be monitored to determine whether Pied-Piper effects are occurring.

D03 - WATER FLOWS, RIGHTS AND CLAIMS

213. <u>Additional Storage</u>. Concern that additional water storage will be needed to make this work. Are there plans for additional water storage in the basin? The EIS should include an opinion regarding the need for additional storage.

The EIS (and the Council) should make a statement in support of more impoundment of water for the Yakima watershed. A failure to note this will only increase fears by irrigators that they have no choice but to tie up the hatchery project in litigation. The EIS should assure fishermen that existing fish populations will not be included in your EIS statement when addressing this concern.

This project management should initiate or lead future efforts on water storage or at least coordinate with other agencies who are leading work on water problems.

Response: These issues are outside the scope of this RDEIS. No additional water storage is needed to allow the proposed actions to be carried out. However, BPA is coordinating with the Bureau of Reclamation and other agencies who are working on the water storage issues.

214. <u>Additional Flows</u>. What are the water requirements for this project? Will there be a need for additional water flows or passage improvements to make this project work? What happens if the lower river dries up as it has in the past? The EIS should address the possible increased water necessary to provide habitat for the additional wild salmon.

The DEIS states that a major problem for Yakima fish is maintenance of instream flows. However, the YFP does little, if anything, to solve this most important problem.

The YFP is being sold as "operating with existing instream flow levels and project operations would not impact water rights in the Yakima River Basin." This appears to be a true statement about the operation of the hatchery and the acclimation ponds; however, there are eight references to taking more water for fish in the EIS.

Response: The project is designed to operate within existing instream flow levels. See responses to **Issues # 222** and **223,** below. There are cooperative efforts underway to increase instream flows in the basin. These efforts, however, are not a part of this project. The DEIS statements regarding additional flows do not refer to the "taking of water for fish." These statements are simply substantiating the fact that additional instream flows would be beneficial for anadromous fish in the basin, including those produced as part of YFP.

217. Accountability. Who will be accountable in a water-short year if there isn't enough water for the irrigators because of this project? Will someone be legally accountable?

Response: Irrigation water in the Yakima Basin is distributed by the Bureau of Reclamation. In water-short years, irrigation water is distributed according to relevant court decisions, which includes prorating of some irrigation water supplies. The YFP will not have any legal claim to any consumptive water use, in water-short years or at any other time.

219. Aquifers. Where are the aquifers in this region? Their condition and methods of replenishment? We already know that water tables are going down in some regions (i.e., Moxee) of the basin. What effect will this have on surface water quantities?

Response: Groundwater resources at the project sites are described in Section 3.2.2 of the Revised DEIS. Possible project impacts are summarized in Section 4.1.1.1. The groundwater studies for this project, described in Chapter 3.0, indicate that the required water from wells could be obtained without undue stress on the groundwater system.

220. Flooding. In the fall of 1990, a 100-year flood occurred in parts of the upper YRB and resulted in major damage to facilities in this area. An evaluation of the results and causes would help this project design and illustrate watershed status.

Since the structure will be built in or near the floodplain, construction of facilities must be built to withstand floods and the structures should not affect channel flow capacity.

Response: The proposed project would be compatible with Executive Order 11988, which specifies that Federal agencies must avoid or minimize adverse impacts associated with short-term or long-term modification and occupancy of floodplains. Where fish culture facilities would be located within the designated floodway or 100-year floodplain, certain design restrictions or limitations would apply. County authorities and the Federal Emergency Management Agency would be contacted to ensure that any new construction would not alter floodplain characteristics or channel flow capacity. If facilities were located within the floodplain, they would be designed to withstand flooding. (See Sections 3.2.3 and 4.1.1.1 of the RDEIS.)

222. Impact on Water Allocation/Rights. The issue of instream flows needed for returning salmon has not been adequately addressed. Although the facilities may be water-neutral, the DEIS has failed to deal with impact of returning fish, both in the mainstem and tributaries. The large number of returning fish and fish straying into non-target streams will result in an increased demand for water that is currently used for irrigation. If fish from the hatchery are going to be taking more water in the future, then a supply should be provided for before the project is started. We ask that you establish and publish a policy to protect property rights from this impact.

Who will decide if it will be the fish or farmer who gets the water in a water-short year? What process will be used to make sure there will be no negative impacts on the existing water users or the existing water rights caused by returning salmon? This needs to be dealt with in the Final EIS or the water supply issue needs to addressed.

I would support the continuation of your supplementation process if the following conditions are met prior to implementation. The public must be informed what sequence of events is likely to occur when supplementation fish stray into tributaries where they were not intended to go. The process by which the State governments and the Yakama Indian Nation would secure flows for fish must be made clear in the beginning to avoid unnecessary misunderstanding of the way agencies and tribes can secure more water for fish. This should also include the implications of the inevitable listing of stocks of steelhead and salmon within the Yakima Basin as threatened or endangered.

The issue of water allocations needs more discussion in the EIS. There have recently been major new Federal laws regarding water allocation in California. What effects will they have on the Northwest? Who has jurisdiction now? Who will have it ten years from now? Who gets priority?

If BPA does not have authority to mitigate these future fishery water impacts, the appropriate entity to solve such water requirements must be named and charged with that responsibility in the Final EIS.
We support the "No Action Alternative" for these reasons: 1) BPA's fisheries project will take water rights and interfere with the Acquavella water rights adjudication; 2) water for BPA project can only be provided by additional storage or appropriation of irrigation water; and 3) BPA's fisheries project will result in the need for additional water resources for fish.

We request that BPA work with our Yakima project to assure the Final EIS presents a thorough analyses and a resulting structure that can respond to conflicting demands on the available water resources within the Yakima Project. The Final EIS should provide a more detailed presentation of the existing water management system, its constraints, and how it may potentially conflict with the supplementation project. Hopefully, it can also propose a process for jointly resolving any conflicts that may exist.

The DEIS does not recognize that the increased numbers of salmon in the Yakima River and its tributaries will lead to calls for more water for instream uses. The Kittitas County Irrigators Association believes the Final EIS should deal with this problem in two parts:

> 1) Only allow fish migration into streams designated in the present EIS that will support anadromous fish and have had corrective measures completed. For future streams that will be designated, the EIS must support a program to mitigate the impact of enhanced fish stocks on the culture and customs of the associated community.
>
> 2) Efforts must be undertaken to provide increased water supplies for the main stem of the Yakima with the waters to be used for incubation flows, flushing flows and water quality enhancement. These increased supplies should come from increased storage capacity, allowing capture of previous water lost to untimely or excessive winter or spring runoffs.

Rational water conservation measures such as re-regulation reservoirs and canal lining can also play a role.

Response: Water rights in the Yakima River Basin, including rights for instream flows, are the subject of a general stream adjudication commenced by the State of Washington in 1977. The adjudication process is the means by which any instream flow rights would be established in the basin. BPA is not a participant in the adjudication process, and project facilities would not affect the adjudication process in any way. Furthermore, project facilities are designed to operate under current or future water management practices. The adjudication process will proceed totally independent of the YFP.

The Pacific Northwest Electric Power Planning and Conservation Act of 1980 (Section 10 [h]) states:

> "Nothing in this Act shall be construed as authorizing the appropriation of water by Federal, State, or local agency, Indian Tribe, or any other entity or individual. Nor shall any provision of the Act or any plan or program adopted pursuant to the Act (1) affect the rights or jurisdictions of the United States, the States, Indian Tribes, or other entities over waters of any river or stream or over any groundwater resource, (2) alter, amend, repeal, interpret, modify, or be in conflict with any interstate compact made by the States, or (3) otherwise be construed to alter or establish the respective rights of States, the United States, Indian Tribes, or any person with respect to any water or water-related right."

Section 1501(5) of the Council's 1987 Fish and Wildlife Program, in consideration of the language of the Act, states that "Nothing in this program will : . . . (5) Alter or establish the respective rights of the United States, states, Indian Tribes, or any person with respect to any water or water-related right." Projected returns of all Yakima River salmonid stocks would increase significantly with improved instream flows. Nevertheless, project operations scenarios assume current instream flow regimes.

The United States has filed a claim for instream flows on behalf of the YIN Treaty-reserved water rights in the adjudication process. This claim includes the Yakima River and all tributaries. The claim for Treaty-reserved instream flows does not depend on current use by anadromous fish.

In November 1990, Judge Walter Stauffacher issued an Amended Partial Summary Judgement that defined the Treaty-reserved instream flow rights as "The maximum scope of the diminished treaty water right for fish is the specific 'minimum instream flow' necessary to maintain anadromous fish life in the river, according to the annual prevailing conditions as they occur . . . ." However, the court did not quantify specific instream flow levels. BPA does not participate, in any manner, in the setting of instream flows pursuant to the court's ruling.

The Partial Summary Judgement was appealed to the Washington State Supreme Court. On April 22, 1993, the State Supreme Court upheld Judge Stauffacher's Partial Summary Judgement. It is not yet known whether this decision will be appealed to the U.S. Supreme Court.

In summary, the Yakima Basin water adjudication process has been in progress since 1977 and is currently ongoing. The outcome and timing of the adjudication as it moves through the judicial process will not be affected, one way or the other, by the YFP. We have revised the EIS to help clarify these water right issues. See Sections 3.9.2 and 4.1.1.1.

223. <u>Water Neutral Concept</u>. To coin a new phrase such as "water neutral" means nothing in the matter of the adjudication. If this project, and any of its related activities, including the out-planting of fish at any stage, is to have no impact, the court adjudicating the water rights must be approached and certification given to it by each level of government (the Governor, the Secretaries of Interior and Commerce) that no water or land right will be affected in any way. We are surprised that the Department of Ecology has not asked for this action before these hearings are held.

Response: As noted in the response to **Issue # 222**, above, this project will not have any impact on the adjudication of water rights in the Yakima Basin. The adjudication of water rights will continue with or without this project, including those associated with instream flows.

224. <u>Straying Fish</u>. The impact stray fish will have on small tributaries of the Yakima River is a major concern. The stray fish provide an excellent opportunity for a State Department to "take" total control of the small streams. Maybe it would be possible to screen the mouths of the smaller tributaries so as not to unduly burden streams with multiple water users.

There are some Yakima tributaries with no salmon, and no plans for salmon propagation there, such as the Ahtanum. Suppose salmon are found in those streams, will water right holders be pressured or forced to provide water for the "accidentally" stocked salmon streams?

The fact that there has been no guarantee that fish straying into creeks where they historically didn't exist will be treated as lost fish, I'm not in favor of the hatchery project at this time.

Fish must only be allowed in the tributaries designated in the Final EIS. Any additional waterways that could be designated should have a complete study reported in the Final EIS. Cost of screens and other enhancements should be weighed against potential benefits.

Response: Salmon and steelhead historically spawned and reared in all rivers and streams in the Yakima Basin. Fish in any Yakima Basin stream are subject to the protection and regulation of the laws in effect at that time. Current laws dealing with fisheries and habitat protection are briefly discussed in Section 3.9.2 of the Revised DEIS. BPA does not regulate fisheries or fisheries habitat in any manner. Those regulations will remain in force with or without this project.

233. **Compensation.** BPA should provide funding to pay for losses of property values, income, irrigation water, stock water and land use. We oppose BPA's proposals for this project unless BPA provides compensation to private individuals for losses caused by the proposed project.

Response: BPA pays fair market value for any land rights it acquires.

D04 - THREATENED AND ENDANGERED SPECIES

240. **Potential for ESA Listings.** The Endangered Species Act (ESA) has no provision for "experiments" of this kind, however laudable, to be able to hold harmless those who by your activities or actions of others connected to this project, acquire an endangered species or threatened species upon their property in its "habitat area." Before proceeding you need to tell private property owners, Federal and State lessees, and other levels of government, just how you plan to conduct this experiment outside the requirement of the ESA without confiscating private land and water by the presence of a salmon in the same manner government confiscated land and timber by the presence of a spotted owl.

Supplementation cannot circumvent the biological data triggering the need to list a "species" under the ESA. The Yakima proposal may contribute to the need for listing species under the ESA.

Most efforts to increase weak salmon populations through hatchery production have had an adverse effect on the naturally spawning stocks. Adverse effects are caused by the taking of members of the natural population for broodstock. This both reduces the number of natural spawners and also affects the genetic makeup of the stock. As a result, the Yakima Project may lead to the listing of one or more of the existing Yakima River salmon populations under the ESA. Worse, it may cause the extinction of such populations.

Response: At present, the Yakima River Basin does not contain any anadromous species listed as endangered or threatened under the ESA. Should any Yakima Basin species be listed under the Endangered Species Act, BPA and project managers will comply with all legal requirements.

It is correct that supplementation cannot circumvent the biological data triggering the need to list a "species" under the ESA. To date, however, supplementation has not been shown to decrease anadromous fish populations within the Columbia River Basin. Therefore, BPA and its cooperating governments and agencies will identify and manage any risks to the existing anadromous fish populations as a result of this project. It is also important to note that YFP will operate under the principles of "adaptive management." Should supplementation increase risks to the basin's anadromous fish populations, the managing authorities will evaluate these risks in light of the overall benefits generated by the project. If the project risks outweigh the benefits, steps will be taken to eliminate those risks.

There is the chance that the YFP could lead to increase natural production of depressed stocks while avoiding adverse genetic impacts (the definition of success for the project). If so, it might contribute to the efforts to reduce the likelihood of future ESA listings.

243. **Bald Eagle Impacts.** We cannot concur with Bonneville's finding of "no effect" to the bald eagle, because the potential impact of site specific and cumulative construction activities has not been fully evaluated.

It is likely that the benefits to bald eagles, in terms of increased fish and carcass abundance, are likely to outweigh any effects of acclimation sites located within the bald eagle winter range (Summary p. viii, para. 4).

The bald eagle utilizes much of the Yakima Basin as winter range. It is expected that the eagles will tolerate some disturbance during construction but that no impact other than temporary dislocation will occur. In the long run, the increased prey base will be beneficial for wintering bald eagles.

Response: Bald eagles tend to use the Yakima River primarily during winter and usually disperse from wintering areas by late March. Surveys conducted during 1992 (January-March) for wintering eagles confirmed the presence of a resident winter population. Proposed construction and operation of project facilities should not affect wintering bald eagles; however, removal of overstory trees used for perching and roosting could have an impact. Bald eagle nesting has not been reported previously for any of the proposed acclimation pond or hatchery facility sites, and surveys conducted in May 1993 for nesting eagles confirmed this.
It is expected that the eagles will tolerate some disturbance during construction, but also that no impact other than temporary dislocation will occur. In the long run, the increased food base would be beneficial for wintering bald eagles. The overall goal, to increase smolt survival and thus numbers of adults returning to the Yakima River system, would provide a long-term benefit of increasing anadromous fish stocks for bald eagle foraging. See also **Issue # 294.**

244. **Snake River Salmon.** Increased hatchery production in the Columbia Basin, such as the proposed action, may have a deleterious effect on the listed species of Snake River salmon due to interactions among the outmigrating juveniles and increased harvest in the mixed-stock fishery. Apparently no consultations have taken place between BPA and the National Marine Fisheries Service regarding this proposal, either to meet the requirements of NEPA or Section 7 of the Endangered Species Act. The DEIS should be revised to include the results of such consultations.

Response: Informal consultation with the NMFS was initiated in December 1992 regarding project effects on listed Snake River chinook salmon. NMFS issues included potential interactions between YFP fish and listed Snake River salmon in the Columbia River corridor (competition, disease transmission, and predation), the potential of returning YFP fish to stray into the Snake River basin, and the potential for taking listed adult Snake River salmon while collecting broodstock for this project. This informal consultation is still underway, but will be completed prior to the Final EIS. (See Sections 3.4.2 and 4.1.6.1.)

245. **Other ESA-Listed Species.** Bonneville has not made effect determinations for other listed species or critical habitat that may occur in the project vicinity. In accordance with Section 7(c) of the Endangered Species Act, Bonneville must prepare a biological assessment to evaluate potential project impacts to listed species (i.e., northern spotted owl, gray wolf and grizzly bear) and critical habitat and determine whether listed species or critical habitat may be affected by the proposed action. If Bonneville determines that listed species or designated critical habitat may be affected, consultation with the U.S. Fish and Wildlife Service should be requested.

Response: A Draft Biological Assessment addressing potential impacts on spotted owls, gray wolf, grizzly bear, and bald eagles will be submitted to the USFWS for the action alternatives (Alternatives 1 and 2). Included within the Attachments to its Draft Biological Assessment are consultations with the U.S. Forest Service (USFS), the WDFW, the Washington State Department of Natural Resources Natural Heritage Database, and the USFWS. The Draft Biological Assessment was prepared in consultation with local area resource managers from the Cle Elum and Naches districts of the USFS and the Yakima office of WDFW.

D05 - DISEASE

248. **Disease Transmittal.** What studies show that diseases aren't transmitted from hatchery fish to wild fish and where can copies be obtained? Would like to see details regarding possible disease transmittal from hatchery fish to the resident trout.

Response: The DEIS has been modified to include additional information concerning disease transfer possibilities (see Section 4.1.2.1). A recent literature review by Miller et al. (1990) found that, in spite of the comparatively high incidence of disease among hatchery stocks, there is little evidence that diseases or parasites are routinely transmitted from hatchery to wild fish. Wild fish seldom exist in the high densities necessary for culture. They also feed on living insects and other aquatic organisms, as opposed to processed fish feeds. These factors result in less stress and increased resistance to disease. There are no absolutes in the biological sciences, but risks can be minimized with modern fish husbandry practices.

249. **Stock Transfers.** No stock transfer should be made until all risks of transfer of diseases has been eliminated.

Response: The project will use only indigenous Yakima River salmonids to supplement the existing natural populations. While coho that would be studied under Alternative 2 are imported from outside the basin, the importing of coho is not funded by BPA and is not proposed to be funded under this project at this time. All transfers would be consistent with the *Policies and Procedures for Columbia Basin Anadromous Salmonid Hatcheries* (IHOT, 1994) The coho are screened for pathogens and diseases by the Fish Health Section of the Oregon Department of Fish and Wildlife.

250. **More Nonsupplemented Streams Needed.** Wouldn't it be better to leave some streams alone (i.e., no supplementation), so that if you get a disease problem in a the central hatchery, you don't spread it throughout the Yakima Basin?

Response: The issue of disease transfers is addressed in **Issue # 248** above and in the Revised DEIS (see Section 4.1.2.1). It should be noted that many tributaries are not targeted for supplementation.

D06 - WATER QUALITY

256. **Impacts on Returning Adults.** How will poor water quality conditions and high water temperatures in the lower Yakima River affect returning adult fish? What is the impact of the silt barrier at the mouth of the Yakima River? Are any of these problems being addressed?

Response: Poor water quality conditions and high water temperatures in the lower Yakima River do affect returning adult salmon as well as outmigrating smolts during the summer months. The natural runoff conditions (good vs. poor water years) also affect the water quantity and quality in the lower basin. In good water years adequate conditions for survival extend later into the spring than in bad years. Most of the returning adult spring chinook migrate through the lower Yakima before water conditions limit survival. Steelhead adults do not enter the lower Yakima River until water conditions improve after the main part of the irrigation season has ended in early September. It is expected that adult coho would also return to the Yakima in the fall after the end of the irrigation season when water conditions have improved.

Water quality parameters, including temperature, are currently being evaluated under other programs to determine potential adverse impacts on adult migration and juvenile passage and possible improvement strategies. WDOE has just announced a study of the potential sources of pollution in the lower river that hopefully will lead to programs to improve conditions.

258. **Impacts of Decaying Salmon.** How will water quality be affected by the thousands of returning salmon that will die and decay in the streams?

Possible species interaction scenarios may include a change in growth or condition of resident fish through a change in their diet. The DEIS should expand on the positive benefits which could come from the effect of carcasses in the system such as replenishment of deficient minor elements which wash out of the watershed and can only be replaced by the fish returning from the ocean.

Response: Salmon carcasses will provide essential nutrients that may become incorporated into the food chain. Dead and dying salmon may provide food for upper-level carnivores as well. For example, raptors (i.e., hawks and eagles) and mammals such as coyotes may use salmon carcasses as an important food source during the spawning season. Thus, the overall productivity of the Yakima River and surrounding terrestrial ecosystem would be enhanced by the presence of returning adult salmon.

Decaying salmon carcasses have been reported as an important source of soluble and organic phosphorus, and nitrogen in Alaska streams (reviewed in Foerster, 1968). Spawned-out sockeye salmon may provide a major input of phosphorus and nitrogen to some aquatic ecosystems. However, the size of the sockeye salmon run in these systems is much higher than that estimated for the YFP (e.g., >500,000 returning sockeye adults in the Alaska studies versus about 10,000 adult salmonids present in the Yakima system today). Additionally, nutrient budgets are easier to estimate for a lentic system (lake) than for a lotic system (river) like the Yakima where nutrients would likely be flushed from the system and diluted over time.

262. <u>Cle Elum Water Supply</u>. The hatchery is proposed to be 0.5 miles above the city of Cle Elum's water intake. Will this have any impact on the city's water supply?

Response: The hatchery discharge point for the Cle Elum central facility has been moved downstream, as shown in the Revised DEIS. Hatchery effluent from the Cle Elum central facility will be treated to comply with Washington State Department of Ecology standards for receiving waters. These standards are designed to protect both aquatic life and human health. Thus, drinking water supplies in the Yakima River downstream of the discharge point will not be affected under normal hatchery operations. The hatchery effluent will also be diluted several-fold by the Yakima River during average flow conditions (i.e., under maximum use, hatchery effluent represents only 6 percent of the total river flow). Under current practices, the river water is also treated by the City of Cle Elum prior to domestic use. This further reduces the risk that hatchery effluent will adversely affect downstream drinking water supplies.

266. <u>Hatchery Wastes and Chemicals.</u> What chemicals will be used in the acclimation ponds and could they pose a threat to the aquatic environment?

The DEIS does not adequately consider the impact of its hatchery wastes and other chemicals (e.g., formalin, antibiotics, disinfectants) in regard to possible pollution of streams. Will the number of rearing sites affect water quality at any point? The Final EIS should evaluate these impacts.

The impact statement obfuscates impacts from the use of large quantities of formalin by stating on page 4.38 that "Because the formalin is expected to be used up by the facility during operations, the facility is not expected to be a dangerous waste generator." The important impact to be analyzed is not disposal of waste formalin, but the actual impacts from the use of the formalin. What are the impacts to fish and aquatic resources as hundreds of pounds of formalin are "used up." The DEIS fails to report how much formalin will be "used up" at each facility. What is the cumulative effect of adding formalin to the already contaminated water?

Response: The use of chemicals for fish culture purposes is severely limited by the FDA. Projections of the amount of a limited list of chemicals to be used are made before hatchery construction and are part of the permit application process to the Washington Department of Ecology. The hatchery operator is then required to monitor effluent water and provide routine reports to DOE. In the case of the YFP, the expected use of chemicals is described in the project's draft operations manual.

Formalin and other chemicals used at the facilities will be disposed of according to State and Federal regulations. Formalin is sometimes diluted and used to treat certain fish diseases and is administered at low concentrations within holding vessels. Hatchery water that contains formalin will be disposed in accordance with EPA and Washington State Department of Ecology regulations for receiving waters. No adverse impacts on water quality are anticipated by hatchery practices involving chemical treatment. A water quality monitoring program is being developed as a condition of the NPDES permit to evaluate hatchery effluents and to ensure that water quality standards are not exceeded during YFP operations.

273. Water Quality Discussions Inadequate. Water quality discussion in the DEIS requires major expansion of content and scope. Watershed management throughout the basin needs more attention, particularly riparian enhancement plans and enforcement of environmental regulations.

Response: The U.S. Geological Survey (USGS) recently completed an extensive assessment of the historic water quality in Yakima River Basin (Rinella et al. 1991). Information gathered from this study and studies by the U.S. Bureau of Reclamation was used to assess the current and historic water quality conditions in the basin. More recently, Pacific Northwest Laboratory has been conducting water quality investigations and gathering temperature data as a follow-up to the YFP preliminary design work. A report by the USGS that assessed pesticide and trace organic compounds from 1987-91 was also distributed in late 1992. Information from these recently completed studies has been incorporated into the Revised DEIS.

Resources managers involved with the YFP promote sound land use practices designed to protect riparian habitats. Other groups are also involved with watershed characterization and water quality assessment in the Yakima River Basin. For example, the Yakima Valley Conference of Governments has been developing a basin-wide water quality plan for the Yakima Basin. This effort is coordinated with the U.S. Environmental Protection Agency and the Washington State Department of Ecology.

274. Waste Treatment. Although tens of thousands of pounds of food will be purchased for hatchery operations (p. 4.28), treatment of fish waste is not discussed. Cumulative nutrient enrichment will exceed standards for several facilities listed in Table 4.2. Can impacts from fish waste be mitigated with treatment? Have costs associated with fish waste treatment been added to the proposal?

Response: The possible impacts on surface water quality are presented in Section 4.1.1.1 of the Revised DEIS. The analyses conducted for this EIS indicate that hatchery effluents under either alternative would not adversely affect the aquatic ecosystem as a result of increased nutrient loading. The facilities will be designed to meet all of the requirements of the Department of Ecology's latest regulations on discharges from hatcheries. National Pollutant Discharge Elimination System (NPDES) permits will be acquired from Ecology for all facilities. Best management practices will be used to minimize the impact of facilities operation on water quality.

D07 - FISH HARVESTS

277. Expected Harvest Regime. What is the expected harvest regime of the fish produced by this project (e.g., sport, commercial, tribal)? Are there any harvest plans or agreements for these fish (i.e., high-seas fisheries, off-shore fisheries, in-shore fisheries, river commercial fisheries, etc.)?

The EIS must address the issues of hydro-power fisheries intercept, Columbia River net fisheries, high seas net intercept, various offshore/ocean fisheries intercept and the escapement levels of spawning fish returning to the spawning ground.

Response: Comments regarding the expected harvest regime are outside the scope of this EIS, as BPA has no harvest regulatory authority. The YFP is designed to operate within the constraints of existing harvest management regimes. It should be noted that harvest plans for ocean and lower river fisheries do not specifically address Yakima River stocks. They are, however, based on the need to protect weak stocks in those fisheries. Fisheries in the mainstem Columbia River are regulated according to the CRFMP—an agreement among Oregon, Washington and the treaty Indian tribes under *U.S. v. Oregon*. This agreement also recognizes the need for protection of weak stocks and directs the allocation of harvest within the mainstem. The State and tribal fisheries managers are committed to the goal of conducting fisheries management so as to conserve the existing genetic resources of the Yakima Basin and meet the experimental needs of the project. Additional details regarding harvest management can be found in Section 3.9.1 and Appendix D of the Revised DEIS.

280. Conservative Harvest Approach. Would like to see a conservative harvest approach on the sport fisheries until the fish runs rebuild.

Care must be taken in the early years of this project to insure that harvest opportunities do not adversely affect either the test of the supplementation concept or the status of wild stocks. It must be clear from the onset that this is not to be a hatchery production project.

Response: The recommendation for a conservative harvest approach is noted, but is outside the scope of the EIS.

281. Off-Shore Interceptions. Is there any evidence that these fish will be intercepted off the west coast of Canada and what impact could this have on the project?

Discussion of spring chinook harvest should be expanded to include discussion of potential harvest outside the basin and the Columbia River. Canadian and Alaskan harvest of these stocks must be recognized and accounted for in the plan.

Response: These comments regarding off-shore interceptions are noted, but are generally outside the scope of this EIS. The Council and BPA have no fishery management authority and can not mandate fishery regulations. The Canadian and Alaskan fisheries will have a limited impact on coho and spring chinook. The United States, through recent negotiations with Canada, is attempting to lower the harvest ceiling on chinook and coho in the Canadian waters. These negotiations are still underway, and the impact of them on the YFP is uncertain at this time.

Spring chinook have received substantial protection from fisheries within the Columbia Basin. Commercial fisheries targeting upriver spring chinook have been closed since 1977 and 1963, respectively. Recreational harvest has also been severely restricted on the upriver runs. Limited tribal ceremonial and subsistence harvest have been permitted in the mainstem Columbia and in the Yakima River. The impact of these fisheries has been considered in the evaluation of the potential for success of the project.

282. Off-Shore Drift Nets. The off-shore drift net fisheries could affect this project? What efforts are underway to make sure this project will work?

Response: This comment is also outside the scope of the EIS. The effect of the off-shore drift net fisheries on the salmon and steelhead resources of the Pacific Coast has remained a serious concern of fishery managers for a number of years. Their actual impact on specific stocks, however, is not known. The Federal government has taken steps to control these fisheries in ocean areas where our coastal anadromous stocks feed.

285. Mixed-Stock Harvest Impacts. The EIS does not explain how nontarget subpopulations are to be protected from overharvest should harvest goals of the project be realized. No matter which project alternative is pursued (3-stock, 5-stock or 7-stock alternative), the potential for overharvest of unsupplemented stocks will exist. Neither the EIS nor any of the project background documents presents a detailed assessment of the problem, or a plan for dealing with mixed-stock harvest within or outside the Yakima Basin. No evidence has yet been presented that the mixed-stock harvest problem can be effectively addressed. If BPA has a theoretical answer to this problem, what is the evidence that the agencies responsible for harvest management can and will carry out the plan?

The EIS also fails to detail the timing and location of present and past mixed-stock fisheries, and to advance specific proposals to shift the harvest focus from mixed stocks to marked hatchery-produced stocks. The EIS should establish the feasibility of mixed-stock management measures which can meet the challenges posed by the YFP. No part of the YFP should be implemented without the demonstrated ability to protect unsupplemented or unenhanced stocks from overharvest and possible extinction.

Response: The issue of mixed stock fisheries has received significant attention for more than a decade. The Council highlighted the need to reduce impacts from mixed stock fisheries in Section 500 of their first Columbia River Basin Fish and Wildlife Program (NPPC, 1982). The impact of mixed stock fisheries outside the Yakima Basin on Yakima stocks is associated with international fisheries managed under the U.S./Canada Treaty, the U.S. coastal fisheries managed by the Pacific Fishery Management Council, and mainstem Columbia River fisheries managed under the Columbia River Fish Management Plan. Each of these has potential to impact fish stocks originating in the Yakima Basin. However, their management is beyond the purview of the Yakima Fisheries Project and none of the fisheries or harvest opportunities is expected to be significantly influenced by the moderate level of supplementation proposed for the Yakima Basin.

The managers reviewed the alternatives presented in the first DEIS and determined that the 3-, 5- and 7-stock alternatives are no longer appropriate (see Section 2.6.2 of RDEIS). Only upper Yakima spring chinook would be supplemented under the current preferred alternative (the potential for coho salmon supplementation would be evaluated using smolts currently imported into the basin under the U.S. v. Oregon fish management plan). The potential for mixed stock harvest impacts between supplemented upper Yakima spring chinook and unsupplemented Naches and American River spring chinook can be managed through "status indexed" fisheries or selective fisheries. The managers have described harvest objectives to be consistent with project genetic, natural production, and experimentation objectives (Table 2.2, RDEIS). Analysis of harvest and natural production responses is premised on "status indexed" and selective access to hatchery adults from supplemented stock (see Section 2.3.1, RDEIS). It must be understood that the Project has no regulatory discretion to directly manage in-river or intercepting fisheries. The managers have, however, captured their intent to foster the needs of the project in appropriate regulatory forums through a Memorandum of Understanding, part of the Project Management structure.

D08 - WILDLIFE AND OTHER ECOLOGICAL RESOURCES

294. Ospreys. Ospreys are significant predators on Yakima rainbow and they are not mentioned at all. No study of the impact on fish predator species has been started yet. Hatchery operations are attractive nuisances for all measure of mammals and birds. There needs to be plans to deal with conflicts. These plans for managing predators need to be spelled out.

Response: Osprey are designated as a State monitor species by the WDFW. The WDFW, the USFWS, and the Washington Department of Natural Resources Natural Heritage Database were consulted regarding the distribution of unique wildlife resources, including osprey, in relation to specific locations of each of the proposed project features. Two territorial ospreys occur in the vicinity of the proposed Cle Elum project features. Although osprey do consume rainbow trout, birds consume a variety of other fish species present in the Yakima River, including whitefish, yellow perch, suckers, carp and squawfish. Increased numbers of anadromous salmonids resulting from the YFP may reduce the potential for osprey to prey on the resident rainbow trout that occur in the system. The hatchery and acclimation facilities will employ predator deterrents such as overhead wires, netting, and other devices.

295. Wetlands. The proposed Cle Elum facilities will be in a riparian/wetland site unique to this portion of the Yakima Basin. How do planners propose to mitigate the loss and disturbance of this site?

The DEIS states a variety of wetlands have been identified in the vicinity of the proposed facility and acclimation pond sites. Table 3.4 shows that roughly two-thirds of the thirty sites have wetlands in the vicinity. The Final EIS should address the potential impacts of this type of development on the wildlife (e.g., birds, deer, small mammals) that utilize these areas. Mitigation for these impacts should be discussed.

Response: The proposed sites have all received a preliminary review for wetlands. Wetland habitat was found near several proposed sites. However, facility construction and operations would be planned to avoid impact on wetland areas. Additional surveys would be coordinated with all appropriate State and Federal entities on each site before construction begins. Information from wetland delineation surveys would be used during final design to develop mitigation measures, if necessary, and to ensure that the project would result in no net loss to wetlands. Issues relating to wetlands mitigation and wildlife are discussed in greater detail in the Revised DEIS (see Sections 3.2.3, 4.1.1.1, and 4.1.5.1).

297. Squawfish Removal. Why can't there be a northern squawfish removal program on the Lower Yakima for 1993? We have a lot of young people and lower-income families in the Yakima Valley who could use a $3 per fish boost. This looks like the lowest overhead, and fastest response time solution to the fish loss problem.

Response: An evaluation of the squawfish removal program on the Columbia River mainstem is currently underway. If the program proves to be successful, it could be extended to subbasins such as the Yakima. These efforts, however, are being conducted independent of the YFP. See also **Issue # 184** above.

300. Wildlife. The discussion of potential impacts to wildlife is inadequate. The DEIS does not provide actual baseline data. In addition, the discussion of site degradation due to human activity does not provide necessary information to assess overall site integrity (time of year impacts occur, magnitude of impacts).

Response: The DEIS has been modified to include additional information concerning possible wildlife impacts (see Sections 3.4.1 and 4.1.5.1). The WDFW, the USFWS, and the Washington Department of Natural Resources Natural Heritage Database were consulted regarding the distribution of unique wildlife resources, including State and Federal threatened, endangered, and sensitive species. Baseline information for these unique wildlife species has been gathered through consultation with local biologists from the USFS and the WDFW, and by conducting independent field surveys. Limitations on timing and areal extent of construction disturbance are discussed relative to species-specific habitat requirements (e.g., spotted owls, marbled murrelets) within the Draft Biological Assessment that was prepared for this project.

Most proposed acclimation pond and hatchery facility sites are located within developed, disturbed, or previously disturbed (e.g., timber harvest access) areas. The sites are accessible by primary, secondary, or oil/gravel surfaces traveled by local residents, area resource managers, and recreationists (e.g., off road vehicle users, equestrians). Construction disturbance from increased traffic and habitat conversion should temporarily displace local wildlife species.

D09 - SOCIOECONOMIC RESOURCES

302. <u>Economic Impacts</u>. Previous economic studies of this project have only looked at economic benefits, not the possible negative impacts that could occur. The EIS should examine the possible economic impacts, in particular, the economic impacts associated with the potential loss of water rights.

BPA should make a socioeconomic study of the basin and State in relation to the project.

Response: A new economic analysis has been conducted to show the associated costs and potential economic impacts of the different project alternatives (see Section 4.1.8). The economic impacts associated with the potential loss of water rights were not analyzed because the project will not cause increased demands for instream flows, nor will it cause water rights to be taken from irrigators (see response to **Issue # 222** above and Section 4.1.1.1 of the Revised DEIS). A socioeconomic study of the entire State of Washington in relation to this project is beyond the scope of this EIS.

303. <u>Fishing-Related Impacts</u>. The EIS should look at the possible economic impacts to the resident trout fishery and economic impacts associated with additional salmon and steelhead anglers.

Response: These impacts are addressed in the revised socioeconomic analysis - see Section 4.1.8 of the RDEIS.

306. <u>Study Period</u>. Why are economic benefits only assessed for a 25-year period (Summary p. viii, para. 6)? Are there no benefits beyond 25 years?

Response: Economic impacts in the revised study were assessed for a period of 15 years, which includes 4 years of construction activities and an additional 11 years of operation and maintenance activities. This does not mean that economic impacts will not occur beyond the project's maturity date in 2010. Some economic impacts would continue as long as the project continued to fulfill its intended purpose.

308. Benefit-Cost Analysis. The project should only be implemented if fishery benefits are quantifiable and sufficient to outweigh costs of the project and associated impacts. There are governmental guidelines available to evaluate fishery and associated recreation and commercial values, yet there is no evidence that this type of such an analysis has been conducted. Copies of existing economic analyses would be appreciated.

The cost-benefit analysis in the DEIS is flawed. The DEIS appears to misstate the project costs. Updated numbers should be provided and costs and benefits should be expressed in terms of dollars per returning adult. The cost-benefit analysis is also inadequate because it fails to acknowledge expressly that the analysis does not attempt to take into account the costs of environmental impacts and does not include the full opportunity costs of the project, which include natural production lost due to inadequate funding for habitat improvements, etc.

Response: There is no requirement that the project be justified based on a benefit-cost analysis. More detailed cost data for this project was previously published as Appendix D of the Yakima/Klickitat Production Project Preliminary Design Report (BPA 1990). The cost estimates in the DEIS came directly from the design documentation and are the most recent cost estimates available. Opportunity costs of the project are not factored in because these potential costs are not part of the construction and operation costs considered under the different project alternatives.

D10 - RECREATIONAL RESOURCES (OTHER THAN FISHING)

309. Elk Hunting. There are many elk that now graze in the Cle Elum area of the proposed hatchery site. Is that area going to be closed down to hunting once the hatchery is built?

Response: Due to the unique wetland and terrestrial habitats at the Cle Elum central hatchery site, it is expected that more than 200 hectares (500 acres) will be purchased, of which only 4 to 6 hectares (10 to 15 acres) will actually contain hatchery facilities. A wildlife management plan, and recreation and access plan will be developed for the remainder of the land. These plans are in the preliminary stages and there has been no formal public input as yet, although there have been discussions with the City of Cle Elum. At this time, we do not expect that hunting would be an appropriate activity for the site.

D11 - INSTREAM AND RIPARIAN HABITAT

312. Inventory of Critical Habitat. The project, as currently designed, is dependent on successful completion of instream to ocean and back life cycles. These life cycles are dependent on adequate habitats for the long term. Considering the scope and expense of this project, detailed knowledge of instream and near stream habitat is essential. Have you begun to identify and inventory critical habitat components, not just in the stream, but in the adjacent terrestrial environs? Where is a hard copy of this research? If you haven't, what is your plan to identify and inventory critical habitat components? If you have a plan, does it look beyond the banks of the Yakima and its tributaries?

Response: Basic information on certain characteristics of the Yakima River subbasin and its aquatic and terrestrial resources is available and can be accessed through existing sources (e.g., Northwest Environmental Database; Timber, Fish and Wildlife Yakima Basin Resource Management Plan). However, compilation of an extensive inventory of detailed aquatic and terrestrial habitat information has not been developed as part of this project. The YFP planners have identified the need to develop such an inventory to identify and address specific critical factors limiting natural production. Although beneficial, it should be emphasized that such an inventory is not essential in order to evaluate supplementation success, which is a major component of the project's purpose and need. However, resolving limiting factors may be important to achieve sustainable increases in natural production over the long term.

316. Habitat Quality. The DEIS (p. 4.23) states that existing habitat can support much higher levels of natural production. Have you documented those levels in the ground? The DEIS further states that "increased returns of anadromous fish would likely result in more careful management of water resources and habitat quality." What is the habitat quality currently? What have you done to interact with one of the lead agencies in control of habitat quality—the counties?

Response: The potential for existing habitat to support increased production of anadromous fish has been field-tested only minimally. Studies of species interactions in the Yakima Basin above Roza Dam provide some information. Other field activities conducted by the YIN and the USFWS provide additional support. The quality of existing habitat has been judged to be highly variable by fisheries professionals working in the basin. BPA project managers and the State of Washington participate in a continuing dialogue with representatives in Kittitas and Yakima counties regarding environmental issues.

318. Carrying Capacity. Has the current carrying capacity of the Yakima Basin been considered in the proposed numbers of smolts to release? There currently appears to be a few very restrictive environmental conditions in the basin that may be limiting natural production to their current levels. If such conditions persist, then it is ludicrous to assume that releasing millions of smolts into the system will in any way increase natural production. Flow management in the upper Yakima Basin will undeniably affect the potential to rear juvenile fish for one to three years prior to the seaward migration. The project's answer that there is enough water to return (for adults) during spring, and that there is enough water to migrate out (for smolts), leaves the entire remainder of the natural production life cycle (summer and winter rearing) unaccounted for. I would support the continuation of your supplementation process if the following conditions are met prior to implementation. Carrying capacity will be more accurately determined prior to arriving at figures for hatchery releases. Field data will be used to predict the capacity of a subbasin to sustain year round salmonid production and those figures will drive the policy decisions. If it is determined that a system may currently be at carrying capacity (due to some environmental bottleneck such as no summer flow) then no supplementation fish will be released there. No fish will be released until this is complete.

Response: Carrying capacity for Yakima Basin stocks has been considered in modeling analyses, which involve development of natural production and harvest objectives. Smolt release numbers involve considerations for experimental design needs, as well as natural production objectives. Revised natural production objectives are included in the RDEIS. (See also **Issues # 27 and 28,** above.)

323. Impact on Habitat Funds. The DEIS fails to discuss the impact that funding the project could have on the availability of funds for other projects that might produce long-term benefits, such as habitat protection and enhancement.

Response: Your comment is noted; however, this issue is outside the scope of this EIS. It should be emphasized, however, that long-term benefits are also expected from the YFP.

324. Passage Problems. Can supplementation succeed if all passage problems are not corrected? Have all diversions of surface water in the Yakima Basin been effectively screened to protect fish? If not, why not? Have all passage bottlenecks been removed from the migratory path of fish to be produced by this project?

Response: An extensive screening program has been underway in the Yakima Basin over the past decade. When completed in the near future, this effort will have essentially screened all important surface water diversions to aid fish passage. Any remaining passage problems in the Yakima or Columbia rivers are not viewed a significant constraint to the project's success. Columbia River passage problems are being addressed under the Snake River Salmon Recovery Plan.

E - OTHER ISSUES AND CONCERNS

328. Management Outside the Basin. What control do you have over the other factors impacting the fish runs, such as commercial gill nets, drift nets and high water temperatures? We can't solve the problems by just producing more fish.

We support the Bonneville efforts to enhance existing stocks of anadromous fish in the Yakima River Basin, and to reintroduce stocks formerly in the Basin. But we must also urge the BPA, Northwest Power Council, Yakima Indian Nation and all other parties that the problems of passage impediments, habitat loss and harvest pressures must also be solved if the fish stocks are to be sustainable in future years. A healthy main stem of the Columbia is essential for fish recovery.

Response: Several commentors expressed concern for the many forces and conditions outside the Yakima Basin that could influence the project results. The project *is* subject to external forces, such as intercepting fisheries, water quality problems, passage problems, and the entire range of obstacles typically encountered by all migrating salmonids in the Columbia River Basin. Clearly, fish stocks in the Yakima Basin should benefit from any improvements made throughout their range. **However, the Yakima Basin was chosen for this project because its location provides one of the best opportunities for success of a project of this type.** Managing entities involved with this project are also involved in the regional efforts to resolve fishery-related issues, whether it is downstream passage problems posed by mainstem dams, in-basin habitat problems, or harvest issues.

339. <u>Use of the Term "Hatchery."</u> Use of term "hatchery" to distinguish YFP production from naturally spawning fish is awkward, since the project is designed specifically to avoid such differentiation. A less-pejorative term, such as "supplementation fish" should be used.

The proposed action is a fish hatchery, yet the words "fish hatchery" appear nowhere in the impact statement title or the abstract. Either the word "fish hatchery" should be included in the title and the general description of this project, or coho salmon and chinook salmon production for harvest should be dropped.

Response: The Revised DEIS reflects concerns over the use of the term "hatchery." Generally, "hatchery" has been used to refer to past practices with the basin and the region that fit the usual connotations of a traditional hatchery program. The term also refers to the facilities necessary for the initial broodstock holding, egg incubation and hatching, and initial fry/fingerling rearing prior to transfer to the acclimation/final release sites. The "fish hatchery" elements of YFP are just part of the tools needed to meet the project's goals. As such, they have been included in the general project description.

344. <u>Mainstem Passage and Survival.</u> The EIS lacks sufficient detail on how to reduce heavy losses of downstream migrants after smolts leave the Yakima River. BPA is one of the agencies with jurisdiction over mainstem Columbia River projects which have for years and still continue to kill a high percentage of outmigrating smolts every year. Correction of those problems is critical to success of the YFP and should precede any large projects such as this. BPA's evaluation of this interconnection should be discussed in more detail in the Final EIS.

Response: Issues such as losses of downstream migrants in the Columbia River are being dealt with in other environmental forums such as the System Operations Review, the Operating Plan and associated biological opinions, and the Snake River Salmon Recovery Plan.

Appendix B: 1995 Planning Status Report Volume 3
Yakima Spring Chinook Salmon

Yakima/Klickitat Fisheries Project
Planning Status Report 1995

Volume 3: Yakima Spring Chinook Salmon

May 1995

Prepared for
Bonneville Power Administration
Portland, Oregon

Preface

This is Volume 3 of the eight-volume 1995 Planning Status Report for the Yakima/Klickitat Fisheries Project. It contains an introduction detailing background information, project philosophy, and document organization, followed by specific information on Yakima spring chinook salmon. A general summary of project planning for all target species may be found in Volume 1. Detailed information for species other than Yakima spring chinook salmon may be found in the accompanying volumes:

Volume 2: Yakima Fall Chinook Salmon

Volume 4: Yakima Summer Chinook Salmon

Volume 5: Yakima Coho Salmon

Volume 6: Yakima Summer Steelhead

Volume 7: Klickitat Spring Chinook Salmon

Volume 8: Klickitat Summer Steelhead

NOTE: SPACES HAVE BEEN RESERVED FOR TABLES AND FIGURES THROUGHOUT THE DOCUMENT. THESE REFER PRIMARILY TO PROJECT PLANNING PROCESSES AND WILL BE INCLUDED WITH THE FINAL ENVIRONMENTAL IMPACT STATEMENT

Summary

The long-term YKFP goal for Yakima spring chinook salmon is to supplement and enhance the three identified stocks and associated habitat within the Yakima River Basin, while preserving stock characteristics, adaptability, and fitness. Yakima spring chinook salmon stocks include the Naches stock, upper Yakima stock, and the American River stock. The Upper Yakima stock will be the first to be supplemented. If supplementation is successful, the Naches stock will be included, followed by the American River stock.

Essential elements of the Yakima spring chinook salmon program are captured in the objectives and strategies **(Table S.1)**. More detailed statements are expected for the next iteration of the Planning Status Report.

These strategies are based on assumptions of varying degrees of uncertainty: accepted, resolvable, and unresolvable. Risks associated with accepted and unresolvable uncertainties are managed through risk-containment monitoring. Resolvable uncertainties are slated for resolution through uncertainty-resolution taskwork scheduled in the URP. Uncertainty resolution is an iterative process that is managed through the application of adaptive management.

Experimentation with spring chinook salmon in the YKFP supplementation facilities will initially compare two experimental treatments (detailed discussion of treatments is found in Chap. 8):

- Treatment A is an Optimal Conventional Treatment (OCT) that incubates, rears, and acclimates spring chinook salmon using optimal conventional fish-culture methods derived from artificial propagation experiences within the Columbia River Basin.

- Treatment B is a New Innovative Treatment (NIT) that incubates, rears, and acclimates spring chinook salmon using natural-like environments (e.g., natural cover, substrate, in-water structures) to produce fish that mimic attributes of naturally produced spring chinook salmon.

A third treatment, the Limited New Innovative Treatment (LNIT), that uses the OCT during the incubation to rearing phase and uses the NIT during other portions of the acclimation to release phase has been described for later implementation.

Supplementation and investigation of Yakima spring chinook salmon will require permanent and temporary facilities/structures to implement the program that is currently considered. Facilities are currently being planned and include those for supplementation, broodstock collection, and monitoring.

Monitoring for the project will encompass five levels: quality control, product specification, research (treatment effectiveness testing, comparison of hatchery vs. natural fish, patient-template analysis), risk containment, and monitoring of stock status. A detailed Monitoring Plan for Yakima spring chinook is found in Chapter 9.

Table S.1. Objectives and Associated Strategies: Yakima Spring Chinook Salmon

Objectives	Strategies
Genetic	
Manage genetic risks (extinction, loss of within- and between-population variability, and domestication selection) to all stocks from management of the fishery.	Segregate identified stocks by selecting broodstock whose origin can be reasonably well determined and release hatchery-reared progeny only in ancestral drainages. Use for broodstock only fish that are not first-generation hatchery fish. Operate the supplementation facilities using appropriate mating procedures, naturalized environments, and experimental numbers to reduce the possibility of extinction, loss of within- and between-population variability, and domestication selection. Use less than 50% of the natural-origin returning adult escapement from each stock for broodstock purposes. Manage the proportion of natural- and hatchery-origin adults allowed to spawn naturally.
Conserve upper Yakima and Naches stocks of spring chinook salmon.	Segregate identified stocks by selecting broodstock whose origin can be reasonably well determined and release hatchery-reared progeny only in ancestral drainages. Collect, identify, and segregate spring chinook salmon by stock through spawning, rearing, and release.
Conserve the American River stock of spring chinook salmon.	Collect, identify, and segregate spring chinook salmon by stock through spawning, rearing, and release. Develop and apply methods to maximize the likelihood that only American River-origin fish enter and spawn in the American River.

Objectives	Strategies
Natural Production	
Optimize natural production of spring chinook salmon with respect to abundance and distribution.	Improve the physical, biological, and chemical environment on a priority basis. Use harvest controls and supplementation to optimize natural spawning distribution (temporal and spatial). Release 810 thousand acclimated smolts into the Upper Yakima Basin.
Optimize natural production of spring chinook salmon while managing adverse impacts from interactions between and within species and stocks.	Improve the physical, biological, and chemical environment on a priority basis. Use harvest controls and supplementation to optimize natural spawning distribution (temporal and spatial). Release 810 thousand acclimated smolts into the UpperYakima Basin.
Maintain the upper Yakima chinook natural production at a level that would contribute an annual average of 3,000 fish to the Yakima Basin adult returns.	Improve the physical, biological, and chemical environment on a priority basis. Use harvest controls and supplementation to optimize natural spawning distribution (temporal and spatial). Release 810 thousand acclimated smolts into the Upper Yakima Basin.
Natural escapement of Upper Yakima spring chinook (hatchery and wild) averages 2000 adult returns and is consistently greater than 1700 spawners per year.	Improve the physical, biological, and chemical environment on a priority basis. Use harvest controls and supplementation to optimize natural spawning distribution (temporal and spatial). Release 810 thousand acclimated smolts into the Upper Yakima Basin.

Table S.1. Yakima Spring Chinook Salmon Objectives and Associated Strategies (continued)

Objectives	Strategies
Experimentation	
Learn to use supplementation as defined by the Regional Assessment of Supplementation Project (RASP 1991) to increase natural production of upper Yakima and Naches spring chinook salmon and increase harvest opportunities.	Conduct experiments using upper Yakima and Naches stocks to evaluate the risks and benefits of supplementation as defined by the Regional Assessment of Supplementation Project (RASP 1991). Design and conduct experiments using upper Yakima and Naches stocks to compare risks and benefits of a New Innovative Treatment against an Optimal Conventional Treatment for supplementation. The New Innovative Treatment will use methods that result in fish which mimic natural fish. The Optimal Conventional Treatment will use methods that result in fish raised according to the state-of-the-art hatchery definition of quality. Conduct an experiment using the upper Yakima stock to test whether it is sufficient to apply the New Innovative Treatment during a limited portion of the final rearing phase (acclimation). Collect Naches broodstock near or downstream from the spawning grounds. Collect upper Yakima broodstock at Roza Dam. Release six groups of 75,000 fish per group of the Naches stock into the Naches River. Release 18 groups of 45,000 fish per group of the upper Yakima stock into the upper Yakima River. Release experimental groups of fish from separate acclimation ponds connected to target streams. Design experiments to detect a 50% or greater difference (with 90% certainty) between test treatments for all response variables.

Table S.1. Yakima Spring Chinook Salmon Objectives and Associated Strategies (continued)

Objectives	Strategies
Harvest	
Increase harvest opportunities for all fishers to 5,400 upper Yakima spring chinook (hatchery and wild) consistent with the requirements of genetic, natural production, and experimentation objectives.	Use selective and/or "status-index harvest" policies to increase harvest opportunities for all fishers.

Glossary

This glossary contains a list of abbreviations and acronyms, technical terms, and species' common and scientific names used in Volume 3 of the YKFP Planning Status Report. Words that would be defined in a desk-size dictionary (for example, the College Edition of the American Heritage Dictionary) are not included. Technical terms are defined as they are used in this report and may differ from uses in other fields.

Abbreviations and Acronyms

BKD	bacterial kidney disease
BPA	Bonneville Power Administration
Council	Pacific Northwest Electric Power and Conservation Planning Council
DOE	U.S. Department of Energy
EIS	environmental impact statement
GHGs	Genetic Hatchery Guidelines
IHN	infectious hematopoietic necrosis
NEPA	National Environmental Policy Act
PAG	Policy Advisory Group
PAR	Project Annual Review
PSR	Planning Status Report
RASP	Regional Assessment of Supplementation Project
RM	river mile
URP	Uncertainty Resolution Plan
USBR	U.S. Bureau of Reclamation
WDFW	Washington Department of Fish and Wildlife
YIN	Confederated Tribes and Bands of the Yakama Indian Nation
YKFP	Yakima/Klickitat Fisheries Project

Technical Terms

Acclimation stage in rearing, preceeding release, intended to condition fish to the ambient environment

Ancestral drainages subbasin where parents spawned

Electrophoretic data genetic data derived through the process of electrophoresis

Fry early juvenile stage in salmonids

Genetic risk risk of affecting genetic characteristics in such a way as to decrease the long-term productivity of a population. It encompasses four types:

Extinction risk of losing a population altogether. Once a population is extinct, all its genetic material is irretrievably lost.

Loss of within-population variability reduction in genetic variability within a population as a result of low, effective population size, which can lead to inbreeding depression and genetic drift.

Loss of between-population variability reduction in gene differences between populations as a result of excessive gene flow, which can lead to outbreeding depression.

Domestication selection nonrandom change in genetic composition of a population as a result of anthropogenic selective forces, intended or not. The two main sources of domestication selection imposed by hatcheries are nonrandom selection of broodstock and the selective force of the hatchery.

Jacks male fish that are sexually mature at an early age, 1 year earlier than the earliest maturing females

Juvenile sexually immature fish

Limited New Innovative Treatment (LNIT) a treatment applied to spring chinook salmon that uses the OCT during the incubation to rearing phase and uses the NIT during other portions of the acclimation to release phase.

Locally adapted stock a stock or population of fish that, although perhaps not native to the stream, is capable of sustaining some level of natural or artificial production

Natural production spawning and rearing of wild or non-first-generation hatchery fish in the environment outside the hatchery.

New Innovative Treatment (NIT) a treatment that incubates, rears, and acclimates spring chinook salmon using natural-like environments (e.g., natural cover, substrate, in-water structure) to produce fish that mimic attributes of naturally produced spring chinook salmon.

Glossary

Nontarget species species not intended for supplementation

Optimal Conventional Treatment (OCT) A treatment that incubates, rears, and acclimates salmonids using optimal conventional fish-culture methods derived from artificial propagation experiences within the Columbia River Basin.

Presmolt fish that have not begun the physiological process of readying themselves for saltwater entry

Preterminal harvest fish caught along their migration route before reaching their subbasin of origin, compared with terminal harvest which occurs in that subbasin

Race a subspecific designation indicating the season during which adult salmonids return to the subbasin (e.g., spring, summer, fall chinook salmon)

Raceways vessels designed to rear fish

Redd a number of adjacent nests (streambed depressions) into which salmon eggs are deposited by one female

Run(s) used interchangeably with "race" in this report

Salmonids trout, salmon, and other fish of the family Salmonidae

Smolt anadromous salmonid that is physiologically fit for saltwater entry and is migrating seaward

Smolt:adult survival ability of a fish to survive from the time it leaves the subbasin as a smolt until the time it returns to the subbasin as an adult

Smolt:smolt survival ability of a fish to survive from the time it becomes a smolt until the time it leaves the subbasin

Smoltification process by which an anadromous fish becomes physiologically fit for saltwater entry

"Status-index harvest" harvest policy that determines the rate of harvest on the basis of the strength of all run components

Steelhead sea-run rainbow trout

Stock a population of salmonids managed as a unit for supplementation purposes

Supplementation artificial propagation in an attempt to maintain or increase natural production while maintaining long-term fitness of the target population and while keeping ecological and genetic impacts on nontarget species within specified limits.

Target species a species intended for supplementation or production

Wild fish indigenous fish that have never been in a hatchery system

Common and Scientific Names

Coho salmon *Oncorhynchus kisutch*
Chinook salmon *Oncorhynchus tshawytscha*
Rainbow trout/Steelhead *Oncorhynchus mykiss*

Contents

Figures

Tables

1.0 Introduction

The Yakima/Klickitat Fisheries Project (YKFP) is a supplementation project designed to use artificial propagation in an attempt to maintain or increase natural production while maintaining long-term fitness of the target population and keeping ecological and genetic impacts to nontarget species within specified limits. The project is also designed to provide harvest opportunities. The planning, implementation, and evaluation of this project are guided by the framework developed by the Regional Assessment of Supplementation Project (RASP 1991). The purposes of the YKFP are to:

- enhance existing stocks of anadromous fish in the Yakima and Klickitat river basins while maintaining genetic resources,
- reintroduce stocks formerly present in the basins, and
- apply knowledge gained through supplementation throughout the Columbia River Basin,

all consistent with the fish and wildlife program of the Pacific Northwest Electric Power and Conservation Planning Council (BPA 1992).

Essentially, the YKFP is an experiment designed to resolve uncertainties (through uncertainty-resolution taskwork) associated with supplementation at the same time that it accomplishes construction and implementation milestones. As a "laboratory," the YKFP would help determine the role of supplementation in increasing natural production of anadromous salmonids.

Adaptive Management Process

The YKFP endorses an adaptive management policy, which expects objectives and strategies to change as new information becomes available (explained by Walters 1986). The PSR is an integral part of the YKFP adaptive management process, which revolves around three annual milestones:

completion of an updated long-range plan, the **Planning Status Report (PSR)**, by February of each year

completion of an updated long-range plan to resolve uncertainties, the **Uncertainty Resolution Plan (URP)**, by April of each year

peer review of work completed and in progress, the **Project Annual Review (PAR)**, during November of each year.

The PSR is intended to contain a complete and precise description of the YKFP long-range plan. It identifies objectives, strategies, and assumptions with justifications documented and changes and modifications recorded. Objectives and strategies are changed through an amendment process, typically in response to new information about the validity of assumptions.

Underlying assumptions form the rationale for the choice of strategies. The PSR identifies those assumptions that are accepted on the basis of their validity and applicability as established in the scientific literature or through peer-reviewed studies within the YKFP or elsewhere. Assumptions that are uncertain (those that lack documented justification) are classified as either resolvable or unresolvable. Those that are resolvable are scheduled for resolution through the URP.

The description of objectives and strategies is iterative in the sense that, as the project moves forward and as different phases of the project approach implementation, more detail is added. Strategies intended for implementation during the coming year are described in more detail than those planned for later implementation. Future strategies, however, are of detail sufficient to provide clear and focused direction for project planning and uncertainty resolution. Consequently, the level of detail varies throughout the PSR.

Results of uncertainty-resolution work are reported in memoranda and annual project, completion and progress reports, all of which are summarized in the PAR. All underlying assumptions in the PSR are then reviewed and reclassified, and new assumptions added. Implications of these revisions on the strategies and objectives are assessed, along with risks and benefits, and amendment proposals submitted for policy review.

While justification for objective and strategy modifications may include technical judgment and policy preference, all changes in uncertainty levels of assumptions must be based on scientific evidence, hence the importance of peer review. Conclusions from the PAR about the progress of ongoing work and the revised uncertainties from the PSR are then used to amend the URP, and thus the adaptive management cycle continues (Figure 1.1).

In planning for the following year, strategies (implementation or experimental) are considered on the basis of the validity of their underlying assumptions (i.e., likelihood of meeting the stated objectives). Strategies are implemented only when the risk of failure is within acceptable limits. This risk is managed and reduced over time through implementation of the URP (i.e., the prior removal of uncertainties) and the Monitoring Plan (Chapter 9). In other words, risk of strategy failure (i.e., where objectives cannot be met and/or strategies cannot be implemented correctly) can be reduced through (1) pre-implementation research or (2) risk-containment monitoring during implementation. The "Risk Analysis" (Chapter 7) is intended to aid in the selection of strategies for implementation.

Figure 1.1. Planning Cycle for the Yakima/Klickitat Fisheries Project

Document Overview

In this volume, the PSR discusses the status of project planning for Yakima spring chinook salmon. The specific plans:

1 present background information,

2 describe objectives, i.e., statements of what is to be accomplished in the genetics, natural production, experimentation, and harvest components,

3 delineate strategies that should accomplish these objectives and the assumptions on which these strategies are based,

4 outline how uncertainties inherent in each assumption will be managed,

5 explain experiments designed to test supplementation for a specific stock,

6 present the risk analysis conducted to define management implications,

7 describe facilities for broodstock collection, hatcheries, rearing, and acclimation,

8 discuss monitoring needs, and

9 cite supporting statements and documents.

2.0 Background

The historical spawning areas for Yakima spring chinook salmon include the Yakima River upstream of the city of Ellensburg, the Naches River, the Cle Elum River (upstream and downstream of Lake Cle Elum), the Tieton River (north and south forks), Rattlesnake Creek, and the Bumping, Little Naches, and American rivers (Figure 2.1). Other areas that may have been important are the Cooper, Wapatus, and Teanaway rivers and Taneum, Swauk, Manastash, Wenas, Cowiche, Ahtanum (plus tributaries), and Logy creeks.

Run sizes for spring chinook salmon were 12,000 to 15,000 fish before 1960 but less than 3500 in 1984. The biological characteristics of native spring chinook salmon populations in the Yakima River Basin are thought to have changed during the past few decades.

Causes for Decline

About 90% of the Yakima spring chinook salmon fishery was lost between 1850 and 1900. The in-basin causes of this decline include (Davidson 1953):

1 construction of unladdered dams (especially Pomona Dam around 1880 and Sunnyside Dam in 1893) that completely blocked adult migration during part of their run

2 entrainment of fry and smolts in unscreened diversion canals (few of which were screened before 1934)

3 periodic destruction of spawning beds by driving logs downriver on large volumes of water suddenly released from dams, as evidenced at Pomona

4 indiscriminate and intensive local fishing

5 elimination of braids and natural floodways by diking and channelization projects

6 drastic reduction in the number of beavers and beaver ponds, and the resultant loss of natural water storage and rearing habitat.

Yakima River Basin escapements were reduced to perilously low levels; e.g., the estimated mean escapement in the decade of the 1970s was 384 fish.

Present Stock Status

Spring chinook salmon currently spawn in the Yakima River upstream of the city of Ellensburg and downstream of Roza Dam; in the Cle Elum River downstream of Lake Cle Elum; and in the mainstem Naches, Bumping, Little Naches, and American rivers and Rattlesnake Creek.

Background

Figure 2.1. Historical Distribution of Yakima Spring Chinook Salmon

Adult spring chinook salmon begin migrating upstream past Prosser Dam in late April and have completed passage by late July. American River populations of Spring chinook salmon begin spawning in the American River in late July and the other Naches populations about 4 weeks later. Upper Yakima River populations spawn in early- to mid-September and usually peak by late-September. American River and Naches populations reach peak spawning by mid-August and mid-September, respectively. All spring chinook salmon populations have completed spawning by mid-October.

Yakima River spring chinook salmon have the most thoroughly examined stock structure of the YKFP target species. Major spawning aggregations have been genetically sampled. To a great extent the current stock structure agrees with that summarized in Howell et al. (1985). Based on differences in electrophoretic data, age composition, and observations of spawning timing between 1989 and 1990, the Naches system and upper Yakima River support clearly separate stocks (Busack et al. 1991; Fast 1990). The most significant differences between recent findings and previous descriptions is that American River stock is apparently not as distinct as once thought and the lower Naches stock is not genetically intermediate between the American River and upper Yakima stocks. In fact, electrophoretic data show the 1989 and 1990 American River samples differ significantly, and the 1990 American River samples are more similar to the Bumping River samples than 1989 American River samples, indicating there may be gene flow between the Bumping and American river populations in some years.

Constraints to Action

Spring chinook salmon production in the Yakima River Basin is limited by suboptimal instream flows, passage around irrigation diversions, degraded riparian and instream habitat, and excessive temperatures. Low instream flows while reservoirs are refilled (approximately mid-October through early July) may be the single greatest constraint to natural production of spring chinook salmon in the Yakima River.

3.0 Project Objectives

The YKFP objectives for Yakima spring chinook salmon are statements of planned accomplishments relative to genetics, natural production, experimentation, and harvest.

Genetic Objectives

1 Manage genetic risks (extinction, loss of within- and between-population variability, and domestication selection) to all stocks from management of the fishery.

2 Conserve upper Yakima and Naches stocks of spring chinook salmon.

3 Conserve American River stock of spring chinook salmon.

Natural Production Objectives

The Preliminary Design Report (BPA 1990) states a quantified natural production objective is to "increase the adult production potential by about 65% to 70% above the current level." The current natural production objectives for Yakima spring chinook salmon are to:

1 Optimize natural production of spring chinook salmon with respect to abundance and distribution.

2 Optimize natural production of spring chinook salmon while managing adverse impacts from interactions between and within species and stocks.

3 Maintain upper Yakima spring chinook natural production at a level that would contribute an annaul average of 3,000 fish to the Yakima Basin adult return.

4 Maintain natural escapement of upper Yakima spring chinook (hatchery and wild) at an average of 2000 adult returns and consistently greater than 1700 spawners per year.

Experimentation Objectives

1 Learn to use supplementation as defined by the Regional Assessment of Supplementation Project (RASP 1991) to increase natural production of upper Yakima and Naches spring chinook salmon and increase harvest opportunities.

Harvest Objectives

1 Increase harvest opportunities for all fishers to 5400 upper Yakima spring chinook (hatchery and wild) consistent with the requirements of genetic, natural production, and experimentation objectives.

4.0 Strategies

The YKFP strategies are statements of action(s) intended to achieve specific objectives. These strategies have been developed on the basis of current knowledge; they are provided in detail sufficient to allow the planning of facilities, operations, and experimentation to proceed in a focused manner. Planned actions relate to genetics, natural production, experimentation, and harvest components. Each strategy relates to at least one project objective.

Strategies to Meet Genetic Objectives

The genetic strategies listed below will be further detailed as the Genetic Hatchery Guidelines (GHGs) are prepared (the first draft was scheduled for completion by spring 1993).

1 Collect, identify, and segregate spring chinook salmon by stock through spawning, rearing, and release. This strategy relates to Genetic Objectives 2 and 3.

2 Segregate identified stocks by selecting broodstock whose origin can be reasonably well determined and release hatchery-reared progeny only in ancestral drainages. This strategy relates to Genetic Objectives 1 and 2.

3 Use for broodstock only fish that are not first-generation hatchery fish. This strategy relates to Genetic Objective 1.

4 Operate the supplementation facilities using appropriate mating procedures, naturalized environments, and experimental numbers to reduce the possibility of extinction, loss of within-population variability, loss of between-population variability, and domestication selection. This strategy relates to Genetic Objective 1.

5 Develop and apply methods to maximize the likelihood that only American River-origin fish enter and spawn in the American River. This strategy relates to Genetic Objective 3.

6 Use less than 50% of the natural-origin returning adult escapement from each stock for broodstock purposes. This strategy relates to Genetic Objective 1.

7. Manage the proportion of natural- and hatchery- origin adults allowed to spawn naturally. This strategy relates to genetic objective 1.

Strategies to Meet Natural Production Objectives

1 Improve the physical, biological, and chemical environment on a priority basis. This strategy relates to Natural Production Objectives 1 through 4.

2 Use harvest controls and supplementation to optimize natural spawning distribution (temporal and spatial). This strategy relates to Natural Production Objectives 1 through 4.

3 Release 810 thousand acclimated smolts into the Upper Yakima Basin. This strategy relates to Natural Production Objectives 1 through 4.

Strategies to Meet Experimentation Objectives

These experimentation strategies all relate to Experimentation Objective 1:

1 Conduct experiments using upper Yakima and Naches stocks to evaluate the risks and benefits of supplementation as defined by the Regional Assessment of Supplementation Project (RASP 1991).

2 Design and conduct experiments using upper Yakima and Naches stocks to compare risks and benefits of a New Innovative Treatment (NIT) against an Optimal Conventional Treatment (OCT) for supplementation. The New Innovative Treatment will use methods that result in fish which mimic natural fish. The Optimal Conventional Treatment will use methods that result in fish raised according to the state-of-the-art hatchery definition of quality.

3 Conduct an experiment using the upper Yakima stock to test whether it is sufficient to apply the Limited New Innovative Treatment (LNIT) during a portion of the final rearing phase (acclimation).

4 Collect Naches broodstock near or downstream from the spawning grounds.

5 Collect upper Yakima broodstock at Roza Dam.

6 Release six groups of 75,000 fish per group of the Naches stock into the Naches River.

7 Release 18 groups of 45,000 fish per group of the upper Yakima stock into the upper Yakima River.

8 Release experimental groups of fish from separate acclimation ponds connected to target streams.

9 Design experiments to detect a 50% or greater difference (with 90% certainty) between test treatments for all response variables.

Strategies to Meet Harvest Objectives

1 Use selective and/or "status-index harvest" policies to increase harvest opportunities for all fishers. This strategy relates to Harvest Objective 1.

5.0 Management of Assumptions and Uncertainties

The project assumptions are intended to be complete sets of significant suppositions or statements of conditions or perceptions that affect the choice of strategies and how these strategies are to achieve specified objectives. Assumptions relate to the genetics, natural production, experimentation, and harvest components. Each assumption relates to at least one strategy.

Any statement of an assumption includes some degree of uncertainty; e.g., a strategy may not be definitely achievable within a planned time-frame, or for a given quantity or frequency of occurrence. The implication of errors in these assumptions is important. The wrong strategy could result in serious damage to a species/stock in the Basin or the fruitless expenditure of monies. To successfully implement the objective-related strategies stated in the previous section, the uncertainties must be resolved and all associated risk must be monitored. Within the context of the YKFP, uncertainty resolution is achieved through the application of adaptive management (Walters 1986) wherein planning, implementation, and evaluation are steps in an iterative process that, over time, reduces uncertainties and risk. The manner in which an uncertainty is resolved depends on its particular place in the uncertainty-resolution structure (Figure 5.1).

Figure 5.1. Resolution of Uncertainties Within the Yakima/Klickitat Fisheries Project

Management of Accepted Assumptions

Some assumptions related to the management of Yakima spring chinook salmon are accepted on the basis of existing knowledge and information, pending documentation (Table 5.1). Each of these is deemed unlikely to be wrong and/or to have more than a minor impact on the success of strategies selected to meet stated objectives. The accumulated risk associated with potential errors in these assumptions is managed through monitoring. New information gradually allows resolvable uncertainties to be moved into this accepted category. The assumptions in Table 5.1 are currently lacking complete documentation.

Management of Critically Uncertain Assumptions

Unresolvable Uncertainties

Some critical uncertainties are not expected to be resolved as part of the YKFP supplementation experiment or other research efforts (Table 5.2). For most of them, resolution is not feasible, and all extend beyond the scope of the YKFP. The risks that any of these assumptions is wrong are managed through monitoring (Figure 5.1). While these uncertainties cannot be resolved, the health and condition of the fish population can be monitored, e.g., for signs of unexpected change. On the basis of new information and other evidence, strategies can be reevaluated.

Resolvable Uncertainties

Four methods can be used to manage those critical uncertainties that can be resolved: by (1) reviewing the scientific literature to determine how others have resolved or managed them; (2) conducting small-scale studies (i.e., short-term laboratory or field experiments), feasibility studies, and baseline studies; (3) learning from studies or experiments conducted outside of the YKFP; and (4) using large-scale multitreatment studies for which the YKFP is designed.

Uncertainties that may be resolved (Table 5.3) are a high priority in the near term, because they affect the ability to implement the YKFP. Thus, careful assignment of priority and execution of work are critical to resolving the short-term questions. Plans for literature searches, small-scale studies, and review of studies done outside the Yakima River Basin are the thrust of the Uncertainty Resolution Plan. Table 5.4 lists the assumptions that will be resolved by specific experiments and hypotheses to be tested once the YKFP is operational.

It is important to note that large-scale studies constitute the main experimental purpose of the YKFP, which offers a unique opportunity to test hypotheses intractable to small-scale studies. In the long-term, the program and its facilities are designed to meet these needs. While the outcomes of small-scale studies can modify details of the large-scale experiments (e.g., incubation facilities design, rearing container design, acclimation pond design, feeding methods, and fish marking methods), these short-term results are not expected to fundamentally change the experiment, but rather help ensure its success. The purpose of small-scale studies and facility planning is to "set up" the large-scale experiments. Consequently, it is important to define the experimental design for spring chinook salmon in detail sufficient to make the planning focused and efficient.

Table 5.1.
Accepted Assumptions Related to Management of Yakima Spring Chinook

Assumption	Strategy Relationship
180 Only releases prescribed by the YKFP will occur.	Genetic Strategies 1 & 2
339 Up to 50% of the adults returning to the upper Yakima and Naches can be taken initially for brookstock without significantly impacting the effective size of the population.	Genetic Strategies 1 & 2
181 Habitat either is available or can be made available in the Yakima River Basin that can be effectively utilized by expanded populations of spring chinook salmon.	Natural Production Strategy 1
182 Smolt:adult mortality related to mainstem passage, pre-terminal harvest, and ocean conditions will be less than or equal to those at present, and are understood well enough to refine strategies.	Natural Production Strategies 1 & 2
183 The natural production potential in the Yakima River Basin is known for spring chinook salmon.	Natural Production Strategies 1 & 2
184 Supplementation can be managed to avoid unintended ecological effects.	Natural Production Strategies 1 & 2
326 Baseline spawning escapements, representing current conditions, for the Upper Yakima, Naches, and American spring chinook stocks are 2260, 830, and 470 (jacks not included).	Natural Production Strategies 2 & 3
329 Yakima spring chinook will be managed to achieve the following on a priority basis: (1) minimum natural spawning escapements, (2) supplementation broodstock, and (3) harvest and spawning escapements above the minimum.	Natural Production Strategies 2 & 3 Experimental Strategy 7
331 Fisheries can and will be managed to achieve stock-specific spawning escapement, broodstock, and harvest objectives in accordance with assumed priorities.	Natural Production Strategies 2 & 3 Harvest Strategy 1
332 Selective harvest of hatchery fish can and will occur to achieve natural spawning and harvest objectives.	Natural Production Strategies 2 & 3 Genetic Strategy 2
338 Prespawning and egg-to-smolt survival in the artificial environment will exceed 80% and 75%, respectively.	Natural Production Strategy 3

185 Supplementation is an appropriate strategy because natural production is limited by smolt:smolt and smolt:adult survival.	Natural Production Strategy 1
186 Release numbers and locations in Experimentation Strategies 6 and 7 are consistent with natural production objectives.	Experimentation Strategies 1 & 2
187 Experimentation fish can be released in a manner that does not confound the results of the experiment comparing hatchery and rearing methods.	Experimental Strategies 2 & 3
188 All harvesting of Yakima spring chinook salmon can be monitored through catch sampling and reporting.	Harvest Strategy 1
189 "Status-index harvest" policy is described in sufficient detail to allow effective implementation.	Harvest Strategy 1
190 Fisheries in the basin can be managed and regulated, and laws enforced to ensure implementation of the harvest strategy.	Harvest Strategy 1
191 Spawner recruit or stock productivity relationships can be developed to establish appropriate harvest rates for each stock component.	Harvest Strategy 1

Table 5.2.
Unresolvable Uncertainties Related to Management of Yakima Spring Chinook

Assumption	Strategy Relationship
192 Upper Yakima, Naches, and American River stocks are the only remaining historical populations; they are all of locally adapted origin and/or locally adapted.	Genetic Strategies 2 & 3
193 Selecting broodstock from naturally produced returns will reduce the possibility of extinction, loss of within-population variability, loss of between-population variability, and domestication selection.	Genetic Strategies 1 & 2
194 The impact of sports fishery on spring chinook salmon smolts can be evaluated by stock and/or release group.	Experimentation Strategies 1, 2, & 8

Table 5.3.
Resolvable Uncertainties Related to Management of Yakima Spring Chinook That Can Be Studied in the **Near Term**

Assumption	Strategy Relationship
3 Facilities and operations afford the ability to segregate by stock from collection through release.	Genetic Strategies 1& 2
4 First-generation and other-generation fish can be identified by stock.	Genetic Strategies 1 & 2
1 Naches stock (including Bumping River) can be identified, described, and collected.	Genetic Strategies 1 & 2
2 Upper Yakima stock can be identified, described, and collected.	Genetic Strategies 1 & 2
5 The American River stock can be effectively identified/ described.	Genetic Strategy 5
6 American River stock can be identified and selected for natural spawning in the American River without handling stocks.	Genetic Strategy 5
7 A broodstock collection protocol can be developed to accomplish collection consistent with minimum genetic risks.	Genetic Strategy 4
8 GHGs can be developed that meet Genetic Objective 4.	Genetic Strategy 4
9 Supplementation facilities can be designed and operated to reduce the possibility of extinction, loss of within-population variability, loss of between-population variability, and domestication selection.	Genetic Strategy 4
10 Effective population size can be managed to achieve optimal natural and supplemented populations.	Genetic Strategy 4
11 A genetic monitoring program can be designed and implemented that will have sufficient power to detect specified levels of impact.	All Genetic Strategies
12 Nontarget species and their ecological relationship to spring chinook salmon can be effectively identified and described.	Natural Production Strategy 1
13 Physical, biological, and chemical limiting factors are well defined for all life stages so that the environment can be improved effectively (in terms of consequences and costs).	Natural Production Strategies 1 & 2

Table 5.3. Resolvable Uncertainities Related to Management of Yakima Spring Chinook Salmon That Can Be Studied in the Near Term (continued)

Assumption	Strategy Relationship
14 Upstream and downstream passage problems in the Yakima River Basin can be identified, and natural production can be optimized accordingly.	Natural Production Strategies 1 & 2
15 There are three distinct stocks of spring chinook salmon in the basin; each may have distinct life history characteristics and habitat requirements.	Natural Production Strategies 1 & 2; Genetic Strategy 6
16 A natural production monitoring program can be designed and implemented that will have sufficient power to detect specified levels of impact.	All Natural Production Strategies
17 Methods for evaluating risks and benefits are available.	Experimentation Strategies 1 & 2
18 Experimental designs are available for evaluating risks and benefits.	Experimentation Strategies 1 & 2
19 Genetic guidelines for raising fish under both the New Innovative Treatment and Optimal Conventional Treatment are the same.	Experimentation Strategies 2 & 3
20 Hatchery methods to raise natural fish from fertilization to release are known for the New Innovative Treatment.	Experimentation Strategies 1, 2, and 3
325 A New Innovative Treatment can be defined.	Experimentation Strategies 2 & 3
21 An Optimal Conventional Treatment can be defined.	Experimentation Strategies 2 & 3
22 The appropriate response variables for long-term fitness are known.	Experimentation Strategies 1, 2, & 3
23 The appropriate response variable for post-release survival is survival over all return ages to Prosser Dam.	Experimentation Strategies 1, 2, & 3
24 The appropriate response variables for reproductive success are known, and methods for comparing reproductive success among treatments are known.	Experimentation Strategies 1, 2, & 3
25 The appropriate response variables for ecological interaction are known.	Experimentation Strategies 1, 2, & 3
26 Benign marks can be applied to hatchery-reared juveniles and accurately read on returning adults.	Experimentation Strategies 1, 2, & 3; all Genetic Strategies
27 Key attributes that characterize natural fish are known, including some that can be observed in smolts at the time of release.	Experimentation Strategy 2

Table 5.3. Resolvable Uncertanities Related to Management of Yakima Spring Chinook Salmon That Can Be Studied in the Near Term (continued)

Assumption	Strategy Relationship
28 Hypotheses in terms of measurable response variables that reflect risks and benefits have been stated.	Experimentation Strategy 2
29 Key attributes that describe returning adults are known and measurable.	Experimentation Strategy 2
196 Experimentation fish can be released in a manner that does not confound the results of the experiment comparing treatment methods.	Experimentation Strategies 1 & 2
30 Facilities and operational procedures for experimentation protocols can be accommodated.	Experimentation Strategies 2, 6, 7, & 8
31 Naches broodstock can be most effectively collected from spawning grounds.	Experimentation Strategy 4
32 Naches broodstock can be collected without adversely impacting the American River stock.	Experimentation Strategy 4
33 Upper Yakima broodstock can be most effectively collected at Roza Dam.	Experimentation Strategy 5
34 An experimentation monitoring program can be designed and implemented that will have sufficient power to detect specified levels of impact.	All Experimentation Strategies
35 Adult fish can be readily identified by origin for selective harvest purposes.	Harvest Strategy 1
36 Preseason forecast and inseason update of runsize and composition can be determined.	Harvest Strategy 1
197 Spawner recruit or stock productivity relationships can be developed to establish appropriate harvest rates for each discrete stock component.	Harvest Strategy 1
37 A harvest monitoring program can be designed and implemented that will have sufficient power to detect specified levels of impact.	Harvest Strategy 1

Table 5.4.
Resolvable Uncertainties related to management of Yakima Spring Chinook that can be resolved in **long-term** YKFP studies

Assumption	Strategy Relationship
199 The survival of fish reared in the artificial environment (from spawner to smolt) will be at least five times higher than average survival in the natural environment.	Experimentation Strategy 1
200 Release of smolts that mimic natural fish ensures that post-release survival is greater than half the survival of wild smolts.	Experimentation Strategy 1
201 The Optimal Conventional Treatment will not produce the same kind of fish as the New Innovative Treatment.	Experimentation Strategies 2 & 3
202 New Innovative Treatment fish have a post-release survival 50% better than Optimal Conventional Treatment fish.	Experimentation Strategies 2 & 3
203 Experiments can be designed that are statistically powerful enough to detect a 50% difference between treatments with a 90% certainty.	Experimentation Strategy 9
327 Average straying rates will not exceed 5%, and straying in excess of 10% will not occur. Straying rate is the annual percent of non-local spawners in the spawning escapement of the recipient stock.	Genetic Strategy 5
328 Smolt-to-smolt survival for all natural stocks (and for hatchery fish) decreases as smolt abundance increases, over the range of abundances expected under the YFP.	Natural Production Strategies 2 & 3
333 Quantity and quality of spawning and rearing habitats available in the Upper Yakima, Naches, and American rivers are equivalent to smolt capacities of about 540,000, 200,000, and 140,000 outmigrants.	Natural Production Strategies 2 & 3
334 Natural spawning escapements in excess of 200 will ensure that effective population sizes are consistent with genetic objectives.	Genetic Strategy 4
335 The proportion of hatchery- and wild-origin adults allowed to spawn naturally can be effectively managed.	Natural Production Strategies 2 & 3 Genetic Strategy 4 and 7
336 Smolt production for all stocks is controlled by spawning escapement and the availability of habitat needed by presmolts in the winter (winter capacity is about 20% of summer capacity).	**Natural Production Strategy 3**

Table 5.4.
Resolvable Uncertainties related to management of Yakima Spring Chinook that can be resolved in **long-term** YKFP studies

Assumption	Strategy Relationship
337 Habitat degradation and associated loss of life-history diversity are primary local causes of reduced productivity in the Yakima Basin.	Natural Production Strategies 1, 2, & 3
NEW # Baseline spawning escapements, representing current equilibrium conditions for the Upper Yakima, Naches, and American spring chinook stocks are; 2,260, 830, and 470, jacks not included.	Natural prod. Strategies 2 and 3

6.0 Experimental Design

The YKFP is designed to conduct experiments to test alternative supplementation treatments. These experiments were chosen to maximize the likelihood of detecting a significant difference between treatments. Three candidate treatments were identified. These treatments were chosen on the basis of the hypotheses that:

- a treatment can be designed that results in fish with characteristics approximating those of their natural counterparts,
- conventional hatchery treatments will not produce such fish, and
- by producing such fish, the likelihood of supplementation success is increased.

Treatment A is an **Optimal Conventional Treatment (OCT)** that incubates, rears, and acclimates spring chinook salmon using optimal conventional fish-culture methods derived from artificial propagation experiences within the Columbia River Basin.

Treatment B is a **New Innovative Treatment (NIT)** that incubates, rears, and acclimates spring chinook salmon using natural-like environments (e.g., natural cover, substrate, in-water structure) to produce fish with attributes approximating those of naturally produced spring chinook salmon.

Treatment C is a **Limited New Innovative Treatment (LNIT)** applied to spring chinook salmon that uses the OCT during the incubation to rearing phase and uses the NIT during other portions of the acclimation to release phase.

As proposed, the initial phase of implementation will be limited to upper Yakima spring chinook. The experimental design selected will test two treatments: A (OCT); and B (NIT). As the experiment progresses through years and cycles Treatment C (LNIT) or other refined treatments may be incorporated (Table 6.2).

The experimental design for upper Yakima spring chinook will be based on Design 1 as described under the "Experimental Design " discussion (p. 6.2). The design was selected based upon utility to meet experimental resolution and flexibility for application at a number of production and replication levels. The specific experimental combination is that shown by the fourth entry in Table 6.6. The number of fish per pond was increased slightly to take full advantage of pond capacity. A total of 810,000 smolts will be released with each replicate pond containing 45,000 fish. The experimental facilities and their operation are described fully in Chapter 8.

Replicates, Treatments, and Fish Per Pond

Individual treatments will be assigned to more than one rearing raceway, and fish from each raceway will be transferred to an acclimation pond, one pond per raceway. The number of raceways and associated ponds equals the number of replicates.

Numbers of replicates and treatments may differ between the Naches and upper Yakima stocks of spring chinook salmon depending upon refined experimental needs, stock status, and relative potential carrying capacity of the two systems.

Treatment Composition

Treatments A and B are common for both stocks. Treatment C may be evaluated for either stock during subsequent year(s) of experimentation (Table 6.1).

Table 6.1. Treatment Composition for Yakima Spring Chinook

Treatment	Nature of Treatment	Treatment Initially Tested on	
		Naches Stock	Upper Yakima Stock
A	Optimal Conventional Treatment	?	Yes
B	New Innovative Treatment	?	Yes
C	New Innovative Treatment during acclimation	?	No

Unless there is a strong indication of failure in the first year's experimental releases, a preferred treatment would not be selected on returns from just one year's release. The treatment effect on adult survival from one year's release cannot be fully assessed until the age distribution of the returning adults is reasonably well represented. Therefore, a given set of treatments may be repeated over a 5-year or longer period before a new set of treatments is implemented (Table 6.3), the 5-year period being the number of years encompassed by two sets of releases through adult returns.

It is not possible to make comparisons between sets of years unless the sets are linked through common treatments. Normally, the best treatment from Set 1 would be extended into Set 2 as a common treatment for those sets. The same logic holds in extending a treatment from any set into the next set. For example, the treatment composition during a 2-year period of supplementation for the Naches stock may look something like the information in Table 6.4.

The common treatment may differ from one stock to another. For example, a given treatment might initially to be tested only for the upper Yakima stock. If that treatment is the more successful treatment, it may be continued into Set 2 as a common treatment for the upper Yakima stock and may also be included as a new treatment in Set 2 for the Naches stock. Other treatments would then be used as the common treatment for the Naches stock.

More than one common treatment can be used to link sets for the upper Yakima stock. For example, Treatments B and C can be held as common treatments between sets, and a new treatment can be substituted for Treatment A.

Experimental Design

For an experimental design to be effective over many years of use, it must be adaptable to changing conditions. Two alternative experimental designs are compared according to their flexibility. The *flexibility* of each design is measured by the minimum requirements in number of smolts, in baseline survival of OCT fish, and in required sampling rate. A design that requires fewer smolt, lower survival, and lower sampling rates is applicable to more conditions and is, thus, more flexible.

The two designs different in absolute number of acclimation ponds and number of smolt per pond. The recommended design is the most flexible one and has more acclimation ponds and fewer fish per pond. However, both designs are described for the case that cost considerations should preclude the adoption of the recommended design. For each design, a set of guidelines is given that directs how the design should be adapted for various levels of broodstock and baseline survival rates. The set of guidelines illustrates the flexibility of each design. Simulation studies used to evaluate prospective designs and develop the guidelines are detailed in Hoffmann, Busack, and Knudsen (in prep.). The results of the simulation studies are based on a single release year and multiple return years.

For both designs, ponds will be constructed in clusters, three or five, depending on stock status, site criteria, and production levels necessary to meet underlying assumptions for survival and sampling rates. Within each cluster, there will be either one or three replicates where a replicate consists of a full complement of treatments. A replicate will consist of two ponds each containing one of two treatments (OCT, NIT), or three ponds each containing one of three treatments (OCT, NIT, LNIT). The acclimation ponds for a treatment complement are located in the same vicinity to reduce the pond-to-pond variation. The clusters will be distributed spatially over the stock's rearing area. This distribution is designed to return adults from each treatment over the natural spawning area.

Table 6.2. Expected Age Composition of Adult Returns of Yakima Spring Chinook

Experiment Year	Treatment Year									
	First Set of Treatments					Second Set of Treatments				
	1	2	3	4	5	1	2	3	4	5
1	Rearing									
2	Release	Rearing								
3	Age 2	Release	Rearing							
4	Age 3	Age 2	Release	Rearing						
5	Age 4	Age 3	Age 2	Release	Rearing					
6		Age 4	Age 3	Age 2	Release	Rearing				
7			Age 4	Age 3	Age 2	Release	Rearing			
8				Age 4	Age 3	Age 2	Release	Rearing		
9					Age 4	Age 3	Age 2	Release	Rearing	
10						Age 4	Age 3	Age 2	Release	Rearing

Table 6.3. Treatment Composition for Naches Stock

		Experiment				
Set	Experiment Year	A	B[(a)]	C[(b)]	D	E
1	1	x	x			
	2	x	x			
	3	x	x			
	4	x	x			
	5	x	x			
2	6		x	x		
	7		x	x		
	8		x	x		
	9		x	x		
	10		x	x		
3	11			x	x	
	12			x	x	
	13			x	x	
	14			x	x	
	15			x	x	
4	16			x		x
	17			x		x
	18			x		x
	19			x		x
	20			x		x

(a) Common treatment linking Sets 1 and 2.
(b) Common treatment linking Sets 2, 3, and 4.

Design 1

For design 1 there are three replicates per cluster and either two or three treatments per replicate (Table 6.4.). For three clusters, three replicates per cluster and two treatments per replicate, there will be 3X3X2 = 18 acclimation ponds (units). For five clusters, three replicates per cluster and three treatments per replicate, there will be 5X3X3 = 45 acclimation ponds (units).

Table 6.4. Replicates and Treatments of Design 1 for Yakima Spring Chinook.

Clusters	Replicates (r)	Treatments (t)	Units[a] (r*t)	Fish/Unit[b]
3	9	2	18	25,000
5	15	3	45	25,000

(a) The unit is the rearing raceway or the pond.
(b) Major criterion for determining no. fish per unit and the minimum number of replicates is the ability to detect a relative between-treatment-effect difference of 50 percent in adult survival (with a significance level of 0.1 and a 90 percent certainty or power).

Design 2

For design 2 there is one replicate per cluster (Table 6.5) and either two or three treatments per replicate. For three clusters, one replicate per cluster and two treatments per replicate, there will be 3X1X2 = 6 acclimation ponds (units). For five clusters, one replicate per cluster and three treatments per replicate, there will be 5X1X3 = 15 acclimation ponds (units).

Table 6.5. Replicates and Treatments of Design 2 for Yakima Spring Chinook.

Clusters	Replicates (r)	Treatments (t)	Units[a] (r*t)	Fish/Unit[b]
3	3	2	6	75,000
5	5	3	15	75,000

(a) The unit is the rearing raceway or the pond.
(b) Major criterion for determining no. fish per unit and the minimum number of replicates is the ability to detect a relative between-treatment-effect difference of 50 percent in adult survival (with a significance level of 0.1 and a 90 percent certainty or power).

Guidelines for Adapting the Designs

Each of the two designs can be adapted to various number of smolt available and to various anticipated survival rates for OCT fish. The survival rates are gauged in terms of OCT survival since NIT survival is assumed to be 50 percent greater. The number of broodstock available will not affect the layout of the ponds, but will affect the number of fish per pond and the number of treatments compared. If the number of fish per pond is too low for the power specifications, then the number of treatments compared can be reduced from three to two to compensate. Although both designs were described with five clusters, the number of clusters using Design 1 can be reduced to three under the appropriate conditions. The adaptations are described in Table 6.6 and Table 6.7:

Table 6.6. Guidelines for Adapting Design 1 to Varying Broodstock Numbers.

Number of Smolts Available	Treatments Compared	Optimal Experimental Use of Ponds		
		# Sites	# Ponds/Site	# Fish/Pond
1,125K	NIT, LNIT, OCT	5	9	25,000
1,125K	NIT, OCT	3	6	62,500
750K	NIT, OCT	5	6	25,000
750K	NIT, OCT	3	6	42,500
500K	NIT, OCT	5	6	17,000
500K	NIT, OCT	3	6	28,000

Table 6.7. Guidelines for Adapting Design 2 to Varying Broodstock Numbers.

Number of Smolts Available	Treatments Compared	Optimal Experimental Use of Ponds		
		# Sites	# Ponds/Site	# Fish/Pond
1,125K	NIT, LNIT, OCT	5	3	75,000
750K	NIT, OCT	5	2	75,000
500K	No Experiment	-	-	-

For the design layout in each of the row of Tables 6.6 and 6.7, there are survival and sampling rate requirements to guarantee detecting a 50 percent difference in survival with 90 percent power. These requirements are specified in Tables 6.8 and 6.9 and relate to OCT survival rates and the minimum required sampling effort. The survival requirements pertain to survival of OCT fish. Because the NIT survival was assumed to be 50 percent greater than the OCT survival, the absolute difference in survival probabilities between NIT and OCT increases as OCT survival increases. Therefore, with higher OCT survival, the power increases and the required sampling effort decreases (compare the sampling efforts in each row).

The sampling effort pertains to the set of "successful" fish. A successful fish is one that either is recruited into a fishery or returns to a specified location such as Roza Dam or the spawning grounds. Therefore, a 100 percent sampling rate at Roza Dam is not a 100 percent sampling rate unless all fisheries occur above the dam. Three levels of sampling rates on the set of successful fish were considered: 33, 67, and 100 percent.

Table 6.8. Sampling Rates Required to Achieve Experimental Objectives Using Design 1.

Number of Females at Collection Site[a]	Number of Smolts Available	OCT Survival Rates		
		0.0001	0.0002	0.0003
632	1,125K	-[b]	67%	33%
632	1,125K	-	33%	33%
421	750K	-	33%	33%
421	750K	-	67%	33%
281	500K	-	-	33%
281	500K	-	-	67%

(a) The number of females required at the broodstock collection site to produce the specified number of smolts was calculated according to the Biological Specifications Work Group recommendations (BSWG, October 1993).

(b) "-" indicates that at no sampling rate used were the power specifications met.

Comparison of Candidate Experimental Designs

With Design 1, as few as three clusters (Table 6.6) can be used whereas with Design 2, five clusters are required (Table 6.7). However, in order to reduce the number of clusters from five to three with Design 1, the number of treatments compared must also be given the appropriate conditions, this attribute of Design 1 can be used to phase in the project during the first few years.

Table 6.8 and 6.9 show how the sampling effort can be increased to compensate for lower OCT survival rates. From Table 6.8, it appears that at an OCT survival of 0.002, the sampling effort decreases as the number of smolts decrease (compare rows 1 and 3). However, the number of treatments compared in row 1 is three vs. two treatments in row 3 (Table 6.6). The increase in power due to reducing the number of treatments from three to two is enough to compensate for the reduced number of fish to the extent that even a decreased sampling effort is required.

Designs 1 and 2 are compared based on minimum requirements (Table 6.10). Design 1 is the most adaptable to varying conditions because it has lower minimum requirements than Design 2 and is, therefore, the recommended design.

Table 6.9. Sampling Rates Required to Achieve Experimental Objectives Using Design 1.

Number of Females at Collection Site[a]	Number of Smolts Available	OCT Survival Rates		
		0.0001	0.0002	0.0003
632	1,125K	-[b]	-	33%
421	750K	-	-	33%
281	500K	-	-	-

(a) The number of females required at the broodstock collection site to produce the specified number of smolts was calculated according to the Biological Specifications Work Group recommendations (BSWG, October 1993).

(b) "-" indicates that at no sampling rate used were the power specifications met.

Table 6.10. Comparison of the Candidate Experimental Designs.

Minimum Requirements	**Design 1**	**Design 2**
Number of Clusters	3	5
Number of Acclimation Ponds	18	10
Total Number of Smolt	500K	750K
Survival Rate of OCT	0.0002	0.0003
Sampling Effort	33%	33%

Experimental Layout of Raceways and Incubation Facilities

It may be necessary to "block" the rearing raceways according to potential differences in operations or management. If so, the number of raceways per group would equal the number of treatments, and treatments would be randomly assigned to the raceways within groups. Groups of raceways will be randomly assigned to pond replicates.

For the incubation treatments to be included in the replication process, it will be necessary to have a unique set of incubation trays associated with each raceway.

7.0 Risk Analysis

The 1993 Risk Analysis for Yakima spring chinook salmon follows.

Uncertainty and Risk Analysis Applied to Supplementation of Upper Yakima Spring Chinook Salmon

Introduction

This report presents an assessment of the uncertainties and risks of supplementing spring chinook salmon in the upper Yakima River Basin. The purpose of supplementation is to test the assumption that new artificial production can be used to increase harvest and enhance natural production while maintaining genetic resources. This assessment is based on a systematic method for considering (1) the objectives, (2) the strategies to achieve the objectives, (3) the operating assumptions needed to accept the strategies, (4) the uncertainties associated with these assumptions, (5) the risk of meeting stated objectives if the assumptions are false or the strategy is not feasible, and (6) the need to manage the uncertainty and risk associated with supplementation.

The Bonneville Power Administration, the State of Washington, and the Yakama Indian Nation must weigh these perceived risks and benefits through a variety of complex processes, which typically include intuitive and values-driven considerations. The process we used to identify the uncertainties and risks is illustrated in **Figure 7.1**.

Objectives

The objectives for supplementing upper Yakima spring chinook salmon are listed in the May, 1995 Planning Status report for the Yakima/Klickitat Fisheries Project. They are listed according to four general components: genetics, natural production/ecological interactions, experimentation, and harvest. These objectives will be accomplished while minimizing adverse genetic and ecological impacts to non-target species of interest. The objectives should be accomplished before existing threatened stocks reach extinction.

Strategies

The strategies under consideration are listed in the May, 1995 Planning Status Report for the Yakima/Klickitat Fisheries Project.

Assumptions

Certain assumptions must be "accepted" or resolved before adopting a suite of supplementation strategies to test whether new artificial production can be used to increase harvest and enhance natural production while maintaining genetic resources. Acceptance implies a range of actions. Here, we mean that an individual or agency (1) agrees or consents, (2) accommodates or reconciles, and, most importantly, (3) regards the assumption as true, valid, normal, or usual. If one does not accept the following statements as true, then one may need to find other strategies or, at least, monitor the results of implementing the strategies.

Figure 7.1 Structure of uncertainty and risk identification within the project management framework.

Uncertainty

Any statement of an assumption implies some degree of uncertainty; e.g., supplementation may not be definitely achievable within a planned time-frame, or for a given quantity or frequency of occurrence. The implication of errors in these assumptions is important. If supplementation is the wrong strategy, it could result in serious damage to all fish and other aquatic resources in the Yakima River or in the fruitless expenditure of monies. Before implementing supplementation as the strategy to test the assumption that new artificial production can be used to increase harvest and enhance natural production while maintaining genetic resources, either the uncertainties must be resolved or the associated risk(s) identified and a monitoring plan to contain or manage the risk must be in place.

Uncertainty Resolution The manner in which uncertainty is resolved depends on its particular place in the uncertainty management structure (**Figure 7.2**). Some assumptions related to supplementation are "accepted" on the basis of existing knowledge and information, pending documentation. "Acceptance" is a statement that:

- the uncertainty related to a given assumption has so little chance of adversely affecting the realization of meeting the objective (to test the assumption that new artificial production can be used to increase harvest and enhance natural production while maintaining genetic resources) or

- we know so much about this particular biological/ecological/engineering relationship that it is not worth studying any further in the context of supplementing spring chinook salmon in the Yakima River Basin.

Accepted assumptions. Even if one of these assumptions is false, we will still be able to test the assumption that new artificial production can be used to increase harvest and enhance natural production while maintaining genetic resources of the Yakima River Basin.

Unresolvable uncertainties. Some critical uncertainties are not expected to be resolved before a decision to supplement the Yakima River spring chinook salmon is made or even if the uncertainty is studied during supplementation. For most of these, resolution is not feasible, and all extend beyond the scope of the Yakima Fisheries Project. The risk that any of these assumptions are false must be assessed and managed through monitoring. While these uncertainties cannot be resolved, the health and condition of the Yakima River fisheries can be monitored for signs of unexpected change. On the basis of new information and other evidence, supplementation (any other strategy) to test the assumption that new artificial production can be used to increase harvest and enhance natural production while maintaining genetic resources will have to be continually reevaluated. If there are other factors that limit the production of Yakima River spring chinook salmon, these factors could not be defined or quantified before a decision to use supplementation is implemented. Additionally, the cost required to quantify every causal relationship to supplementation is prohibitive.

Figure 7.2. Structure of uncertainty resolution within the project management framework.

Resolvable uncertainties. Some uncertainties are critical and should be resolved before a decision to implement is made. (The ultimate decision related to resolution may require that an assumption be accepted). This will happen if new information is identified, if fiscal or temporal restraints preclude timely resolution, or if risk management is feasible.) Three methods can be used to manage those critical uncertainties that can be resolved: (1) review the scientific literature to determine how others have resolved or managed them; (2) conduct small-scale studies (i.e., short-term experiments in the field and laboratory, with models, engineering analyses); and (3) learn from supplementation projects from outside the Yakima River Basin.

If a critical assumption is false, then supplementation will not provide the information needed to test the assumption that new artificial production can be used to increase harvest and enhance natural production while maintaining genetic resources. The cost and time required to (1) conduct a literature review, (2) conduct a laboratory, field, modeling, or engineering study, or (3) study supplementation in another basin should provide enough information to resolve the uncertainty associated with these assumptions. This information is necessary to make a decision about supplementing chinook salmon in the upper Yakima River Basin.

Near-term Uncertainty Resolution. Uncertainties that may be resolved are a high priority in the near term, because they affect the ability to select supplementation as a viable strategy to increase harvest and enhance natural production while maintaining genetic resources. While the outcomes of literature reviews, small-scale tests, or studies in other basins can modify details of the selected strategy to increase harvest and enhance natural production while maintaining genetic resources, these short-term results are not expected to fundamentally change the objective but rather help ensure its success. The purpose of the small-scale studies and planning is to "set up" the selected strategy. Consequently it will be important to define a selected strategy in sufficient detail to make the planning focus on the objective.

Long-term Uncertainty Resolution. If the assumption is false, then supplementation will not provide the information needed to test the assumption that new artificial production can be used to increase harvest and enhance natural production while maintaining genetic resources. These assumptions, however, cannot be resolved in the near term. Their only apparent means of resolution is to implement supplementation in the Yakima Basin. Resolution of these uncertainties is the basis for the experimental aspects of the project. The resolution of these uncertainties will result from hypothesis testing during the implementation phase of the Yakima Fisheries Project.

To summarize the uncertainty management process: The objective is known (to increase harvest and enhance natural production while maintaining genetic resources). The strategy (supplementation) and the assumptions have been stated. The uncertainties have been examined and those uncertainties that must be resolved have been identified. Now, we must identify the risk of having selected the wrong strategy or accepting false assumptions.

Risk Analysis

The risk of using supplementation to test the assumption that new artificial production methods can be used to increase harvest and enhance natural production while maintaining genetic resources lies in the strategies and their associated assumptions (**Figure 7.3**). If a strategy does not work or is not feasible, harvest and natural production will not increase. (At least, production will not increase because of supplementation.) Additionally, if the assumptions are false, then production may not

Figure 7.3. Structure of risk analysis within the project management framework.

increase and, in fact, production may decrease or some other unwanted result may occur.

Each decision maker will determine which risks apply to the possibility of supplementation not working or the probability that one or all of the assumptions are wrong. The decision maker must weigh the risks and decide how to proceed in the face of uncertainty. Implementation of supplementation must be preceded by a systematic evaluation to detect and permit correction of unforeseen errors. The following sets of questions related to feasibility, uncertainty, alternatives, and monitoring define a process for evaluating the strategies for supplementation.

> ***Feasibility*** *Are the strategies sufficiently well defined and are they feasible? If not, why not? What is missing? Are assumptions related to feasibility of facilities and operations (including monitoring) accepted? (If they are accepted; reports, documents, or study results that address the specifics are available.)*
>
> **Uncertainty** What are the risks associated with uncertainties? (Risk refers to the likelihood of failing to meet the objectives stated for using supplementation to test the assumption that new artificial production can be used to increase harvest and enhance natural production while maintaining genetic resources.) What are the implications to using supplementation to test the assumption that new artificial production can be used to increase harvest and enhance natural production while maintaining genetic resources, if these assumptions are wrong? What is the likelihood that some of the accepted assumptions are wrong?
>
> ***Alternatives*** *What alternatives to supplementation are feasible (including taking no action) and what are their implications? (Implications refer to the risks, costs, and other impacts of the alternatives.) Are there alternatives to supplementation to test the assumption that new artificial production can be used to increase harvest and enhance natural production while maintaining genetic resources for which the risks and implications are less severe? What are the implications of delaying supplementation? Can some of the critically uncertain assumptions be effectively resolved through literature review or near-term studies? If so, should they be resolved by experiments, studies, modeling before implementation of supplementation?*
>
> ***Monitoring*** *Supplementation may be implemented using an adaptive management process, even though it poses risk of uncertain outcomes, providing this risk is contained through monitoring. Therefore, we must finally ask, are the provisions in place for monitoring the outcome(s) of using supplementation for upper Yakima spring chinook salmon in the Yakima River Basin?*

These questions were addressed by four individuals, and the their individual studies were discussed at a meeting in Seattle, Washington on October 7-8, 1993. The results of their individual studies are recorded as appendices to the Risk Analysis reported to BPA and the YKFP policy group. Appendix A ("Experimentation Risk Assessment of YKFP Spring Chinook Salmon") is authored by Dr. Annette Hoffmann from the Associated Western Universities, Richland, Washington. Appendix B ("Genetic Analysis of PSR Strategies, Assumptions, and Uncertainties") is authored by Dr. Craig Busack from the Washington State Department of Fisheries, Olympia, Washington. Appendix C ("Risk Analysis Harvest") is authored by Dr. Lars Mobrand from Mobrand Biometrics, Inc., Vashon, Washington. Appendix D (Evaluation of Strategies and Assumptions to Meet Natural Production Objectives for Upper Yakima Spring Chinook Program") is authored by Mr. David Geist from the Pacific Northwest Laboratory, Richland, Washington.

Two types of experimentation risk were identified: (1) ability to test production levels relative to supplementation, and (2) ability to learn about the quality of supplemented fish and their impacts to the ecosystem. Four types of genetic risk were identified: (1) extinction, (2) loss of interpopulation variability, (3) loss of intrapopulation variability, and (4) domestication. Two types of harvest risk were identified: (1) harvest access, and (2) harvest numbers. Three types of natural production/ecological interaction risk were identified: (1) limitations of abiotic components of the environment, (2) limitations of biotic components of the environment, and (3) adverse ecological interactions.

Monitoring Plan Input

For each risk identified in the risk analyses, we identified measures that can be monitored. These measures provide possible input to develop a monitoring plan. All the measures that were identified during the risk analysis are listed in **Table 7.1**. The source of the risk associated with each measure is given in the table by the objectives.

Additionally, for each list of measures (i.e., experimentation, genetic, harvest, and natural production/ecological interactions), the most important measures were identified by the individuals who did the assessments.

For **experimentation** risks, this list included:

- Reading the marks on returning adults at Roza, Prosser, and the spawning grounds to estimate the number of spawners
- Estimating the harvest rates by stock and gear type
- An electrophoretic analysis by stock of the returning adults
- Estimating the density and distribution relative to specific habitats for both target and non-target species
- Estimating smolt-to-adult survival for wild and hatchery fish
- Estimating the number of emergent fry/redd by stock and spawning area.

For **genetic** risks, the list of most important measures included:

- Data that could be collected from adults on the spawning grounds (i.e., electrophoretic analysis, age, sex, length, timing, numbers, reading marks)
- Data related to spawner performance (i.e., number of fry/redd, fecundity, egg size, egg weight, length, weight)
- Data related to harvest (i.e., electrophoretic analysis of adults, age, read marks, length, sex, time of catch, place of catch, gear type)

For **harvest** risk, the list of most important measures included:

- Timing and identification of marks on fish in a test fishery
- Timing and identification of adults at Prosser
- Timing and identification of fish in the harvest
- Timing and identification of adults at Roza

For **natural production/ecological interactions**, the list of most important measures included:

- Density and distribution of upper Yakima spring chinook salmon relative to specific habitat types over time and space
- Density and distribution of non-target species relative to specific habitat types over time and space
- Number of upper Yakima spring chinook adults returning to the basin
- Number of upper Yakima spring chinook smolts migrating out of the basin
- Occurrence of prey items in target and non-target predators
- Harvest estimates

Based on the list of priority measures, four sets of data or information are identified: (1) estimates of the number of adults returning to the basin, (2) early-life-history survival, (3) spawning performance, and (4) ecological interactions among spring chinook salmon and other fish species in the basin. These data/information sets can and should be used to develop a monitoring plan to manage or contain the risk of supplementing upper Yakima spring chinook salmon. However, as indicated in the figure illustrating the process used to define risks, not all the measures are feasible nor are they focused on specific objectives. Measures that are not feasible must be considered for future research and development. Measures that are not focused because of a lack of defined objectives must be reconsidered in light of more specific objectives.

Estimating the number of adults that return to the basin can be accomplished by a number of measures (e.g., electrophoretic analysis, reading marks, age analysis, enumeration at specific facilities or areas within the basin). Early-life-history survival can be accomplished for hatchery fish and for those life-history types that migrate out of the upper basin as age 1+ fish. Early-life-history survival for life-history types that migrate out of the upper basin as 0-age fish is not possible. They are too small to be marked with individual tags before they pass Roza Dam. After passing Roza Dam, outmigrating upper Yakima spring chinook salmon cannot be distinguished from spring chinook salmon from the Naches or American rivers.

Spawning performance can be monitored in part. Meristic and morphometric measures can be collected from spawning adults, eggs, and emerging fry. Straying rates can be estimated from reading marks on first-generation hatchery fish. (Straying rates from second-generation or unmarked hatchery fish can ot be estimated.)

Ecological interactions are difficult to define at this time. The Yakima Fisheries Project has not defined objectives for the non-target species. Estimating the density and distribution of key non-target species relative to specific habitat types over time and space can only be used to contain or mange risk when the project defines or identifies the objectives for these key species.

Therefore, the measures that define the priority input to the preliminary monitoring plan for the upper Yakima spring chinook salmon supplementation program are:

- Estimate adult returns at strategic locations within the basin. The locations suggested by the risk assessment include a test fishery in the lower basin, Prosser Dam, Roza Dam, at the hatchery, and on the spawning areas.
- Estimate early-life-history survival for hatchery fish in the basin.
- Describe some measures of spawning performance on the spawning grounds throughout the basin.

Five levels of monitoring are defined for the Yakima Fisheries Project. They are (1) quality control, (2) performance, (3) hypothesis testing, (4) comprehensive monitoring, and (5) stock status monitoring.

Quality control ensures that supplementation is conducted as intended and record keeping is accurate and complete. Performance monitoring is the measurement of smolt attributes, especially as it relates to smolt survival. Hypothesis testing is the monitoring of "statement of the objective" for supplementation. By stating the hypothesis for supplementation, we will be able to statistically design the collection of monitoring data to examine likenesses and difference between survival related to different risks that were identified in the risk analysis. Comprehensive monitoring relates to the determination of whether supplementation is progressing toward the objective of increasing harvest and enhancing natural production while maintaining genetic resources. This also contributes to a sensitivity analysis, which helps determine how critical an assumption is to the success of a particular strategy. Monitoring of stock status provides information to track long-term performance and fitness. This is defined as the estimated annual spawning escapement and attributes that profile changes in the populations over time.

The input from the risk assessment will be provided to project individuals who are developing the monitoring plan. They will consider the measurements and incorporate them along with input from other project planning activities (e.g., the biospecifications, treatment definitions, and hypothesis analysis). Measures to contain and manage risk comprise only a part of the monitoring plans.

Summary

The risk assessment for supplementing upper Yakima spring chinook salmon to test the assumption that new artificial production will increase harvest and enhance natural production while maintaining genetic resources has been completed. The assessment indicates that all the risks can be identified and that supplementation of upper Yakima spring chinook salmon can proceed and accomplish the testing of new artificial production methods.

The risks to upper Yakima spring chinook salmon have been identified relative to the experimentation, genetic, harvest, and natural production/ecological interaction objectives. They are: inability to test production levels relative to supplementation, inability to learn about the quality of supplemented fish and their impacts to the ecosystem, extinction of the stock, loss of inter- and intrapopulation variability, domestication, inability to control harvest access, inadequate harvest numbers, limitations by abiotic components of the environment, limitations by biotic components of the environment, and adverse ecological interactions.

Between 75 and 100 measures were identified to manage or contain these risks. The priority measures that are being developed in the preliminary monitoring plan are to: estimate adult returns at strategic locations within the basin, estimate early-life-history survival for hatchery fish in the basin, and describe some measures of spawning performance on the spawning grounds throughout the basin.

Four new or redefined strategies were identified for meeting the genetic objectives. They are: (1) acclimate and release fish from sites dispersed throughout the natural spawning range of the upper Yakima stock; (2) keep American and Naches River escapements at a minimum harmonic mean of 250 fish per year, (3) keep straying of upper Yakima chinook salmon into the American and Naches rivers at less than 5% of the recipient population, and (4) limit proportion of first-generation hatchery fish on spawning grounds to 50%. The managers of the Yakima Fisheries Project should consider amending the Project Status Report to include these strategies.

Measures to estimate early-life-history survival of wild or naturally spawning fish are not feasible at this time. The potential risks to the Yakima Fisheries Project can be managed without this technology; however, the managers of the Columbia Basin Fish and Wildlife Program should consider directing the research and development needed to estimate early-life-history survival of all life-history types of wild and naturally spawning fish.

A monitoring plan to contain or manage the risks of adverse ecological interactions can only be developed after specific objectives for key non-target species have been defined or identified. The key non-target species that were identified during the risk assessment are: coho salmon, fall chinook salmon, rainbow trout and steelhead, cutthroat trout, bull trout, redside shiner, sculpins, northern squawfish, and smallmouth bass. The managers of the Yakima Fisheries Project should define or identify objectives for these species.

The risks have been identified relative to the objectives, strategies, and assumptions stated in the long-range plan for the Yakima Fisheries Project (Project Status Report, February 1, 1993). Measures to contain or manage the risks have been input to a monitoring plan for supplementation of upper Yakima spring chinook salmon.

Table 7.1
Complete List of Measures Identified to Manage Risk Associated with Supplementation of Upper Yakima Spring Chinook Salmon

Measure	What	Where	When	Objective[1]
Electrophoretic analysis by stock	Adult/Upper Yakima, Naches, American	spawning grounds	during spawning	E,G,N
hatchery v. wild	Upper Yakima	spawning grounds	during spawning	G
Electrophoretic analysis by stock	Juvenile/Upper Yakima, Naches, American	spawning grounds	during spawning	G
hatchery v. wild	Upper Yakima	wild at Roza	presmolt & smolts	G
	Upper Yakima	hatchery at hatchery	smolt	G
Scale analysis (age) analysis by stock	Adult/Upper Yakima, Naches, American	spawning grounds	during spawning	G
Size (L)	Adult/Upper Yakima	spawning grounds	during spawning	G
Age structures	Adult/Upper Yakima	spawning grounds	during spawning	E,G
Spawn timing (date)	Adult/Upper Yakima	spawning grounds	during spawning	E,G
No. of Spawners	Adult/Upper Yakima Naches, American	hatchery	during spawning	E,G,H,N
Read Marks	Adults/Upper Yakima, Naches, American.	spawning grounds, Prosser, Roza	during spawning	E,G,H,N
Electrophoretic analysis	Upper Yakima Naches, American	usual/ customary sites & test site	during harvest	E,G,H,N
Read scales analysis	Upper Yakima Naches, American	usual/ customary sites & test site	during harvest	E,G,H,N
Read marks analysis	Upper Yakima	usual/ customary sites & test site	during harvest	E,G,H,N

(1) E=Experimental
G=genetics
H=harvest
N=natural production/ecological interactions

Table 7.1 (cont.)

Measure	What	Where	When	Objective
Size (L) analysis	Upper Yakima	usual/ customary sites & test site	during harvest	G,H,N
Sex	Upper Yakima Naches, American	usual/ customary sites	during harvest	E,G,H,N
Time of Catch	Upper Yakima Naches, American	usual/ customary sites & test site	during harvest	E,G,H,N
Place of Catch	Upper Yakima Naches, American	usual/ customary sites & test site	during harvest	E,G,H,N
Gear Used	Upper Yakima Naches, American	usual/ customary sites	during harvest	E,G,H,N
No. Emergent Fry/Redd	Upper Yakima Naches, American	spawning at grounds	emergence	E,G,N
Origin of spawners on selected redds (hatchery v. natural)	Upper Yakima	spawning grounds	during spawning	G
egg #/female	Upper Yakima	Roza	during spawning	E,G
egg size	Upper Yakima	Roza	during spawning	G
egg volume	Upper Yakima	Roza	during spawning	G
Size (L)	Upper Yakima	Roza	during spawning	G
Size (W)	Upper Yakima	Roza	during spawning	G
smolt-smolt survival (hatchery fish)	Upper Yakima	Horn Rapids McNary	spring	E,G,H,N
smolt-smolt survival (Wild)	Upper Yakima, Naches	Horn Rapids McNary	spring	E,G,H,N
smolt-adult(hatchery)	Upper Yakima	Prosser	fall	E,G,H,N

Table 7.1 (cont.)

Measure	What	Where	When	Objective
smolt-adult (wild)	Upper Yakima,Naches	Prosser	fall	E,G,H,N
collect gametes	Upper Yakima	hatchery/ spawn	spawning (every 3 yrs)	G
collect liver samples for DNA analysis	Upper Yakima,Naches	hatchery/ spawn	spawning (every 3 yrs)	G
total area	land use type (e.g,ag,timber, urban)	basin	every 5 years	N
miles stream access during upstrm passage	Upper Yakima, Naches	basin	every 5 years	N
channel depth (min. max,av.)	Upper Yakima, Naches	basin	4 times/yr every 3 yrs.	N
width channel (min. max,av.)	Upper Yakima, Naches	basin	4 times/yr every 3 yrs.	N
volume (m^3) of pools (min. max,av.)	Upper Yakima, Naches	basin	4 times/yr every 3 yrs.	N
volume (m^3) of riffles (min. max,av.)	Upper Yakima, Naches	basin	4 times/yr every 3 yrs.	N
volume (m^3) of runs (min. max,av.)	Upper Yakima, Naches	basin	4 times/yr every 3 yrs.	N
volume (m^3) off-channel, wetlands (min. max,av.)	Upper Yakima, Naches	basin	4 times/yr every 3 yrs.	N
gradient (depth,elevation)	Upper Yakima, Naches	basin	4 times/yr every 3 yrs.	N
flow (m^3/s) (min. max,av.)	Upper Yakima, Naches	basin	4 times/yr every 3 yrs.	N
velocity (surface) (min. max,av.)	Upper Yakima, Naches	basin	4 times/yr every 3 yrs.	N
velocity (subsurface) (min. max,av.)	Upper Yakima, Naches	basin	4 times/yr every 3 yrs.	N
area of boulders (min. max,av.)	Upper Yakima, Naches	basin	4 times/yr every 3 yrs.	N
area of cobble (min. max,av.)	Upper Yakima, Naches	basin	4 times/yr every 3 yrs.	N
area of overhanging bank (min. max,av.)	Upper Yakima, Naches	basin	4 times/yr every 3 yrs.	N
area of canopy cover (min. max,av.)	Upper Yakima, Naches	basin	4 times/yr every 3 yrs.	N

Table 7.1 (cont.)

Measure	What	Where	When	Objective
area of near shore vegetation	Upper Yakima, Naches	basin	4 times/yr every 3 yrs.	N
area of large organic debris	Upper Yakima, Naches	basin	4 times/yr every 3 yrs.	N
area of small organic debris	Upper Yakima, Naches	basin	4 times/yr every 3 yrs.	N
area of fine material in substrate	Upper Yakima, Naches	basin	4 times/yr every 3 yrs.	N
water temperature	Upper Yakima, Naches	basin	continuous	N
density & distribution relative to specific habitat	Upper Yakima and Naches spring chinook	basin	all life stages annually	E,N,H
density & distribution relative to specific habitat	coho salmon	basin	all life stages annually	E,N
density & distribution relative to specific habitat	fall chinook salmon	basin	all life stages annually	E,N
density & distribution relative to specific habitat	rainbow trout & steelhead	basin	all life stages annually	E,N
density & distribution relative to specific habitat	cutthroat trout	basin	all life stages annually	E,N
density & distribution relative to specific habitat	bull trout	basin	all life stages annually	E,N
density & distribution relative to specific habitat	redside shiner	basin	all life stages annually	E,N
density & distribution relative to specific habitat	sculpins	basin	all life stages annually	E,N
density & distribution relative to specific habitat	northern squawfish	basin	all life stages annually	E,N
density & distribution relative to specific habitat	smallmouth bass	basin	all life stages annually	E,N

Table 7.1 (cont.)

Measure	What	Where	When	Objective
weight/volume	terrestrial,benthic & near benthic organisms	basin	4 times/yr every 3 yrs.	E,N
#/volume	terrestrial,benthic & near benthic organisms	basin	4 times/yr every 3 yrs.	E,N
Length	Upper Yakima spring chinook (emergent through smolt)	basin	annually at all life stages	N
Weight	Upper Yakima spring chinook (emergent through smolt)	basin	annual ly at all life stages	N
Age	Upper Yakima spring chinook (emergent through smolt)	basin	annual ly at all life stages	N
occurrence of fin nips	Upper Yakima spring chinook (emergent through smolt)	basin	annual ly at all life stages	N
incidence of BKD black spots,parasites	Upper Yakima spring chinook (emergent through smolt)	basin	annual ly at all life stages	N
occurrence of prey items (stomach contents)	Upper Yakima spring chinook (emergent through smolt)	basin	annual at all life stages	E;N
occurrence of prey items (stomach contents with special note of hatchery v. wild upper Yakima spring chinook)	key non-target species (coho,fall chinook, rainbow trout/steelhead, cutthroat trout,bull trout, redside shiner,sculpins, northern squawfish, smallmouth bass)	basin	annual ly	E,N
occurrence of behavioral displays (nips,crowds, charges)	Upper Yakima spring chinook (emergent through smolt)	basin	annual ly at all life stages	N
number of adults	Upper Yakima Naches, American	Roza Prosser, Horn Rapids (?) spawning grounds	upon return	E,H,N
number of pre-smolts	Upper Yakima	Horn Rapids	outmigration	E,N
Weight of pre-smolts	Upper Yakima	basin	outmigration	E,N
number of smolts	Upper Yakima	basin	outmigration	E,N

Table 7.1 (cont.)

Measure	What	Where	When	Objective
number of non-target species	(coho,fall chinook, rainbow trout/steelhead, cutthroat trout,bull trout, redside shiner,sculpins, northern squawfish, smallmouth bass)	basin	every 5 yrs.	E,N
weight of non-target species	(coho,fall chinook, rainbow trout/steelhead, cutthroat trout,bull trout, redside shiner,sculpins, northern squawfish, smallmouth bass)	basin	every 5 yrs.	E,N
number of fish entrained in diversion canals	Upper Yakima spring chinook	basin	annual	E,N
number of fish entrained in diversion canals	(coho,fall chinook, rainbow trout/steelhead, cutthroat trout,bull trout, redside shiner,sculpins, northern squawfish, smallmouth bass)	basin	annual	N
number of spring chinook harvested	Upper Yakima,Naches American	Horn Rapids to Roza, all harvest sites	season	E,G,H,N
number of Upper Yakima spring chinook harvested by gear type	Upper Yakima,Naches American	Horn Rapids to Roza,all harvest sites	season	H

8.0 Facilities and Operations

Facilities and operations are planned to accommodate the supplementation of two Spring chinook salmon stocks: the Naches and upper Yakima stocks. Facilities are to be designed, constructed, and operated for broodstock collection, adult holding, spawning, incubation, rearing, acclimation and release, and monitoring activities of the spring chinook salmon project. These facilities will be designed to accommodate and conduct supplementation experiments. The facility currently being designed will test supplementation of upper Yakima spring chinook and will accomodate two experimental treatments: the Optimal Conventional Treatment (OCT), and the New Innovative Treatment (NIT). The Limited New Innovative Treatment (LNIT) may be tested in later years for either upper Yakima or Naches spring chinook. Monitoring facilities are to be designed and operated to meet the requirements for five levels of experimental monitoring.

Broodstock of upper Yakima spring chinook salmon will be trapped at Roza Dam from late May through September. Adults will be transported to the Cle Elum Facility for spawning, where egg incubation and fry and juvenile rearing will occur. Fry will be ponded and reared in raceways. Satellite acclimation ponds will be used for smolt acclimation and release. Each acclimation satellite will release OCT, and NIT, treatments. Five candidate satellites have been identified and surveyed (Keechelus Dam, the town of Easton, Cle Elum River, Teanaway River, and Clark Flat). The program calls for the release of 810 thousand upper Yakima spring chinook salmon smolts.

Naches Spring chinook salmon broodstock will be collected from July through September, either on the spawning grounds or at a collection facility (if Naches stock can be effectively discrimated from American stock), and transported to the Oak Flats Facility and held for spawning. Adult spawning, egg incubation, and fry and juvenile rearing will also be conducted at Oak Flats continuing into October. Three acclimation satellites are planned: the Little Naches River, Naches River, and Rattlesnake Creek locations. The program calls for the release of 450,000 Naches spring chinook salmon smolts.

Prior to initiating final design of facilities, treatment definition and biological specifications documents will be provided to the project managers and designers as guidelines for determining scientific and biological requirements for implementing and conducting the experimental treatments. Prior to facilities operations, scientific and biological operations manuals that set forth protocols, methods, and procedures for conducting experimental treatment activities (broodstock collection, adult holding, spawning, incubation, rearing, acclimation and release, and monitoring), will be institutionalized within the project.

1. Treatment Definitions And Descriptions

Introduction

The Yakima Fisheries Project (YFP) is designed to test the assumption that supplementation can be used to increase natural anadromous fish production and improve harvest opportunities while maintaining genetic resources. This document will focus on upper Yakima spring chinook salmon, one of three genetically distinct chinook salmon stocks in the Yakima basin (Busack 1993, Appendix A).

Facilities will be constructed in the Upper Yakima River Basin to serve as a production scale laboratory to resolve critical uncertainties related to supplementation. Scientists will use this laboratory to evaluate the alternative fish culture techniques that can be used in supplementation programs. These evaluations will generate improved fish culture and release techniques that yield high survival of wild-like fish that is assumed to be needed for supplementation to contribute to rebuilding depleted wild salmon and steelhead stocks throughout the Columbia River Basin.

Naturally-produced fish have or display a broad array of characteristics believed to be important indicators of pre-smolt and smolt status. These attributes (fish health, morphology, behavior, and survival) will serve as target specifications for monitoring and evaluating the effectiveness of artificial culture methods in producing fish with the appropriate wild-like characteristics (Table 1).

It is crucial that the facility be designed to scientifically resolve current and future critical uncertainties regarding the culture and release of fish for use in supplementation programs. Therefore, to provide the maximum statistical power in the most cost effective manner, the biological specifications require that the facility be planned so that treatments can be statistically blocked throughout broodstock holding, incubation, rearing, and acclimation phases. This will enable researchers to apply experimental treatments at any level of fish culture from broodstock management through release, as new critical uncertainties emerge.

The main value of the scientific information obtained from this facility over the next several decades is its adaptive management application to other programs within the Columbia River Basin. Therefore, the biological specifications require that certain aspects of the facilities (e.g., raceways) be designed as models of most of the other hatcheries. This will allow those concepts that are demonstrated scientifically to be valuable to be readily retrofitted to existing facilities.

The biological specifications define facilities in which two (2) experimental treatments can occur. At acclimation there are nine (9) replicate vessels/treatment. For this level of replication to be maintained in any given experiment, there must be nine (9) or more vessels/treatment available from the time the treatment is applied. Therefore to maximize experimental flexibility, statistical power, and facilitate fish handling the biological specifications must provide at least nine (9) incubation, rearing, and acclimation vessels/treatment. The design must also provide some capability to accommodate other research needs.

The project experimental design requires that each experiment be conducted over one life cycle. Thus with spring chinook salmon, the facility will be dedicated to comparing treatment effects over five year blocks. The first five-year block will compare the effectiveness of conventional rearing methods and semi-natural rearing methods for producing spring chinook salmon suitable for supplementation programs. The two treatments to be applied are Optimal Conventional Treatment (OCT) and New

Innovative Treatment (NIT), (Fast 1992, Appendix A; BPA 1992). Experimental treatments will be applied to the particular study groups at the start of feeding and continued until the smolts leave acclimation ponds.

Table 8.1. Target biological attributes for upper Yakima spring chinook.

ATTRIBUTE	PARAMETER	MEASURES	SAMPLING INTERVAL (VARIES PER NEED)
FISH HEALTH	PHYSIOLOGY	GILL Na+/K+ ATPase	MEAN = $x_{1..n}$ SD = $y_{1....n}$
		THYROXINE	"
		CORTISOL	"
		LIVER GLYCOGEN	"
		IMMUNO COMPETENCE	"
		HEMATOCRIT	"
		WHITE CELL COUNT	"
	PATHOGEN PREVALENCE	IHN VIRUS	"
		ERYTHROCYTIC INCLUSION BODIES	
		Renibacterium salmoninarum	
		Ceratomyxa shasta	"
		Chondrococcus columnaris	"
		Aeromonas salmonicida	"
		Yersinia ruckeri	"
		Cytophaga spp.	"
		ENDOPARASITES	"
		Ceratomyxa shasta	"
		ECTOPARASITES	"
	CONDITION	% FAT	"
		% PROTEIN	"
		PROTEIN:FAT RATIO	"
		CONDITION FACTOR (K)	"
		EYE CONDITION	"
		GILL CONDITION	"

		FIN CONDITION	"
		PARASITIC SCARRING	"
MORPHOLOGY	CRYPSIS	DORSAL COLORATION INDEX	"
		PARR MARK/TOTAL BODY INDEX	"
		PARR MARK DARKNESS INDEX	"
		NO. DORSAL SPOTS	"
		LATERAL IRIDESCENCE INDEX	"
	MORPHOMETRICS	FORK LENGTH	"
		STANDARD LENGTH	"
		WEIGHT	"
		TRUSS MEASUREMENTS (INDEX)	"
BEHAVIOR	MIGRATION	FROM ACCLIMATION PONDS	"
		SUSTAINED SWIMMING SPEED	"
		UPSTREAM/DOWNSTREAM MOVEMENT	"
	HABITAT PREFERENCE	% TIME SPENT IN COVER	"
		DISTANCE FROM BOTTOM	"
		DISTANCE FROM STRUCTURE	"
		DISTANCE FROM SIDE	"
		DEPTH PREFERENCE	"
		VELOCITY PREFERENCE	"
BEHAVIOR	FORAGING PREFERENCE	#TEST PREY/TAXON CONSUMED	"
	FORAGING EFFICIENCY	PREY ATTACK:STALK RATIO	"
		PREY CAPTURE:ATTACK RATIO	"
		PREY INGESTION:CAPTURE RATIO	"
		PREY ACQUISITION/UNIT TIME	"
		PREY HANDLING TIME	"
	FORAGING ABILITY	TOTAL CONTENTS/WEIGHT/STOMACH	"
		% FOOD ITEMS (BY WGT)/STOMACH	"
		% NON-FOOD ITEMS " "	"
	PREDATOR AVOIDANCE	PREDATOR RECOGNITION INDEX	"

		PREDATOR EVASION INDEX	"
		RESPONSE TIME:COVER RATIO	"
	GENERAL SOCIAL	NIPS/UNIT TIME	"
		DISPLAYS/UNIT TIME	"
		INTER-FISH DISTANCE	"
		POLARIZATION INDEX	"
SURVIVAL	SUPPLEMENTATION FISH	EMERGENT FRY:SMOLT SURV RATE	"
		SMOLT:SMOLT SURV RATE TO ROZA	"

Production Objective

The experimental design requires the production of 18 separate lots of 45,000 smolts for release as experimental groups into the watershed above Roza Dam (Table 8. 2). These fish will be 15 per pound at release and, in total, weigh 54,000 pounds.

Table 8.2. Production requirements for Upper Yakima spring chinook salmon research (BPA 1990).

No. of release groups	18
No. of smolts/group (approx.)	45,000
Total programmed for release	810,000
Release size (fish per pound)	15
Total pounds to be released	54,000

STANDARD TREATMENT METHODS

This section presents anticipated culture methods that will be applied to all experimental treatment groups from broodstock collection to the start of fry feeding. It also provides biological and operational criteria for associated fish culture and monitoring facilities.

Adult Collection and Monitoring

Adult spring chinook salmon will be trapped at Roza Dam and transported to Cle Elum Hatchery (ibid.).

The U. S. Bureau of Reclamation designed the Roza Dam adult collection facilities, and began construction during 1992 with a scheduled completion in 1993 (USBR 1992). The scientific basis for facility design was provided in a memorandum (Easterbrooks 1991, Appendix B). Scientific requirements and specifications were:

- 6 holding compartments for fish segregation: (a) 4 for holding 25 unsampled fish each, (b) 2 for holding 50 sampled fish each
- Holding volume - 10 cubic feet per fish
- Minimum pool depth - 5 feet
- Sorting flume with mounted coded wire tag (CWT) (Jefferts et al. 1963) detector equipped with auto-sorting instrumentation (operating procedures and protocols included)
- Crowding capability and "immobilization" brail to facilitate fish handling by use of plastic (pvc) tubes.

- Bio-sampling work area including anesthetic tank, processing table, recovery tanks, and chutes for sorting fish that are either held or returned to the Roza pool

- Off-ladder holding pool and features, assuming a Denil fishway design

The minimum flow per adult requirement is 1 gallon per minute at 50°F (assuming a 15 pound/fish average weight) with the inflow adjusted at 5% per degree of average water temperature departure from the standard(Senn, et al. 1984). Flow must be provided so that the holding vessel outflow dissolved oxygen level is 7 mg/L or greater (ibid.).

The new adult trapping facility incorporates proven design features and is located on the left bank of the Yakima River (Roza pool) approximately 300 feet upstream of Roza Dam (General Plan, Appendix B). It is hydraulically connected to the existing fishway by a flow control structure and a light-ported spiral-ribbed aluminum pipe which serves as a lake level fish transport channel (following Cowlitz Hatchery design). An intake provides a gravity source for the transport channel and a river water source, via pumps, for the trapping facilities. The head end of the transport channel is a collection area consisting of a "V" trap entrance, crowder, and a Bonneville-Hatchery style fish lock and lift. From the top of the fish lock, a fish sorting flume (Prosser Dam design) descends past four holding tanks and exits as a river return line. Access to each holding tank is provided by remotely or automatically controlled quick acting power gates. Holding tanks are provided with a crowder channel access port and individual crowders. The common crowder channel is provided with a crowder that is used to separate/crowd fish retained for hatchery transfer or for crowding to a fish-handling "scalloped" brail. A water-to-water fish transfer brail is used for lifting fish from the crowder channel and for fish transport truck loading.

Fish will ascend the Roza fishway and enter the trap via the transportation pipe. Trapped fish will be crowded into the fish lock that will subsequently be closed and flooded to the elevation of the fish sorting structure. A false floor (lift) will be raised to crowd the fish upward within the lock. Fish sorting will be managed by an operator controlling the lock and lift operation. Fish will have the opportunity to exit the lock volitionally over the false weir as flow is increased or will be otherwise encouraged to exit by the raising of the false floor which serves as a brail. The individual controlling the fish lock will also be responsible for either sorting fish (by species) into holding tanks, or directing fish to pass through and exit into the Roza pool.

Processing of collected adults will entail: (1) crowding from the holding tanks, (2) crowding to the head of the crowding channel, and (3) crowding via brail for handling adults. Handling will involve: (1) placing captive fish into plastic tubes (while on the brail) for control during anesthetizing, (2) examination for specific identifiers (tags, fin-marks, brands, etc.), and (3) other project-related sampling. Fish selected for hatchery use will, while anesthetized, be injected with an antibiotic before transfer to adult holding ponds at Cle Elum Hatchery.

Following Genetic Hatchery Guidelines (GHG), only naturally produced (non-marked) fish will be selected for hatchery use and no more than 50% of the available non-hatchery fish can be used for broodstock (Kapuscinski and Miller 1993). The adult population will be sampled such that the collected adults represent population parameters including arrival time, age, size, etc. (ibid.; Busack 1993a, Appendix A).

The project report "Optimal Conventional and New Innovative Treatments for Upper Yakima Spring

Facilities and Operations

Chinook Salmon Supplementation Project" (BSWG, 1994) and Planning Status Report (1995) provide the experimental basis for the number of adult spring chinook salmon broodstock required to support the supplementation program. It will be necessary to collect and transport 1,108 adult fish (Table 8.3).

Fishway, trap, and transport pipe will be in continuous operation under gravity water flow, except per a BPA/USBR agreement related to winter operations (Appendix B). Adult collection and monitoring facilities requiring pumped water will be operated on a daily basis with no fish being held overnight.

1. Sorting & Enumeration The facility operator will have the responsibility for operating the fish lock/lift and sorting flume gates. This person will discriminate the fish by species entering and passing down the sorting flume either to holding tanks or to the Roza pool. It is expected that electronic tag detection and automatic sorting devices will eventually be incorporated into the sorting process. An assistant may be required to operate the trap crowder to haze fish into the lock chamber for holding until the access port is closed.

2. Biological Processing Biological processing will involve anesthetizing (MS-222, 130-260 mg/L - Collinsworth and Moberly 1983), handling the fish as necessary to verify and record species, fish origin (experimental of "wild") by the presence of fish identifiers, and to further observe fish to assure appropriate broodstock collection.

Adults selected for hatchery use will be injected with an antibiotic during bio-processing. Adult mortality and juvenile disease related to bacterial kidney disease (BKD) is reduced by injection of an antibiotic, erythromycin. Treatment methodology presently involves injecting 20-30 mg/kg fish weight of "Erythromycin-200" into the dorsal musculature (Harrell 1993; Moffitt, et al. 1993).

3. Broodstock Acquisition Returning adults will be sampled to assure that fish selected for broodstock are representative with respect to time of arrival, age, size, sex-ratio, etc. (Busack 1993a; Kapuscinski and Miller 1993). Fish taken for hatchery broodstock will be transferred to adult holding facilities the day of collection.

Fish Transportation - Adults Fish transport support will be accomplished by a combination of large and small equipment for an estimated 150 96-mile round-trips. Tank trucks, tank bearing utility trucks, and truck/trailer combinations are routinely used to transport salmon and steelhead adults at public fish production facilities.

The adult transport tank loading rate is 1.0 pounds of fish per gallon at 50°F. Generally, loading should be decreased as temperature increases above 50°F and should be reduced by 10% for each degree of increased temperature above 60°F (Bell 1990). The loading rate can be increased by up to 30% for short hauls. Tempering is required where temperature differences between tank and receiving water exceed 10°F (note: the change upward has the greatest potential for reducing survival of transported fish). Ice used for tempering must be free of residual chlorine (Bell 1986).

Oxygen will be provided using liquid or gaseous oxygen and ceramic or carbon rod diffusers. The rate of oxygen delivery at 10°C of 3 Lpm (@ 80 psi) per 1m carbon rod normally supports up to 550 pounds of fish (Weydemeyer 1992). Other transport tank features will include electrical agitators for recirculation, insulation for temperature control, water level sight gauge for volumetric measurement of loaded fish, and oxygen delivery controls and monitoring system to assure proper tank conditions (OPTT 1992).

Adult fish will be transported by tank truck to Cle Elum adult holding ponds. The transport tank will be discharged via a rear-located spring loaded gate.. Considering the characteristics of the adult holding vessels, the tank contents (adult fish) will be released via a flume to direct fish away from pond walls and bottom. Flumes are commonly used for this purpose.

B. Broodstock

1. Adult Holding/Handling A maximum of 1,110 Upper Yakima spring chinook salmon adults is required to be collected at Roza Dam and transported to Cle Elum Hatchery for spawning retention (Table 8.3). The assumptions used to derive the preliminary estimate of the numbers of broodstock are: egg to smolt survival - 65%, adult mortality - 20%, and eggs per female -4,300 (BPA 1990). The mean fecundity estimate has subsequently been revised downward to 3,500 eggs per female (Knudsen and Busack 1993, Appendix A).

Table 8.3. Egg and broodstock requirements

Eggs required (assumed 65% survival)	1,242,000
Eggs per female	3,500
Females required (assumed 20% mortality)	444
Sex ratio (male:female)	1.5:1
Adults required	1,110

Holding Volume The adult spring chinook salmon holding volume is 10 ft^3 per adult following the design standard recently implemented at upper Columbia basin projects, such as Eastbank and Methow hatcheries (Scribner 1993). A minimum volume of 11,100 ft^3 of adult holding space will be required to retain adult fish from collection to spawning.

Two adult holding vessels are required to provide operational flexibility and the opportunity for retention of broodstock separately by experimental treatment (e.g., OCT, NIT).

Inflow The minimum inflow requirement (1,110 gallons per minute) for adult spring chinook salmon holding is derived from the criteria of 1 gallon per minute, at 50°F, per fish (Senn, et al. 1984). The inflow is adjusted at a 5% rate per degree of average water temperature increase from the 50°F standard (ibid.).

Water Quality Adult holding success is dependent upon water quality. Water quality must be sufficient for adult holding in terms of both water chemistry, pathogens, and temperature. The availability of pathogen-free water, typically from groundwater, can enhance adult holding by reducing mortality and, correspondingly, the number of broodstock required to support the supplementation program.

Facilities and Operations

Project water quality standards determine the fish culture utility of potential/candidate Cle Elum Hatchery water sources. Results of biological studies and water quality analyses indicate that characteristics "appear quite suitable for fish production" (Dauble and Mueller 1993, Appendix C). In addition, water quality information summarized by Dauble (1993, Appendix C) indicates fish culture suitability of water sources where upper Yakima River acclimation sites may become established.

With respect to dissolved gases in groundwater, it is recommended "that waters be stabilized before use in a fish hatchery if the dissolved oxygen is less than 90% saturation, or if the dissolved nitrogen is greater than 102% saturation" (Senn, et al. 1984). Ideally, the total gas saturation should not exceed 100%.

Concern exists as well for the presence of supersaturated gas in surface water. This is of particular importance in the case of upper Yakima River facility planning since nitrogen supersaturation was measured in the Cle Elum River 1993 and was known to cause losses of captive fish below Cle Elum Dam (Harrell 1993a, Appendix C). Colt, et al. (1991) reported reduction of the impact of surface water gas supersaturation in hatchery water supplies through the use of degassing structures.

In anadromous fish culture, process water that has been used for rearing a single group of juvenile fish (first-pass) is generally accepted as an alternate adult holding water source if pathogen, chemical, and temperature requirements are met. Such water may require aeration in order to re-establish dissolved oxygen levels sufficient to allow maximum inflow loading (1 adult per gallon per minute at 50°F.). Alternatively, flow must be increased to maintain dissolved oxygen levels if aeration is not provided.

The YFP has accepted the use of 2nd or 3rd-pass water for adult holding for facility design purposes when constrained by water availability (BPA 1990). However, water re-use will only be considered as a contingency action.

<u>**Water Temperature**</u> The recommended adult salmon holding temperature range is 43°F (Leitritz and Lewis 1980) to 55°F (Piper et.al 1982; OPTT 1992a). In nature, adult spring chinook salmon ascend rivers, select and hold in environments of their preference and generally spawn in water temperatures ranging from 42°F to 51°F (Bell 1990). Stuehrenberg (NMFS, personal communication) indicated that radio-tagged spring chinook salmon holding in the upper Yakima drainage is commonly associated with dense cover (woody debris, primarily) but that associated temperature data on adult holding areas have not been gathered. In another Yakima River study, Berman and Quinn (1991) observed behavioral thermoregulation in which spring chinook salmon adults maintained an average internal temperature of 2.5^{oC} below ambient river temperature.

<u>**Fish Health**</u> Several diseases occur in adult salmon and will probably occur in fish held for broodstock. The most prevalent external and internal diseases are discussed below.

Fungus: Fungus (*Saprolegnia sp.*) is expected to be the most prevalent external disease of adults at Cle Elum Hatchery. This disease is a secondary invader of external lesions, abrasions, and external bacterial infections and is a common factor in mortality of salmonid broodstock.

The contemporary treatment practice involves the use of a formalin (37% formaldehyde) "bath" in which fish are regularly exposed to the chemotherapeutant for a prescribed period. Harrell (1993) indicated that fungus control in spring chinook salmon held at the Washington Department of Fisheries (WDF) Hupp Springs Rearing Facility was realized with a 1:6000 treatment applied every other day from ponding until the adult fish showed obvious signs of sexual dimorphism. Safe application of formalin will require the use or construction of a distribution system which meets workplace safety standards (State of Washington 1992) and prevailing fire codes. In addition, proper storage for formalin must be provided on site.

Bacterial Kidney Disease (BKD): BKD is caused by a ubiquitous systemic bacterium (*Renibacterium salmoninarum*). Under some conditions, this disease can cause extensive mortality in salmon broodstock. The disease may also be transmitted from infected female salmon (via eggs/ovarian fluid) to offspring.

As noted previously, adults selected as broodstock will be injected with erythromycin at Roza Dam during bio-processing activities. They will also receive a second such treatment before being spawned. These injections should minimize adult mortality due to BKD and may mitigate vertical transfer (parent to offspring) of the disease.

Ceratomyxa: Research of project Fish Health Specialists has shown the presence of the protozoan *Ceratomyxa shasta* in returning salmon, however, to date the organism has not been found in juvenile salmonids held in liveboxes or recovered from migrants sampled at Prosser Dam (Harrell and Snell 1992). Currently, the organism is not expected to pose management problems.

Others: Parasitic copepods (Anchor Worms) of the genus *Lernea* have been found on most maturing spring chinook salmon observed in the Yakima River (Harrell and Snell, 1993). These parasites have been reported to predispose adults to *Saprolegnia* and/or cause additional stress on adults held for broodstock (Phyllis Barney, USFWS, pers. comm.). There is no known treatment for anchor worms at this time, however, treatment options will be investigated if these copepods pose a threat to adult survival.

Monitoring: A technical support room will be provided for diagnostic/routine fish health monitoring activities as well as other project-related research activities.

Physical Features The facility design will include physical features that minimize the mortality of adult spring chinook salmon held as broodstock and consequently the number of fish to be removed from the natural spawning escapement.

The construction of an upwelling process water supply, overhead spray, and provision of features which otherwise eliminate loss through jumping or injuries are required (Senn, et al. 1984). Water upwelling reduces a tendency of adults to jump and the overhead spray serves to act as a cover, possibly refracting light. These features are incorporated into adult holding ponds of the recently constructed Snake River and upper Columbia salmon hatcheries (e.g., Lyons Ferry and Eastbank).

Flexibility will be designed into the holding and fish handling facilities so that two primary groups of adults can be held separately and handled with minimum stress. External tags might be applied as the fish are collected at Roza Dam to provide the basis for broodstock research including the opportunity to assess time related differential mortality.

Illumination required for security will only be used as necessary to accomplish tasks safely. Otherwise, fish held within the adult holding vessels should not be influenced by artificial illumination so that spawning is not delayed by inadvertent photoperiod extension.

Facilities and Operations

Biological processing Biological processing of maturing adult spring chinook salmon requires the handling of live fish for injection, maturation testing for maturation. Fish in spawning condition will be killed within the pond, and removed for disinfection following NMFS sockeye handling methods (Flagg, et al. 1991).

A specialized area will be provided adjacent to the adult holding vessel(s) for the completion of pre-spawned fish handling. This area shall also provide containment of killing-related waste (blood, mucous, wash-down water, disinfectant) (State of Washington 1990, Appendix 5).

2. Spawning/Mating

Mature fish will be taken from the adult holding area following sorting/killing to a designated area (refer to biological -processing Area, below) for spawning, mating, and sampling necessary to support fish health, genetics, and long-term fitness monitoring and research.

Disinfection procedures will be implemented to minimize the potential for the spread of pathogens during transfer of fish from the adult holding ponds to the spawning area. Iodophor solution of 100 ppm provides general disinfection with a 5 minute exposure (Collinsworth and Allee 1988).

Spawning Eggs will be removed from females using the incision method (Leitritz and Lewis 1980) with eggs and ovarian fluid retained together. Eggs and sperm (milt) from individual spawners will be placed in separate containers.

As necessary, gametes will be stored to prevent or minimize change from the ambient water temperature prior to fertilization. Troughs or refrigerated storage will be required to retain the gamete containers until fertilization. It is assumed that this gamete retention will be of short duration, not exceeding one hour.

Fertilization Fertilization will take place before container transfer to a disinfection room to reduce the extent to which containers and personnel must be disinfected (Carl Ross, Lyons Ferry Hatchery Manager, personal communication, 1993). Use of a similar approach to transfer samples to the technical support room will also be used to reduce or eliminate disinfection of foot traffic to and from the building.

Mating Mating will be randomized with respect to phenotypic traits, including size, within each group of adults which are ripe on the day of spawning. The mating scheme will follow Hatchery Genetic Guidelines (Kapuscinski and Miller 1993).

Biological Processing Area A biological or "bio-processing" area will be provided for research and fish health support activities (OPTT 1992b). The purpose of this area is to make the research and fish handling efficient, and worker-friendly, and to manage activities so that data accuracy is assured. Lifting will be minimized and should only be necessary for removal of carcasses from racks during spawning. There will be no requirement for lifting from the deck, except the necessity to place the killed fish onto racks. Post-spawn processing will occur on a table with the carcasses slid from work station to work station and eventually transferred to leak-proof plastic bins ("totes") as the processing is completed.
The bio-processing area will serve the following functions:

- **Technical Support Fish Identification:** Individual fish will be assigned a unique alphanumeric identifier that will support research/fish health activities. Multiple-part forms may be used to tabulate data derived during these activities (ibid.).

- **Spawning:** Identifiers will be applied to the individual gamete containers.

- **Mating:** Mating procedures will follow Hatchery Genetic Guidelines (Kapuscinski and Miller 1993). Gamete container identifiers will be integrated to provide the genetic history of the pairing.

- **Pathogen Characterization:** Cavity fluid will be sampled as eggs are removed and other appropriate tissues will be excised after spawning for the detection of infectious diseases (e.g., virus and BKD). Samples will be matched, by label, to individual incubation units. Results of the tissue analyses may determine the disposition of individual egg lots and influence fish health management practices.

- **Genetic Sampling:** Samples of heart, eye, liver, and muscle tissues will be taken for electrophoretic and other genetic analyses.

- **Morphometric Measurement:** Morphometric work involving length and weight measurements will occur during bio-processing. Some of this work may precede spawning procedures.

- **Fish Identification:** Coded wire tags, PIT tags (Prentice, et al. 1990), and other identifiers may be present in broodstock; therefore it will be necessary to keep the adults separated from the spawning process until the identifiers can be discriminated for proper matings to occur.

Biological sampling will require use of an adjacent working area (technical support room) for related information management, sample processing and storage, tag recovery and identification, other miscellaneous work, and technical equipment storage.

<u>Carcass Handling and Storage</u> Spawned carcasses held in totes will be loaded onto trucks by fork lift or a tractor equipped with lifting tines. Carcass disposal will be consistent with state and federal regulations and project policy.

An area will be provided for daily storage, cleaning, and disinfection of totes. This area will also be used for equipment disinfection.

<u>C. Incubation</u>

Two systems, isolation-buckets (Novotny, et al. 1984) and vertical incubators (Senn, et al. 1984) will be used to incubate spring chinook salmon eggs at the Cle Elum Hatchery. Wells will provide pathogen-free process water for incubation (BPA 1990). Spring chinook salmon eggs will be isolated from fertilization through the eyed stage to allow for disease certification (CH2M-Hill 1991). Incubation will occur under dark or low-light (working) conditions. Filament lighting in the incubation room is preferred to fluorescent lighting (Bell 1990).

Egg development during incubation will be controlled through using chilled water after development to the 128 cell stage (Combs 1965; Tang, et al. 1987). This provides flexibility to mimic natural conditions (BPA 1990). Managing the incubation temperature also accomplishes several objectives: (1) it regulates the number of days reared prior to transport to acclimation pond, (2) it allows growth control aimed at preventing the fish from attaining a larger than specified size, and (3) it provides opportunity to reduce the time between group ponding, and (4) it facilitates feeding of all fish through water temperature management.

Agency pathologists, per interview, (Hager 1991), preferred a facility design which provided the following:

- Isolation of incubating groups (species). The best-case design would provide separate rooms, not rooms partitioned with moveable curtains. Each room would be separately ventilated to further reduce risk of air-borne disease transfer and include other sanitation features.

- Use of isolation buckets for retaining fertilized eggs, by female, in summer chinook salmon, spring chinook salmon, and summer steelhead. This concern is driven by diseases which may be present in the adults and transmitted via gametes.

1. Disinfection and Water-Hardening

A disinfection (sanitation) room will be provided for post fertilization disinfection and water-hardening processes to increase protection from horizontally and vertically transmitted pathogens and to help control the spread of infectious agents within the incubation facility.

Fertilized eggs will be transferred from the bio-processing area to the disinfection room. Eggs will be dipped for 5 seconds in 100 mg of active iodine per liter of pathogen-free water prior to placement into iso-buckets for 1 hour water-hardening in 100 ppm iodophor to maintain the desired 100 mg/L concentration of disinfectant (Chapman and Rogers 1990). After one hour in iodophor, pathogen-free water will be circulated/introduced to the containers to rinse disinfectant from fertilized eggs. Following water-hardening, iso-buckets will be transferred to the incubation room.

Isolation Bucket Incubators Iso-bucket incubation capacity will be provided equal to the number of females to be collected and retained for spawning (632).

The incubation system uses a down-welling water supply and a pair of nested buckets. Eggs are retained in the upper (inner) bucket and flow is introduced at the top of the bucket and exits downward through a screened bottom. Water level is controlled by ports cut near the top edge of the bottom bucket which serves as a "trough" for the egg bucket. Water will be delivered through mist nozzles at a rate of 18 gallons per hour (Public Utility District NO. 1 of Chelan Co. Wa. 1988).

2. Incubation Through Eyeing

Water-hardened eggs in iso-buckets will be transferred to a separate incubation room for isolation of spring chinook salmon eggs. The iso-buckets will be placed into deep troughs that will be used to control wastewater.

Eggs will remain isolated by bucket until they reach the eyed stage and the parents have been characterized for important diseases (bacterial kidney disease, viruses). Chinook salmon eggs will have accumulated approximately 450 temperature units at eyeing (Senn, et al. 1984).

Chemical treatment will be necessary to control fungus. Formalin is the only effective chemotherapeutant available presently but other agents are being actively investigated and may be available in the future.

Eyed eggs will be physically shocked (Leitritz and Lewis 1980) and allowed to stand overnight before removal of undeveloped or infertile eggs("picking"). Picking and enumeration tasks will be accomplished by a mechanical egg sorter (ibid.).

3. Eyeing Through Emergence

Vertical incubators will be used for the final phase of incubation to facilitate genetic research with up to 50 individual families (Busack 1993a). Hatching fry will be provided substrate within trays (BPA 1990). While there are several alternatives, the shallow tray incubation substrate of choice is heavy plastic netting which is folded and retained in four layers to fit within the trays (Fuss and Seidel 1987).

Following shocking and removal of dead eggs, eyed eggs from each iso-bucket (mating) will be placed into vertical incubator trays that will be arrayed in two stacked 8 tray cabinets as a "stack". In normal production use, each tray has a carrying capacity of 5,000 eggs and each 16 tray stack is provided with up to 10 gallons per minute (gpm) (Senn, et.al. 1984). The number of available vertical incubator trays should match the planned number of iso-buckets (632).

At swim-up, fry will be transferred by pipe or by tray to rearing vessels with the actual ponding date determined by visual observations, condition factor, or ventral slit measurement (Fuss and Seidel 1987). In the latter case, fry are to be ponded when the ventral slit has closed to 1-3 mm in width.

Monitoring flow and temperature of incubation process water is mandatory.

__Fish Health__ Bacterial Kidney Disease (BKD) and IHN Virus: Egg takes from mating pairs with positive indication of virus will not be destroyed automatically but will be managed as necessary, including possible isolation of high titer groups.

__Indoor Rearing__ Fifty troughs will be provided for the indoor rearing of family groups for genetic research (Busack 1993a). The troughs will have sufficient volume to rear each group (assuming a maximum of 5,000 fish) to a size large enough for application of coded wire tags and fin-marks (approximately 250 fish/lb).

The rearing density index will be .175 lbs/ft^3/inch of body length (BPA 1990). Assuming an average length at marking of 2.37", maximum rearing density will approximate .41 lbs per ft^3. The volume requirement per group 250/lb is 48.8 ft^3.

The maximum inflow loading rate is 2 lbs/gpm. It is approximately one-half of the recommended value cited by Piper, et al. (1982) for chinook and coho salmon at 50°F because of handling and marking stress-related considerations. Accordingly, the maximum flow requirement per trough will be 10 gpm. (Note: This quantity is only partially additive to the total flow requirement for the facility since vertical incubator flow will be available in 10 gpm increments for use as fry are ponded.)

EXPERIMENTAL TREATMENTS - FISH REARING

Facilities and Operations

Spring chinook salmon juveniles will be reared under a variety of conventional and experimental conditions (treatments) in hatchery vessels and acclimation ponds. The following discussion encompasses aspects of both experimental and controlled variables (those common to all treatments) to be applied to OCT, NIT, and LNIT treatment groups.

A. Optimal Conventional Treatment

The Optimal Conventional Treatment (OCT) is a treatment that incubates, rears, and acclimates salmonids using optimal conventional fish-culture methods derived from artificial propagation experiences within the Columbia River Basin.

1. Hatchery Rearing

The spring chinook salmon production goal of the Cle Elum hatchery is 810,000 spring chinook smolts weighing 54,000 pounds (Table 8.2). The production population will be separated into 18 groups, nine of which will be reared under the Optimal Conventional Treatment. The OCT fish will be reared under conditions in the hatchery and at off-site acclimation ponds that are expected to produce the highest quality and most fit hatchery fish.

Prior to the end of their rearing cycle (approximately one year post swim-up), all experimental groups will be transferred to off-site rearing ponds for acclimation and release (BPA 1990). This transfer will occur in January to assure their presence at the release site before the increase in thyroxine and other physiological indicators associated with smoltification (and effective homing)(Maynard 1993 and 1993a, Appendix A).

By the end of the hatchery rearing cycle, OCT groups will have essentially attained their maximum size per fish (15 fpp) (BPA 1990, Senn 1993) and maximum biomass of approximately 3,000 pounds. The planned size at release is within the range of release size criteria common throughout the region (Hopley 1993; Scribner 1993a; Maynard 1993b, Appendix A).

Rearing Density: controlled variable (applied to all treatments)

The maximum rearing density is 0.75 lbs/ft^3 of rearing space following the chinook salmon yearling rearing standard adopted for the design of upper Columbia basin facilities including Eastbank Hatchery (Public Utility District NO. 1 of Chelan Co. Wa. 1988). Maynard (1993c, Appendix A) summarized the results of spring chinook salmon rearing density experiments showing survival and contribution advantages provided by lower than normal pond loading rates.

Rearing Vessel: controlled variable

By definition, OCT rearing vessels should represent the current Pacific salmon production standards in length, width, depth, and inflow. Raceway vessels typically conform to a ratio of 30:3:1 for length, width, and depth, respectively (Piper, et al. 1982).

Following a literature review and a review of the PDR, Maynard (1993d, Appendix A) concluded that the recommended length and width were common to current design but the depth of 5 feet as represented in the PDR (BPA 1990) was non-conventional. He further concluded that water depth should be maintained at about 3.0 feet. The experimental design will assume a raceway design standard of 100' x 10' x 3.5' (operating depth) as the optimal conventional treatment in keeping with the Lyons Ferry raceway dimensions and current WDF design.

Raceways will be installed as separate but adjacent units. Standardization of vessels is a critical factor needed to reduce experimental variation among the vessels. Maynard (1993e, Appendix A) provides the experimental rationale for the arrangement of vessels on-site.

Vessels will, for experimental flexibility, be dividable into four equal sections and will have infinitely variable water level control. Surface skimming is required to maintain proper fish health and will be provided by two surface level overflow weirs. These will be designed to provide a means of routinely assessing pond inflow.

Inflow: controlled variable

Flow will be provided as necessary to maintain a high level of dissolved oxygen (not less than 7 ppm) (BPA 1990). In particular, raceways will be supplied with 1.44 cfs (650 gpm) through a pond-width manifold following current WDF facility design. In addition, outlet screens will also span the width of the vessel.

The fish growth model provided in the PDR (BPA 1990) uses a variable temperature profile with constant temperature from May into September for spring chinook salmon culture. Accordingly, two water supplies will be required for the culture of spring chinook salmon at Cle Elum Hatchery: (1) a production quantity surface water source to provide a fluctuating environment (water quality and temperature) needed to properly induce smoltification, and (2) a groundwater system to support production during the summer when surface water temperatures exceed the desired range for spring chinook salmon production.

General Fish Culture: controlled variables

The objective of the fish culture program is to produce high quality fish. The program will follow or modify standard practices which will be detailed or specifically referenced in facility and operations manuals.

The project will rely heavily on the collective fish culture experience of management agencies, individuals, and on current salmonid culture literature including Leitritz and Lewis (1980), Piper, et al. (1982), Senn, et al. (1984), Wood (1979), Fowler (1989), and Collinsworth and Moberly (1983).

Fish Feed/Diet *experimental variable*

"The health and well being of artificially reared fish is directly correlated with proper nutrition and feeding" (Fowler 1989).

Fowler (ibid.) summarized general nutritional recommendations, quality control, and feed-related management practices. Specific spring chinook salmon nutritional requirements are presented in Appendix D (Hardy 1993), including storage criteria related to feed moisture levels. In particular, diets available for fish production fall into general categories based upon their general moisture content as follows: "dry" - less than 11% moisture; "semi-moist" - 12-16% moisture; and, "moist" - greater than 16% moisture (ibid.).

The majority of spring chinook salmon reared at public fish culture facilities are presently started and reared to approximately 400/lb using "closed-formula" semi-moist diets. The remainder of the production is usually accomplished through the use of Oregon Moist Pellet (OMP;Hublou 1963) formulations following bid specifications. Use of semi-moist feed in full-term rearing of spring chinook salmon has been limited and not fully evaluated. Semi-moist diet trials have, however, provided favorable comparisons (growth, conversion, size variation, physiological measures) between spring chinook salmon reared on OMP and semi-moist diets (Hager, et al. 1992).

Diet Recommendations for OCT-reared fish (ibid.) are:

1. Start fry on moist or semi-moist diets.
2. Rear juveniles on moist or semi-moist diets until approximately 1 gram average size.
3. Complete rearing on OMP or similar project-specific formulations.

The upper Yakima spring chinook salmon production program will require approximately 136,000 pounds of feed annually (BPA 1990). Diet procurement will follow project-specific manufacturing and nutritional specifications as detailed in Appendix D.

<u>Feeding Methods, Growth Schedule</u> *experimental variable*

First feeding of spring chinook salmon will occur following yolk absorption when at least 90% of the population is free swimming (Fowler 1989). Approximately 1,665 temperature units at 50°F are required for chinook salmon fry development prior to the time of first feeding (Senn, et al. 1984).

Fish feed is commonly delivered by hand and use of several types of feeders that have a wide range in complexity and application (ibid.). Fish will be fed following Piper, et al. (1982) and Fowler (1989), at frequencies recommended by manufacturer's feeding tables, or as otherwise determined by project fish health/quality control staff.

The fish will be reared in concert with the planned temperature regime (BPA 1990) such that the projected growth schedule is followed and the desired size target is met at the appropriate time.

<u>Pond Cleaning/Pollution Abatement</u>: controlled variable

Pond cleaning will be a manual task. Typically, accumulated solids are removed by suction (vacuum) hose that discharges to an "off-line" pollution abatement system. Cleaning will be accomplished in a manner which will not condition fish to become attracted to large moving objects.

A "General Upland Fin-Fish Hatching and Rearing National Pollutant Discharge Elimination System (NPDES) Waste Discharge Permit" from the State of Washington Department of Ecology is required to operate fish culture facilities (Appendix D). This permit requires facilities using "off-line" waste treatment to monitor discharge to assure meeting discharge standards shown in Table 8.4 and the system performance criteria shown in Table 8.5.

Table 8.4. Effluent Limitations - Draft NPDES permit (ibid.: SII, A, 1a.).

Parameter	Monthly Average	Instantaneous Max.
Settleable Solids	0.1 (net ml/L)	
Total Susp. Solids	5.0 (net mg/L)	15 (net mg/L)

Table 8.5. Treatment system operational criteria - Draft NPDES permit (ibid.: SII, A, 2a.).

Parameter	Monthly Average	Instantaneous Max.
Settleable Solids (% removal)	90	
Total Susp. Solids		100 (mg/L)
Total Susp. Solids (% removal)	85	

Besides meeting the above-mentioned operational/performance criteria, the off-line system must be designed to provide 24 hours hydraulic retention for the cleaning system discharge (State of Washington 1990).

2. Acclimation Rearing

Following the preferred experimental design (Hoffman et. al. IN PRESS), five acclimation sites with six ponds per site will be constructed. All ponds on each site will be supplied from a common water source and will represent each of the two treatments (OCT, NIT,). Two of these sites will be located on the Yakima River between Ellensburg and Keechelus Dam and the other on the Teanaway River. The site selection process will consider biological and environmental criteria important to supplementation objectives.

The acclimation ponds will be sized to hold 45,000 spring chinook salmon. These ponds will be of a common design with a rearing volume of approximately 4,500 cubic feet (BSWG). They will be designed with operational flexibility sufficient to accommodate experimental design requirements and, by site, will have common water supplies and drains. Smolts exiting from the ponds will access the receiving water by the pond drain system. Predators will be controlled to assure fish inventory and experimental integrity.

Sites also feature security fencing, and an alarm system with flow/level sensors. The security fencing will be installed to provide protection from furbearers and bird predation systems will be installed to assure inventory important to experimental needs. The pond outlet structure will be designed for electronic monitoring of outmigrants (smolts).

All ponds will be supplied with surface water with fluctuating temperature. Water delivery systems will use both pumped and gravity supplies.

These vessels will be in use from January through May. Following post-release cleaning, the ponds will be drained and allowed to stand dry until the next rearing cycle.

The OCT groups will be reared in acclimation ponds without any modifications thereby representing normal practices. One of these groups will be represented in separate vessels within each of the five acclimation clusters to meet experimental design needs.

General Fish Culture: controlled variable

All acclimation ponds will be visited daily by project staff to assure project integrity and to do routine fish culture work (fish feeding, cleaning intake and outlet screens, verifying flow, recording temperature and other factors, etc.).

Rearing vessels will not be cleaned during use except as required for fish release. Mortality will be removed and counted daily and otherwise processed as necessary to meet project objectives (saving fish for later tag recovery, etc.).

Because of the rearing density and anticipated low water temperatures, it is unlikely that disease treatment will be required during the acclimation and release phase of their culture. Any disease treatment, however unlikely, will be applied consistently with proper experimental methods.

Rearing Procedures: controlled variables

The planned maximum rearing density index for acclimation ponds is 0.11 lbs/inch/ft^3 (BPA 1990). By mid-April, fish size is projected to be 15/lb attaining a peak acclimation pond loading of 3,000 lbs. (BSWG.). Volitional outmigration is expected to offset the impact of increasing water temperature on the pond loading density through mid-May.

Fish will be fed daily by hand such that nutritional needs for health and growth are met. Sampling for size and consideration of water temperature profiles will provide the basis for reducing size variability across ponds and clusters of acclimation ponds.

Predator Control: controlled variable

Predation by birds and furbearers will be controlled by the construction of fencing and bird covers to assure control of population inventory and experimental integrity.

Monitoring: controlled variable

Pond level and inflow will be monitored continuously by use of electronic technology (monitoring and telecommunication systems).

Pre-release Activities: controlled variables

Pre-release activities will involve pond cleaning next to the outlet one week prior to release to meet pollution discharge standards if pond levels are lowered to induce migration (DOE, Appendix D)..

Post-release Activities: non-experimental

Post-release activities will involve removal of support equipment, pumps, intake and outlet screens, stoplogs, and any other items that could be readily taken by vandals. All exposed supply and drain piping structures will be covered.

Additionally, the ponds will be cleaned and allowed to stand dry until the next rearing season. Pond cleaning will range from addition of commercially available bacterials for aerobic digestion of fish waste to physical removal of accumulated material.

On-site waste management opportunities will be developed in concert with the State of Washington Department of Ecology such that water quality standards are not compromised. If fish are released via pond drawdown, the following effluent limits apply (ibid.):

Parameter	Instantaneous Max.
Settleable Solids	1.0 ml/L
Total Susp. Solids	100 mg/L

Accumulated solids will be hauled off-site for disposal or must be otherwise processed "so as to prevent such materials from entering waters of the state" (ibid.). Senn, et al. (1984) detailed concerns regarding the presence of the botulism organism, *Clostridium botulinum* (Type E), which may weigh against the use of fish pond waste as fertilizer. They further suggest that a fish health specialist be contacted regarding disposal of the sludge.

Fish Transportation - Juveniles: controlled variable

Spring chinook salmon juveniles will be transported from the Cle Elum Hatchery to off-site acclimation ponds for release. Preliminary planning for the project envisioned the use of a variety of fish transportation systems (BPA 1990). Hauls from Cle Elum average 20 one-way miles (ibid.). Considering haul length and loading time, fish hauling time will probably not exceed 1.5 hours.

The recommended maximum loading rate for transporting spring chinook yearlings (15 fish/lb) is 1.0 pounds per gallon at 50°F (OPTT 1992). This rate is at the lower end of the range noted by Piper, et al. (1982) for 215 fish/lb chinook salmon.

3. Research Support

Fish Marking: controlled variable

Knudsen (1993) summarized experimental and operational considerations associated with a wide variety of internal and external fish tags, visible implants, fin marks, and elemental scale marks.In addition to providing space for tag recovery as previously noted, hatchery facilities will also be designed to accommodate mobile marking units.

Use of rare earth or elemental solutions will require provisions for neutralization such as activated charcoal filters(ibid.).

Fish Handling: controlled variable

Facilities and Operations

Juvenile fish handling will be accomplished using the method imposing the least stress or risk to fish health. Piper, et al. (1982) noted the importance of assuring an adequate oxygen supply, a clean handling vessel and avoidance of over-loading nets and containers, water temperature shock, etc. Transport tank loading will be mechanized using fish pumps or Archimedes screw technology.

Randomization

Zero-age fish, including family groups will be randomly distributed into each of the treatment sub-populations (groups) before placement into separate vessels (treatments). Randomization will occur at the eyed-egg stage concurrent with automated removal of dead eggs and enumeration of viable eggs. Use of automatic systematic random sampling equipment is envisioned.

4. Behavior Techniques: *experimental variable*

Does not apply.

5. Exercise: *experimental variable*

Does not apply.

6. Vessel Modifications

Raceway Color: *experimental variable*

Does not apply.

Overhead Cover: *experimental variable*

Does not apply.

7. In-water Structure: *experimental variable*

Does not apply.

8. Substrate: *experimental variable*

Does not apply.

9. Subsurface filtration: *experimental variable*

Does not apply.

B. New Innovative Treatment

New Innovative Treatment (NIT) is a treatment that incubates, rears, and acclimates spring chinook salmon using natural-like environments (e.g., natural cover, substrate, in-water structure)to produce fish with attributes that approximate those of naturally produced spring chinook. [(2)]Details of this treatment are being further developed.

This section describes the New Innovative Treatment of planned upper Yakima River spring chinook salmon supplementation research. Five groups of these fish will be reared from initial feeding through release under artificial production circumstances that have been modified physically and procedurally to fit experimental purposes.

Anticipated experimental rearing and release methods and procedures are detailed below.

1. Hatchery and Acclimation Rearing

As previously noted, the spring chinook salmon production goal of the Cle Elum Hatchery-based activities is 810,000 fish weighing 54,000 pounds. Rearing of the NIT portion (405,000 fish) will be accomplished with methods intended to allow enhancement of behavioral, morphological, and physiological characteristics that are important to survival.

Rearing Density: controlled variable

Since the benefits of lower rearing density on survival have been demonstrated (Banks 1990), and the project has chosen an optimal rearing density for OCT fish, the NIT fish will be reared at the same density as OCT fish in raceways and acclimation ponds.

Rearing Vessels: controlled variable

(see OCT)

Inflow: controlled variable

(see OCT)

General Fish Culture: controlled variables

Routine fish culture practices other than those discussed below will be standardized across all treatments.

Fish Feed/Diet: *experimental variable*

NIT fish diets will be supplemented with live organisms throughout their hatchery rearing period to condition released spring chinook salmon smolts to forage more effectively on naturally occurring food organisms. They will otherwise be fed with the OCT diet or possibly with an alternate prepared diet resembling the constituents of natural feed. Diets for NIT use will be manufactured following specifications that provide the desired nutrition requirements and appropriate feed delivery characteristics.

NIT fish will be fed caloric amounts equal to OCT and LNIT treatment groups.

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(2). Yakima/Klickitat Fisheries Project Planning Status Report 1992

Feeding Methods: *experimental variable*

Floating pellet feed will be introduced underwater. Feed delivery will be mechanical and sequenced to follow natural biorhythms from dawn to dusk. Feeding frequency will be appropriate to achieve proper growth.

Growth Schedule: controlled variable

(see OCT)

Pond Cleaning/Pollution Abatement: controlled variable.

a. Raceways: The raceway cleaning system will be designed to work effectively over natural substrates and will not condition fish to seek moving objects.

b. Acclimation Ponds: Cleaning will only take place as necessary to prepare the vessels for smolt release. It is expected that this will be limited to the area next to the outlet structure where settled solids could be disturbed with pond drawdown or increased exit velocity.

Fish Transportation - Juveniles: controlled variable

(see OCT)

Predator Control: controlled variable

Predation by birds and furbearers will be controlled by the construction of fencing and bird covers to assure control of population inventory and experimental integrity. Predator avoidance training is discussed below.

Monitoring: controlled variable

2. Research Support

Fish Marking: controlled variable

(see OCT)

Randomization: controlled variable

(see OCT)

3. Behavior Techniques: *experimental variables*

Predator Avoidance Training: Avoidance training methodology will be applied to NIT experimental groups to allow fish to avoid predators. Fish will be trained to avoid predaceous fish, birds, and possibly mammals.

Conditioning may: (1) follow the approach of Thompson (1966) in which fish were trained with electrified model predators; (2) the approach of Olla and Davis (1989) in which fish were conditioned by exposure of fish to predators; or (3) be achieved by the placement of predators in cages in rearing vessels.

4. Exercise: *experimental variable*

Exercise is envisioned as a means of improving fish performance. This may be accomplished by the use of pumps or temporarily configuring vessel water supplies to create increased water velocities in raceways and acclimation ponds.

The planned exercise velocity will be one fish body length per second (Maynard 1993f, Appendix A).

5. Vessel Modifications: *experimental variable*

It is expected that standard raceways will be modified to improve fish quality and ultimately to achieve higher post-release survival ("quality").

Overhead Cover Overhead cover will be applied at a covered-to-uncovered ratio of 4:1 (ibid.).

> **a. Raceways:** Use of overhead cover will allow fish to become adapted to natural structures to avoid predation. It is expected that the effect of an undercut bank will be achieved by using pond-width aluminum-frames covered with camouflage netting. Approximately 80% of the raceway surface will be covered.
>
> **b. Acclimation Ponds:** Use of floating covers will facilitate fish culture activities and meet experimental needs as well.

6. In-water Structure: *experimental variable*

Use of in-water structures is envisioned to create a varied rearing environment in both raceways and acclimation ponds. While specifics are not available, it is expected that the materials used may be as simple as denuded vegetation or more complex, being constructed to meet the need.

7. Substrate: *experimental variable*

Vessels will be designed to allow randomization of vessels and substrate between years as required by experimentation.
Raceway Color Donnelly (1991) and Maynard (in preparation) indicate that fish exposed to a rearing environment of the color matching that of the natural background of the area into which the fish will be released can be cryptically adapted. A period of at least seven weeks is required for full chromatophore expression.

Raceways will be modified to achieve the appropriate condition as determined by field use of colorimetric methods.

Substrate

Facilities and Operations

a. Raceways: The bottom of each NIT raceway will be covered with gravel substrate of color similar to the general river substrate over which they will be released. The raceway walls will be painted to resemble stream background coloration.

b. Acclimation Ponds: Acclimation ponds will be lined with river rock.

8. Subsurface Filtration: *experimental variable*

A rough substrate has the potential to collect settleable solids and improve environmental conditions within the formal rearing vessels through the actions of decay organisms.

a. Raceways: The bottom of each NIT raceway may be equipped with a substrate biological filtration system to enhance decomposition of organic materials that cannot be removed otherwise.

b. **Acclimation:** does not apply.

C. Limited New Innovative Treatment

This report section describes the Limited New Innovative Treatment, an alternate treatment that may eventually be tested with upper Yakima spring chinook salmon supplementation research. Nine groups of spring chinook salmon will be reared from incubation through transfer to acclimation ponds under normal artificial production (OCT). Their rearing will be completed in acclimation ponds under modified physical conditions identical to NIT procedures.

LNIT is a treatment applied to spring chinook salmon that uses the OCT during the incubation and rearing phase and uses the NIT during the smolt acclimation/release phase.

1. Hatchery Rearing

As previously noted, the spring chinook salmon production goal of the CleElum Hatchery-based activities is 810,000 fish weighing 54,000 pounds. The production population will be separated into 18 treatment groups, nine of which could eventually be reared under standard (OCT) rearing conditions in raceways until transfer to acclimation ponds.

Except as noted under B (NIT) above, all variables associated with LNIT rearing will be controlled and identical to those discussed under A (OCT) above. As such, routine fish culture practices other than those discussed below will be standardized across all treatments.

Rearing Density: controlled variable

(see OCT)

Rearing Vessel: controlled variable

(see OCT)

Inflow: controlled variable

(see OCT)

General Fish Culture: controlled variables

(see OCT)

Fish Transportation - Juveniles: controlled variable

(see OCT)

Fish Feed/Diet: *experimental variable* - identical to OCT

(see OCT)

Feeding Methods, Growth Schedule: Identical to OCT

(see OCT)

2. Acclimation Rearing

The LNIT groups will be separately reared in semi-natural (NIT) condition in acclimation ponds. Rearing in acclimation ponds will be accompanied with methods intended to allow expression of behavioral, morphological, and physiological characteristics that are important to survival.

Except as noted under B (NIT) above, all variables associated with rearing will be controlled and identical to those discussed under A (OCT) above. Routine fish culture practices other than those discussed below will be standardized across all treatments.

Fish Feed/Diet: *experimental variable* - identical to NIT

Feeding Methods: *experimental variables* - identical to NIT

Growth Schedule: controlled variable - identical to OCT

3. Research Support

Fish Marking: controlled variable - identical to OCT

Randomization: controlled variable - identical to OCT

4. Behavior Techniques: *experimental variable*

Raceways: identical to OCT

Acclimation Ponds: identical to NIT

5. Exercise: *experimental variable*

Raceways: identical to OCT

Acclimation Pond: identical to NIT

6. **Vessel Modifications**: *experimental variable*

Raceway Treatment: identical to OCT

Acclimation Pond: identical to NIT

7. **In-water Structure**: *experimental variable*

Raceway Treatment: identical to OCT

Acclimation Pond: identical to NIT

8. **Substrate**: *experimental variable*

Raceway Treatment: identical to OCT

Acclimation Pond: identical to NIT

9. **Sub-surface Filtration**: *experimental variable*

Raceway Treatment: identical to OCT

Acclimation Pond: sub-surface filtration will not apply in acclimation ponds.s

STANDARD RELEASE TREATMENTS

Fish will be allowed to outmigrate volitionally from acclimation ponds and the ponds will be managed in terms of inflows and water levels to minimize residualizing fish.

Procedures Smolt release procedures will follow the experience of WDF in other upper Columbia drainages (primarily the Snake, Wenatchee, and Methow river systems). Generally, screens will be removed at the onset of migration to provide smolts an opportunity to outmigrate without interruption.

Enumeration Migrating fish will be counted as they pass out of the acclimation ponds through or past sensing heads of electronic fish counters. The outlet structure design will reflect current management agency experience with fish counters.

9.0 Monitoring

Monitoring has been planned to track project progress toward meeting objectives. Related to monitoring is the management and dissemination of information so that project results are available in a timely manner and a usable form.

The plan is organized into five sections according to monitoring: Quality Control, Product Specifications, Research, Risk Containment, and Stock Status. These groupings are not absolutely distinct; they simply provide a systematic way to present monitoring needs for each purpose. Monitoring activities to address all five purpose categories are then integrated into a single non-duplicative monitoring plan. This plan identifies measurements to be taken monitor experimental response variables and to contain risks associated with uncertainty. Future iterations of this plan will include more details on sampling methods and frequencies and a detailed quality-control program. The level of detail here is deemed sufficient to proceed with NEPA documentation and design of facilities for supplementation of Upper Yakima spring chinook .

Quality-Control Monitoring

The purpose of quality-control (QC) monitoring is to (1) assure that fish culture and monitoring activities are conducted as intended, (2) reduce to a minimum the variation from manageable sources other than experimental treatments (3) assure the validity of the data collected, (4) assure proper record keeping and access to information, and (5) provide information needed for cost-effective operation. Quality control monitors performance of the facilities and their operators. Quality standards will be established for all fish-culture and data-collection activities. Quality-control monitoring procedures will be included in the operations manuals for all facilities and field activities.

Development of quality-control standards and monitoring protocols is a part of the certification tasks described in the URP. No further details about QC monitoring are covered in this section at this time. As the certification process proceeds, this portion of the monitoring plan will be expanded.

Feedback from QC monitoring affects management and supervision of operational activities. It does not affect the treatment prescriptions. When QC standards are met, it is assumed that various treatments are being applied according to stated protocols .

QC monitoring protocols are modified in response to changes in the treatment prescription, i.e. when the "Treatment Definitions and Descriptions" section of Chapter 8 is altered (e.g., through the results of product-specification monitoring).

Product Specification[3]

Product specification monitoring is an extension of quality control, where the "product of the artificial environment" is monitored and compared with a defined template. For the NIT, this template consists of a profile describing the natural ideal in terms of a set of measurable attributes (Assumption #325). For OCT, it is the standard used in conventional culture (Assumption # 21). The product of the artificial environment for the NIT treatment is described in terms of a history of attributes (measurements) of a group of fish from the selection of their parent broodstock to their liberation from the acclimation sites. The purpose of the NIT treatment is to produce attributes similar to natural fish. For the OCT, the product definition is obtained from other facilities or from the literature.

Monitoring at this level measures how well the defined treatments (NIT/ and OCT) meet their respective product specifications. The product specifications are stated in terms of attributes describing health, morphology, behavior and survival of hatchery fish (see Vol. 3, Chap. 8).

Part of the product specification for NIT is an in-facility survival standard that requires pre-spawning and egg-to-smolt survival to exceed 80% and 65%, respectively. Survival by life stage from spawners trapped at Roza to the release of their offspring into the natural environment will therefore be monitored.

Product specification attributes include both static end-point measurements and growth and development profiles of hatchery fish over time (i.e., histories of attribute measurements). They include both population means and descriptors of diversity (frequencies and/or variances). Table 9.1 lists the measurement categories to be monitored, while the fish are still within the artificial environment.

Table 9.1. Categories of Observations needed to Monitor Product Compliance.

Attributes		at Release		monthly
		mean	frequency	record
Fish Health	Physiology Disease	x x		x
Morphology	Morphometrics Crypsis	x x	x	x
Behavior	Migration time Social	x x	x x	
Survival	by stage	x		x

(3) The term "Performance" which was used in Chapter 9 of the PSR comes from the FWP framework terminology where e.g. "performance" of a flow strategy is measured as changes in travel time. We use "Product Specification" here to avoid confusion, since elsewhere we use the term "performance" to indicate survival, fitness etc.

Product-specification monitoring collects information about the fish. Feedback affects the Treatment Definitions and Descriptions (Chapter 8) and the Operations Manual. When specifications are met, the treatments are assumed appropriate and the supplementation strategies and experimental protocols are implemented as planned, i.e., the Treatment Definitions and Descriptions and the Operations Manual are meeting project objectives. When observations suggest that the fish do not meet the specification, a determination of the needed changes must be made. Changes are then implemented through modifications to the Treatment Definitions and Descriptions and/or the Operations Manual.

The Product Specifications are modified based on results of research and risk-containment monitoring or new policy direction affecting objectives and strategies.

Research

There are critical uncertainties regarding both the artificial and natural environments within which the YFP supplementation project operates. Research activities are planned to test alternatives in the artificial environment (treatment effectiveness testing, e.g., NIT vs. OCT) and to compare performance of artificially and naturally reared fish (e.g., NIT vs. Natural). Assumption #200[(4)], for example, pertains to the relative performance of supplementation and natural fish, whereas #201 and #202 pertain to differences between NITs and OCTs.

Success of the YFP also depends upon a progressively better understanding of the ecological interactions among and within species in the Yakima Basin. There are critical uncertainties about both intra- and inter-specific effects of supplementation. Research pertaining to the dynamics of the ecosystem is described under the heading of PTA (Patient Template Analysis) below.

Treatment Effectiveness Testing

A fundamental hypothesis is that new innovative hatchery treatments (NITs) will improve performance of treated fish significantly over optimal conventional treatments (OCTs) (see assumptions #201 and #202). YFP experiments are specifically designed to test this hypothesis. The monitoring requirements for testing specific hypotheses about differences between NIT and OCT in terms of measurable response variables[(5)] are identified in this subsection.

The different test treatments are compared in terms of performance with respect to survival, reproductive success, and in a more limited sense to long-term fitness[(6)] and ecological interactions[(7)].

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(4) Assumption #200: "Release of smolts that mimic natural fish ensures that post-release survival is greater than half the survival of wild smolts."

(5) The term performance refers to quantitative and qualitative characteristics of groups of fish including fitness,survival, life-history and ecosystem interactions. Performance is observed and measured in terms of response variables.

(6) While the intent of the NIT treatment is to minimize genetic effects due to supplementation, the ability to compare long term fitness among treatments is very limited. Straying rates into the Naches and American Rivers can perhaps be

Monitoring

The experiment described in Chapter 6 is designed to detect a 50% difference in survival among treatments with 90% certainty. Response variables for testing hypotheses for the NIT-OCT comparison experiment are outlined in Table 9.2. Observations required (i.e., where, what and why) to compute response variables are summarized in Table 9.3.

Comparing hatchery and natural fish

Assumption #200 is critical to the success of supplementation. The operation of Chandler Juvenile Monitoring Facility allows the comparison of survival between OCT and NIT smolts from release in the upper Yakima to smolts at Chandler, as well as estimates of survival from egg to smolt for natural and hatchery fish. The juvenile monitoring facility at Roza may also prove valuable although its operation and utility are not comparable to Chandler at this time. The comparison of morphometrics, behavior, and survival of OCT, NIT and naturally produced smolts that survive to Chandler may help to refine the product specifications for improving the NIT. The estimation of survival from smolt to returning adults can also be made as returning adults are monitored at the fish ladders on Chandler and Roza dams.

Another opportunity to compare performance of natural and hatchery fish occurs when the adults return to Roza. Representative subsamples of hatchery and natural-origin fish can be marked and tracked allowing their spawning distribution, timing, and egg-deposition success to be compared.

Tables 9.2 and 9.3 outline the monitoring plans for the NIT vs. Natural fish hypothesis testing.

Patient-Template Analysis

An essential part of the YFP planning process is the so-called Patient-Template Analysis (PTA) where factors limiting production are identified. The PTA is a part of an iterative process by which assumptions about the relationships between life histories and habitat are updated as new information is obtained and analyzed. New information from PTA may result, for example, in a modification of the template for the NIT.

A preliminary PTA (RASP 1991) has been conducted and a draft report is in preparation for upper Yakima spring chinook. Additional analysis of existing data will provide a better understanding about the factors limiting spring chinook production in the Yakima Basin.

The Natural Production Objectives analysis and subsequent risk assessment have pointed out the critical nature of assumptions concerning intra-specific ecological interactions during the smolt outmigration. The feasibility of developing experiments to test hypotheses regarding the effects of hatchery fish on smolt-to- smolt survival of natural fish should be investigated. These uncertainties are

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compared between treatments as a partial measure of adverse genetic impact. Genetic monitoring of the YFP is also covered under Risk Containment.

(7) No ecological response variables are identified to compare interaction effects of NIT and OCT fish. Ecological interactions are subject to research under the PTA topic.

reflected in the risk-containment monitoring plan.

Table 9.2. Response Variables to Test Hypotheses

Population Response Categories	NIT vs OCT Response Variables for Hypothesis Testing	Hatchery vs Natural Response Variables for Hypothesis Testing
Post-Release Survival	Survival from Smolt at release to smolt at Chandler	Survival from smolt at Chandler to returning adult at Chandler and Roza
	Survival from smolt at Chandler to Adults at Chandler and Roza	
Reproductive Success	Returning Adults at Roza (by#,age,sex, and time)	Spawning (time, loc, eggs/carc.) from Tagged samples (Roza) of (OCT,NIT) vs Natural adults. Returns/Spawner[(a)] Smolts/Spawner
	Straying rate into Naches & American Rivers	
	Spawning (time, loc, eggs/carc.) from Tagged samples (Roza) of OCT vs NIT adults.	
Long-Term Fitness	Straying Rate into Naches & American Rivers	To be specified in GMP
Ecological Interactions	To be specified	To be specified

(a) This is a highly variable statistic that in nature varies with density as well as with environmental conditions throughout their life-history, consequently the statistical power of tests based on this response variable is expected to be very poor. However because of the unusual opportunity to intercept and account for all adults returning to Roza, it can be measured and would provide a record of outcomes by brood year.

Risk Containment

Analysis of results from all monitoring levels contribute to decisions about the future of the project. The purpose of risk containment is to identify monitoring needs and to organize information required to make rational decisions based on projected benefits and risks. This is where we test the hypothesis that supplementation in fact works.

The statement of objectives in quantitative and qualitative terms defines project success. When these objectives are met or exceeded, the project' s continuation is justified. Conversely, failure to meet objectives suggests that the project should be significantly modified or perhaps ended. Our ability to distinguish success from failure depends upon the quality of the risk-containment monitoring program. Conclusions about project success (i.e., achievement of objectives) are manifested in decisions to continue or to reshape the project. These decisions are never final; they are reexamined on an iterative basis according to the policy of adaptive management. At each such iteration, an assessment is made regarding benefits and risks of the project, and the conclusions are affected by the results of new information. The question whether or not supplementation "works" is thus constantly reexamined ,and the conclusion is always conditioned upon available information. The decision to continue to supplement is synonymous to a conclusion that supplementation works (i.e., the benefits exceed the risks) at that point in time.

The determination of both risks and benefits requires a synthesis of all available information. This monitoring section should specify information needed to perform this synthesis, beyond what is needed to address the other four monitoring levels. The identification of the risk-containment monitoring needs is performed in a systematic way as described in Chapter 7, Risk Analysis.

The risk analysis defines risk in terms of failure to meet objectives in four categories: genetics, experimentation, ecological interaction/ natural production, and harvest. The monitoring needs for all four categories have been integrated in Table 9.3. The risk analysis provides the rationale for the entries in the table (see Chapter 7).

The entries in the second column of Table 9.3 are defined as follows:

ADLT MARK interr = sampling of adult fish; identifying whether or not they are marked; if they are marked ,the mark is decoded and the experimental treatment and replicate group of the fish are determined; a set of observations are recorded for each sampled fish including, time, location, size, sex, and other benign measurements; subsamples may also be subjected to tissue sampling as needed.

ADLT ENUM = enumeration of fish by externally observable categories (e.g., marked vs .unmarked).

REDDS = observations on the spawning grounds, such as no. fry/redd, and also biosampling of carcasses.

GroupMARK = application of unique marks to juveniles of each replicate group, that can be decoded on returning adults (without harming the fish).

ADULT TAGGING = application of individually unique marks to adults that are passed upstream at Roza or natural spawning. Representative subsamples of NIT, OCT, LNIT, and unmarked fish are selected and marked. These fish are subsequently tracked and observed on the spawning grounds, where time and location of spawning are recorded; redds and carcasses may also be examined.

The scope of the monitoring program may change as more information about needs and feasibility become available. The elements listed in Table 9.3 represent the high-priority monitoring needs that are also judged feasible based upon current technology.

Density and distribution(time, space and habitat type) by life stage are identified as high-priority monitoring needs in the risk analysis for natural production and ecological interactions. Sampling plans to address this need will be addressed following completion of the Patient Template Analysis.

Stock Status

Monitoring of stock status (run size and spawning escapement) provides information essential to track long-term performance and fitness of the population. Monitoring needs for in-season run size assessment are included under risk containment monitoring (see Chapter 7 and Table 9.3). Stock status information includes abundance and distribution (by time, location, and habitat type) as well as other demographics. Target and key non-target species would be monitored.

Table 9.3. Summary of Observations needed to Compute Response Variables

MONITORING LOCATIONS (Where)	MEASUREMENT (What)	MONITORING PURPOSE(8) (Why)			
		Product Specs	Research/Hyp	Risk Containm.	Stock Status
		1) Fish health 2) Morphology 3) Behavior 4) Survival	1) NIT vs OCT 2) Natural vs NIT 3)PTA	1. Genetics 2. Ecological 3. Experimental 4. Harvest	1. Run Size 2. Escapement
CE Hatch	ADLT ENUM GroupMARK attrib/surv histories	 1,2,3,4 1,2,3,4	 1,2,3	1,2,4	1,2 1,2
Accl Pnds	NBR(time,size) Rand Biosample IND MARK subs	2,3,4 1 4			
Roza JV	attr of Hat fish? MARK interrog att of NAT fish	1,2,3 4 1,2,3	3 1, 2 3		
Chandler JV	attr of HAT fish attr of NAT fish MARK interrog	1,2,3 1,2,3 4	3 3 1,2		
Test Fishery	ADLT MARK interr		1,2	4	1
Prosser AD	ADLT MARK interr ADLT ENUM		1, 2	1,3,4 1,4	1 1
Fishery	ADLT MARK interr ADLT ENUM		1	1,3,4	1 1
Roza AD	ADLT MARK interr ADLT ENUM ADULT TAGGING		1 2 2	1,3,4 3	1 1
UY Spwg	ADLT MARK interr ADLT ENUM		1,2	1,4	2 2
Na Spwg	ADLT MARK interr ADLT ENUM		1,2	1,4	2 2
Am Spwg	ADLT MARK interr ADLT ENUM		1,2	1,4	2 2

(8) Quality Control Monitoring is not included.

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Appendix C: Glossary of Species Scientific Names

APPENDIX C

GLOSSARY OF SPECIES SCIENTIFIC NAMES

Adder's tongue (*Ophioglossum vulgatum*)
Aquatic earthworms (Oligochaeta)

Bald eagle (*Haliaeetus leucocephalus*)
Bear grass (*Xerophyllum tenax*)
Beaver (*Castor canadensis*)
Bedstraw (*Galium aparine*)
Belted kingfisher (*Ceryle alcyon*)
Bighorn sheep (*Ovis canadensis*)
Bitter cherry (*Prunus emarginata*)
Bitterbrush (*Purshia tridentata*)
Black cottonwood (*Populus trichocarpa*)
Black flies (Simuliidae)
Black hawthorn (*Crataegus douglasii*)
Black-capped chickadee (*Parus atricapillus*)
Blackberry (*Rubus* spp.)
Blue elderberry (*Sambucus cerulea*)
Bracken fern (*Pteridium aquilinum*)
Bridgelip suckers (*Catostomus columbianus*)
Brook trout (*Salvelinus fontinalis*)
Brown trout (*Salmo trutta*)
Bull thistle (*Cirsium vulgare*)
Bull trout (*Salvelinus confluentus*)
Bulrush (*Scirpus* spp.)
Bursage (*Ambrosia acanhicarpa*)

Caddisflies (Trichoptera/Hydropsychidae)
Caddisfly larvae (Trichoptera/Hydropsychidae)
Carey's balsamroot (*Balsamorhiza careyana*)
Carp (*Cyprinus carpio*)
Cascades frog (*Rana cascadae*)
Cattail (*Typha latifolia*)
Channel catfish (*Ictalurus punctatus*)
Cheatgrass (*Bromus tectorum*)
Chinook salmon (spring, summer, fall) (*Oncorhynchus tshawytscha*)
Chiselmouth (*Acrocheilus alutaceus*)
Choke cherry (*Prunus virginiana*)
Clover (*Medicago* spp.)
Coho salmon (*Oncorhynchus kisutch*)
Coltsfoot (*Petasites frigidus*)
Columbian sharp-tailed grouse (*Tympanuchus phasianellus columbianus*)

Common snipe (*Gallinago gallinago*)
Cutthroat trout (*Oncorhynchus clarki*)

Deer (*Odocoileus* spp.)
Dock (*Rumex* spp.)
Douglas fir (*Pseudotsuga menziesii*)
Douglas squirrel (*Tamiasciurus douglasi*)

Elk (*Cervus elaphus)*

Ferruginous hawk (*Buteo regalis*)
Fireweed (*Epilobium angustifollium*)
Fleabane (*Erigeron* spp.)

Western garter snake (*Thamnophis elegans*)
Golden-crowned kinglet *(Regulus satrapa*)
Goldenrod (*Solidago* spp.)
Grand fir (*Abies grandis*)
Gray wolf (*Canis lupus*)
Green-fruited sedge (*Carex interrupta*)
Grizzly bear (*Ursus arctos = U. a. horribilis*)
Gull (*Larus* spp.)

Hairy woodpecker (*Picoides villosus*)
Harlequin duck (*Histrionicus histrionicus*)
Hawthorn (*Crataegus* spp.)
Hoover's tauschia (*Tauschia hooveri*)
Huckleberry (*Vaccinium* spp.)

Killdeer (*Charadrius vociferus*)
Kinnickinnick (*Arctostaphylos uva-ursi*)
Knapweed (*Centaurea* spp.)
Kokanee (*Onchorhynchus nerka*)

Lake trout *(Salvelinus namaycush*)
Largemouth bass (*Micropterus salmoides*)
Largescale sucker (*Catostomus macrocheilus*)
Leopard dace (*Rhinichthys falcatus*)
Lodgepole pine (*Pinus contorta*)
Loggerhead shrike (*Lanius ludovicianus*)
Longnose dace (*Rhinichthys cataractae*)
Lupine (*Lupinus* spp.).

Marbled murrelet (*Brachyramphus marmoratus*)
Mayflies (Ephemeroptera)
Mock orange (*Philadalphus lewisii*)
Mountain whitefish (*Prosopium williamsoni*)
Mullein (*Verbascum thapsus*)

Northern flicker (*Colaptes auratus*)
Northern goshawk (*Accipiter gentilis*)
Northern red-legged frog (*Rana aurora aurora*)
Northern spotted owl (*Strix occidentalis caurina*)
Northern squawfish (*Ptychocheilus oregonensis*)

Oak (*Quercus* spp.)
Oceanspray (*Holodiscus discolor*)
Oregon grape (*Berberis nervosa*)
Osprey (*Pandion haliaetus*)

Pacific fisher (*Martes pennanti pacifica*)
Pacific yew (*Taxus brevifolia*)
Pearly everlasting (*Anapahlis margaritacea*)
Peregrine falcon (*Falco peregrinus*)
Pine broomrape (*Orobanche pinorum*)
Ponderosa pine (*Pinus ponderosa*)
Purple aster (*Machaeranthera canescens*)

Rainbow trout (*Oncorhynchus mykiss)*
Raven (*Corvus corax*)
Red Alder (*Alnus rubra*)
Red osier dogwood (*Cornus stolonifera*)
Red-breasted nuthatch (*Sitta canadensis*)
Redside shiner (*Richardsonius balteatus*)
Reed canary grass (*Phalaris arundinacea*)
Rose (*Rosa* spp.)
Rubber boa (*Charina bottae*)
Rush (*Juncus* spp.)
Russian knapweed (*Centaurea repens*)

Sandberg's bluegrass (*Poa sandbergii*)
Sculpin (*Cottus* spp.)
Sedge (*Carex* spp.)
Sharp-tailed snake (*Contia tenuis*)
Smallmouth bass (*Micropterus dolomieui*)
Snowberry (*Symphoricarpos albus)*
Sockeye salmon (*Onchorhynchus nerka*)
Southern alligator lizard (*Elgaria multicarinata*).

Speckled dace (*Rhinichthys oscuslus*)
Spotted frog (*Rana pretiosa*)
Spring vetch (*Vicia sativa*)
Squirrel tail (*Sitanion histrix*)
Stoneflies (Plecoptera)
Strawberry (*Fragaria* spp.)
Sucker (*Catostomus* spp.)
Summer steelhead (*Onchorhynchus mykiss*)
Swamp saxifrage (*Saxifraga integrifolia* var *apetala*)

Thimbleberry (*Rubus parviflorus*)
Torrent sculpin (*Cottus rhotheus*)
True flies (Diptera)
Tumblemustard (*Sisymbrium altissimum*)

Varied thrush (*Ixoreus naevius*)
Victorin grape-fern (*Botrychium minganense*)
Vine maple (*Acer circinatum*)

Western fence lizards (*Sceloporus occidentalis*)
Western hemlock (*Tsuga heterophylla*)
Western red cedar (*Thuja plicata*)
Western sage grouse (*Centrocercus urophasianus phaios*)
Western white pine (*Pinus monticola*)
Westslope cutthroat trout (*Onchorhynchus clarki lewisi*)
Wheatgrass (*Agropyron* spp.)
Willow (*Salix* spp.)
Yarrow (*Achillea millifolium*).
Yellow perch (*Perca flavescens*)
Yellow salsify (*Tragopogon dubius*)

Appendix D: Endangered Species Consultation

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Ecological Services
3704 Griffin Lane SE, Suite 102
Olympia, Washington 98501-2192
(206) 753-9440 FAX: (206) 753-9008

October 7, 1994

Rosy Mazaika
Environmental Sciences Department
Battelle Pacific Northwest Laboratories
Portland Operations
500 N.E. Multnomah, Suite 650
Portland, Oregon 97232

FWS Reference: 1-3-94-SP-698

Dear Ms. Mazaika:

This is in response to your letter dated July 8, 1994, and received in this office on July 11, 1994. Enclosed is a list of proposed and listed threatened and endangered species, and candidate species (Attachment A) that may be present within the area of the proposed Yakima Fisheries Acclimation Pond Sites Project in Kittitas and King Counties, Washington. The list fulfills the requirements of the Fish and Wildlife Service (Service) under Section 7(c) of the Endangered Species Act of 1973, as amended (Act). We have also enclosed a copy of the requirements for Bonneville Power Administration (BPA) compliance under the Act (Attachment B).

Should the biological assessment determine that a listed species is likely to be affected (adversely or beneficially) by the project, the BPA should request Section 7 consultation through this office. If the biological assessment determines that the proposed action is "not likely to adversely affect" a listed species, the BPA should request Service concurrence with that determination through the informal consultation process. Even if the biological assessment shows a "no effect" situation, we would appreciate receiving a copy for our information.

Both listed and proposed species may occur in the vicinity of the project. Therefore, pursuant to the regulations implementing the Act, impacts to both listed and proposed species must be considered by the BPA in a biological assessment. The results of the biological assessment will then determine if a consultation and/or conference is required.

Formal conference with the Service is required if the BPA determines that the proposed action is likely to jeopardize the continued existence of a proposed species.

Candidate species are included simply as advance notice to federal agencies of species which may be proposed and listed in the future. However, protection provided to candidate species now may preclude possible listing in the future. If early evaluation of your project indicates that it is likely to adversely impact a candidate species, the BPA may wish to request technical assistance from this office.

There may be other federally listed species that may occur in the vicinity of your project which are under the jurisdiction of the National Marine Fisheries Service (NMFS). Please contact NMFS at (503) 230-5430 to request a species list.

In addition, please be advised that federal and state regulations may require permits in areas where wetlands are identified. You should contact the Seattle District of the U.S. Army Corps of Engineers for federal permit requirements and the Washington State Department of Ecology for state permit requirements.

Your interest in endangered species is appreciated. If you have additional questions regarding your responsibilities under the Act, please contact Jim Michaels or Kristi Swisher of this office at the letterhead phone/address.

Sincerely,

David C. Frederick
State Supervisor

ks/mjr
Enclosures
SE/BPA/1-3-94-SP-698/Kittitas, King

c: WDFW, Region 3 & 4
WNHP, Olympia

ATTACHMENT A

LISTED AND PROPOSED ENDANGERED AND THREATENED SPECIES AND CANDIDATE SPECIES WHICH MAY OCCUR WITHIN THE VICINITY OF THE PROPOSED YAKIMA FISHERIES ACCLIMATION POND SITES PROJECT IN KITTITAS AND KING COUNTIES, WASHINGTON
(T19N R17E S28; T20N R15E S33; T21N R12E S10; T21N R11E S12; T21N R16E S08)

FWS REFERENCE: 1-3-94-SP-698

LISTED

Bald eagle (*Haliaeetus leucocephalus*) - wintering bald eagles may occur in the vicinity of the project from October 31 through March 31.

Gray wolf (*Canis lupus*) - may occur in the vicinity of the project.

Grizzly bear (*Ursus arctos = U.a. horribilis*) - may occur in the vicinity of the project.

Northern spotted owl (*Strix occidentalis caurina*) - may occur in the vicinity of the project.

Marbled murrelet (*Brachyramphus marmoratus marmoratus*) - murrelets may occur in the vicinity of the project.

Peregrine falcon (*Falco peregrinus*) - may occur in the vicinity of the project.

Major concerns that should be addressed in your biological assessment of the project impacts to listed species are:

1. Level of use of the project area by listed species.
2. Effect of the project on listed species' primary food stocks, prey species, and foraging areas and spotted owl nesting, roosting and foraging habitat in all areas influenced by the project.
3. Impacts from project construction/implementation (i.e., habitat loss, increased noise levels, increased human activity) which may result in disturbance to listed species and/or their avoidance of the project area.

PROPOSED

NONE.

ATTACHMENT A Continued

CANDIDATE

The following candidate species may occur in the vicinity of the project:

Bull trout *(Salvelinus confluentus)*
Cascades frog *(Rana cascadae)*
Columbian sharp-tailed grouse *(Tympanuchus phasianellus columbianus)*
Ferruginous hawk *(Buteo regalis)*
Harlequin duck *(Histrionicus histrionicus)*
Loggerhead shrike *(Lanius ludovicianus)*
Northern goshawk *(Accipiter gentilis)*
Northern red-legged frog *(Rana aurora aurora)*
Pacific fisher *(Martes pennanti pacifica)*
Spotted frog *(Rana pretiosa)*
Western sage grouse *(Centrocercus urophasianus phaios)*

FEDERAL AGENCIES' RESPONSIBILITIES UNDER SECTIONS 7(a) AND 7(c) OF THE ENDANGERED SPECIES ACT OF 1973, AS AMENDED

SECTION 7(a) - Consultation/Conference

Requires:

1. Federal agencies to utilize their authorities to carry out programs to conserve endangered and threatened species;

2. Consultation with FWS when a federal action may affect a listed endangered or threatened species to ensure that any action authorized, funded, or carried out by a federal agency is not likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of critical habitat. The process is initiated by the federal agency after it has determined if its action may affect (adversely or beneficially) a listed species; and

3. Conference with FWS when a federal action is likely to jeopardize the continued existence of a proposed species or result in destruction or an adverse modification of proposed critical habitat.

SECTION 7(c) - Biological Assessment for Construction Projects *

Requires federal agencies or their designees to prepare a Biological Assessment (BA) for construction projects only. The purpose of the BA is to identify any proposed and/or listed species which is/are likely to be affected by a construction project. The process is initiated by a federal agency in requesting a list of proposed and listed threatened and endangered species (list attached). The BA should be completed within 180 days after its initiation (or within such a time period as is mutually agreeable). If the BA is not initiated within 90 days of receipt of the species list, please verify the accuracy of the list with our Service. No irreversible commitment of resources is to be made during the BA process which would result in violation of the requirements under Section 7(a) of the Act. Planning, design, and administrative actions may be taken; however, no construction may begin.

To complete the BA, your agency or its designee should: (1) conduct an onsite inspection of the area to be affected by the proposal, which may include a detailed survey of the area to determine if the species is present and whether suitable habitat exists for either expanding the existing population or potential reintroduction of the species; (2) review literature and scientific data to determine species distribution, habitat needs, and other biological requirements; (3) interview experts including those within the FWS, National Marine Fisheries Service, state conservation department, universities, and others who may have data not yet published in scientific literature; (4) review and analyze the effects of the proposal on the species in terms of individuals and populations, including consideration of cumulative effects of the proposal on the species and its habitat; (5) analyze alternative actions that may provide conservation measures; and (6) prepare a report documenting the results, including a discussion of study methods used, any problems encountered, and other relevant information. Upon completion, the report should be forwarded to our Endangered Species Division, 3704 Griffin Lane SE, Suite 102, Olympia, WA 98501-2192.

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* "Construction project" means any major federal action which significantly affects the quality of the human environment (requiring an EIS), designed primarily to result in the building or erection of human-made structures such as dams, buildings, roads, pipelines, channels, and the like. This includes federal action such as permits, grants, licenses, or other forms of federal authorization or approval which may result in construction.

Appendix E: Harvest Management

APPENDIX E

HARVEST MANAGEMENT

In the Yakima River Basin, salmon and summer steelhead harvest management is a cooperative venture between the Yakama Indian Nation (YIN) and the Washington Department of Fish and Wildlife (WDFW). A subbasin harvest management planning process currently exists for spring chinook salmon and summer steelhead.

Tribal subsistence fishing regulations for the Yakima River are adopted by the Yakama Nation Tribal Council. Technical staff prepare a set of options for fisheries that will provide for Tribal fishing opportunities while meeting conservation goals. The Council reviews each option and adopts the one that best balances the needs of Tribal anglers with the needs of the resource.

Fisheries management activities are outside the scope of the proposed project. However, during the review of the DEIS, umerous comments addressed this subject. Since changes in policies and planned efforts would influence enhancement efforts in the basin, a detailed discussion of the status of specific resource management activities in the Yakima River Basin is presented below.

Existing Harvest Management and Managers

The YFP is designed to operate within the constraints of existing harvest management regimes. Harvest management issues are outside the scope of this EIS since BPA has no harvest regulatory authority. The Tribal and state fishery managers recognize the need for adequate harvest management regulations and will regulate the fisheries to assure that the objectives of the Yakima Fisheries Project (YFP) are met.

In ocean waters off the U.S. coast, harvest is regulated by the coastal States out to 4.8 kilometers (km) or 3 miles (mi.) from shore. The Magnuson Fishery Conservation and Management Act of 1976 established the North Pacific Fishery Management Council and the Pacific Fishery Management Council to regulate harvest in the fishery conservation zone located from 4.8 to 322 km (3 to 200 mi.) of the coast. Public hearings are held by these management councils at various coastal locations. Public testimony is also accepted at their regulatory meetings. Final regulation proposals are adopted at their annual meetings and forwarded to the Secretary of Commerce for final approval and adoption.

The WDFW and the Oregon Department of Fish and Wildlife (ODFW) independently regulate non-Indian recreational salmon harvest in the Columbia River system. The WDFW also controls recreational salmon fisheries in the Washington tributaries of the Columbia. The WDFW and the ODFW regulate non-Indian recreational fishing for steelhead and other game species. Each of these agencies has an annual public hearing process for the consideration and adoption of regulations.

Recommendations for Indian and non-Indian commercial fisheries in the Columbia River are developed jointly by technical staff from Tribal, state, and federal co-managers. These recommendations, together with testimony by the public and Treaty Indian tribes, are heard by the Columbia River Compact, which is empowered to approve regulations for non-Indian commercial fisheries. The Compact is composed of representatives from the WDFW and the ODFW. Public hearings are held in the Portland vicinity before each fishing period.

The YIN and other Columbia Basin Treaty Indian Tribes (Nez Perce, Umatilla, Warm Springs) regulate Indian treaty fishing in Zone 6 (Bonneville to McNary dams) within the bounds set by the Columbia River compact. Tribal regulations generally are adopted also by the states into state law. Other Tribes in the Columbia Basin have treaty fishing rights.

The WDFW and the YIN are the entities with primary responsibility for management of resident fish harvest in the Yakima basin. Establishing or revising harvest regulations incorporates an extensive public involvement process. The WDFW assesses issues related to resource status and recreational use and makes harvest recommendations to the Washington Fish and Wildlife Commission, using available biological information and input from the public. The Washington Fish and Wildlife Commission, with members appointed by the governor, establishes regulations for resident fish species in State waters in an open public process.

Applicability to Other Stocks

The harvest management planning process and the subsequent annual harvest management plan for spring chinook salmon fisheries provides a management framework that could be applied to other species. In this plan, harvests are subordinate to escapement for the naturally spawning spring chinook salmon stock. The State and Tribal managers agree that in-basin harvest rates should not exceed 20 percent of the number of adults returning over Prosser Dam until such time as optimum spawner stock size can be estimated. At present, the Tribal subsistence fishery takes priority at run sizes below 5,000 adults at Prosser Dam. Above that number, a sport fishery may occur in a manner agreeable to the co-managers.

Goals of Harvest Management

Development of the annual harvest plan for Yakima River spring chinook salmon is part of a larger process that is intended to provide equitable harvests for treaty and non-treaty anglers in terminal fisheries above Bonneville Dam. The goal of this process is to allocate harvest opportunities between treaty and non-treaty anglers across terminal areas within the ceded area of the YIN in such a way as to be consistent with Federal court rulings on Indian treaty fishing rights. The State and Tribal co-managers have agreed that treaty/non-treaty harvest sharing need not be 50/50 in each terminal fishery, so long as the sum of projected harvests across all co-managed terminal fisheries is approximately 50/50 or is considered "equitable." This allows flexibility between the parties to prioritize harvest needs in terminal areas.

Harvest Planning Process

The annual subbasin harvest planning process, in which the Yakima River basin is included, begins with a technical assessment of expected run sizes to the subbasins within the YIN's ceded area. Harvestable numbers of fish are calculated for each terminal fishery, based on broodstock and natural spawning escapement needs. The co-managers next jointly develop harvest sharing goals, as described above, and propose time/area/gear regulations for their respective fisheries. The regulation packages are adopted by each party upon agreement. Catch-and-effort information is exchanged weekly between the co-managers during fishing seasons.

Steelhead fisheries in the Yakima River Basin do not currently require the close harvest monitoring that is necessary to manage the spring chinook salmon properly. Tribal fisheries harvest very few steelhead in current chinook fisheries, and the recreational fishery is closed at this time. Most wild steelhead that return to the Basin spawn naturally.

Relation between harvest Management and Supplementation

In the event that supplementation of chinook salmon and steelhead stocks does not occur, harvest management alone could not serve to rebuild stock status above current levels. Current harvest levels on wild and natural components of chinook salmon and steelhead runs are relatively minor. For example, harvests of Yakima River spring chinook salmon in the Pacific Ocean and mainstem Columbia River are required by the Columbia River Fish Management Plan (CRFMP) to remain below 12 percent when the aggregate upriver spring chinook salmon run does not reach the Bonneville Dam escapement goal of 128,000. This has been the case every year since 1977. The average terminal harvest rate in the Yakima River Tribal subsistence fishery has been 14 percent since 1980. Despite these low harvest rates, spring chinook salmon stock abundance in the Yakima River is not increasing.

Out-of-basin harvest impacts on Yakima River wild steelhead also are minimal. Wild steelhead cannot be retained in non-treaty fisheries and must be returned to the water unharmed. A small incidental catch of wild steelhead may occur in non-treaty fall season gillnet fisheries below Bonneville Dam, but these fisheries are heavily regulated to minimize steelhead handling and mortality. The Indian fall chinook gillnet fishery above Bonneville Dam is constrained by the CRFMP to harvest no more than 15 percent of wild Group A steelhead (of which the Yakima river stock is a component) crossing Bonneville Dam. Additional harvest impacts may occur during Zone 6 winter fishery, during any sockeye fishery, and during the spring/summer chinook subsistence fisheries. Management actions have reduced the actual harvest rates to around 12 percent or less in recent years as a result of constraints imposed by fall chinook management needs. These low harvest rates have not resulted in rebuilding of the wild steelhead stock in the Yakima River system.

The CRFMP limits further reductions in Columbia River fisheries. Existing harvest provisions in the plan are held at minimal levels to help rebuild upriver stocks. Upriver stocks of salmon and steelhead are managed under the Plan as aggregates of subbasin stocks because stock components cannot be identified in preterminal fisheries. Alteration by the parties of existing provisions of the plan to manage for individual Yakima River stocks within an aggregate is doubtful. However, management in the terminal tributaries is in no way prejudiced by aggregate mainstem management. Furthermore, modifications to existing plan provisions could produce imbalances in treaty and non-treaty harvest-sharing arrangements or violate regional and international harvest agreements.

Harvest of a wide variety of species not targeted for supplementation is also managed within the Yakima subbasin. These include warmwater game fish species such as bass, perch, channel catfish, resident coldwater fishes (e.g. rainbow trout, bull trout), whitefish, and squawfish. These species must be managed concurrently to achieve a balance among objectives such as recreational opportunity, resource protection and maintenance, and impact on YFP supplementation activities or target stock rebuilding.