UPPER COLUMBIA RIVER SUBBASIN
(Priest Rapids Dam to Chief Joseph Dam)

September 1, 1990

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Salmon and Steelhead Production Plan

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Columbia Basin System Planning

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INTRODUCTION

The Northwest Power Planning Council's Columbia River Basin Fish and Wildlife Program calls for long-term planning for salmon and steelhead production. In 1987, the council directed the region's fish and wildlife agencies, and Indian tribes to develop a systemwide plan consisting of 31 integrated subbasin plans for major river drainages in the Columbia Basin. The main goal of this planning process was to develop options or strategies for doubling salmon and steelhead production in the Columbia River. The strategies in the subbasin plans were to follow seven policies listed in the council's Columbia River Basin Fish and Wildlife Program (Appendix A), as well as several guidelines or policies developed by the basin's fisheries agencies and tribes.

This plan is one of the 31 subbasin plans that comprise the system planning effort. All 31 subbasin plans have been developed under the auspices of the Columbia Basin Fish and Wildlife Authority, with formal public input, and involvement from technical groups representative of the various management entities in each subbasin. The basin's agencies and tribes have used these subbasin plans to develop the Integrated System Plan, submitted to the Power Planning Council in late 1990. The system plan will guide the adoption of future salmon and steelhead enhancement projects under the Northwest Power Planning Council's Columbia Basin Fish and Wildlife Program.

In addition to providing the basis for salmon and steelhead production strategies in the system plan, the subbasin plans attempt to document current and potential production. The plans also summarize the agencies' and tribes' management goals and objectives; document current management efforts; identify problems and opportunities associated with increasing salmon and steelhead numbers; and present preferred and alternative management strategies.

The subbasin plans are dynamic plans. The agencies and tribes have designed the management strategies to produce information that will allow managers to adapt strategies in the future, ensuring that basic resource and management objectives are best addressed. Furthermore, the Northwest Power Planning Council has called for a long-term monitoring and evaluation program to ensure projects or strategies implemented through the system planning process are methodically reviewed and updated.

It is important to note that nothing in this plan shall be construed as altering, limiting, or affecting the jurisdiction, authority, rights or responsibilities of the United States, individual states, or Indian tribes with respect to fish, wildlife, land and water management.

Most of the stock-specific information obtained for this report was developed for the Preliminary Information Report (July 8, 1988). Other sources that were particularly helpful and frequently referred to are identified.

Fish production is obviously part of an intricate web of biological and physical processes. Each strand affects the others in the same way. Without a holistic approach toward resource management, resource improvement is but a remote wish. A major step toward protection and enhancement must involve cooperation among the various resource agencies, the public and private sectors and also individuals. This includes educating one another with regard to present and future needs. Without this interdisciplinary approach, goals and objectives will not be realized.

PART I. DESCRIPTION OF SUBBASIN

Location and General Environment

The upper Columbia, as defined in this report, includes 148 miles of mainstem river between Priest Rapids Dam and Chief Joseph Dam. In addition to these two dams there are four others -- Wanapum, Rock Island, Rocky Reach and Wells dams (Table 1).

Table 1. The six dams on the upper Columbia River.

Dam	Year Beginning Operation	River Mile	Operator
Priest Rapids	1959	397.1	Grant County PUD
Wanapum	1963	415.8	Grant County PUD
Rock Island	1933	453.4	Chelan County PUD
Rocky Reach	1961	473.7	Chelan County PUD
Wells	1967	515.1	Douglas County PUD
Chief Joseph	1955	545.1	Corps of Engineers

The primary tributaries entering this section of the Columbia are the Methow, Okanogan, Chelan, Entiat and Wenatchee rivers. Lesser tributaries that are used by anadromous fish include Sand Hollow, Douglas, Rock Island, Trinidad and Johnson creeks.

Water Resources

The construction of dams in the United States and Canada on the Columbia has altered the natural streamflow regime in the Columbia. In general, the effect has been that peak flood events dampened, the annual spring freshets decreased in amplitude and duration, and as a result of optimum power generation, a pattern of local diurnal flow fluctuations established. These flow modifications, along with the expanded cross sectional areas of the impoundments and consumptive use of stored water, have altered the basic riverine character of the Columbia River.

Flows during the critical spring smolt migration are frequently 50 percent of flows prior to hydro development in the river.

After reaching a maximum in about mid-April, mountain snowpack melts with warming spring and summer weather. Runoff swells the discharge of the Columbia River to its normal annual peak, usually in the first half of June. River flow recedes and reaches its normal base flow in the fall.

Flow management in the Columbia is complex, involving a variety of Canadian and United States interests. Competing uses of the water, such as power generation and spill flows for fish, have frequently created management difficulties. Recognizing the critical nature of high flows in sustaining downstream migration of juvenile salmonids, the Northwest Power Planning Council incorporated Section 300, the water budget, into its Columbia River Basin Fish and Wildlife Program. Funded through this amendment, water managers at the Fish Passage Center work to "shape" the flow of the Columbia River by recommending flow increases during the spring migration period, April 15 to June 15. The flow increases must come from the water budget, a 3.45 and 0.45-million-acre-foot volume of water from the Columbia and Snake rivers, respectively. Although this water has no physical location or storage designation, it has been scheduled for release for the benefit of fish passage annually.

The goal of the water budget is to protect the middle 80 percent of the smolt migration by maintaining minimum recommended flows for 30 of the 60 days between April 15 and June 15. Minimum recommended flows are 85,000 cubic feet per second (cfs) for the Snake River at Lower Granite Dam and 140,000 cfs in the upper Columbia at Priest Rapids Dam. Although the recommended flows have frequently been satisfied in the upper Columbia, the Snake River flows have not been. As a result, flows have been less than optimum over much of the migration period in the lower Columbia at John Day Dam.

Flows on the Columbia are considerably modified due to the number of dams, and natural flows no longer exist. Annual low flows, based on mean monthly flows, generally occur in September and October while annual high flows can occur anytime from January through May. The lowest mean monthly flow recorded from 1975 to 1987, as recorded below Priest Rapids Dam, was measured at 65,700 cfs (1985). The highest mean monthly flow recorded was 247,700 cfs (1981). Average annual flow (1975 to 1987) is 70,000 cfs, while average annual high for this period is about 188,000 cfs (Table 2).

Table 2. Stream flow averages in cfs (1972-1987), Upper Columbia River (below Priest Rapids Dam). [USGS Annual Data Reports May 1960-Sept 1978 (Monthly Mean)]

YEAR	LOW	HIGH
1975	70,000	163,500
1976	97,400	185,100
1977	66,400	113,300
1978	95,700	150,600
1979	76,200	126,000
1980	70,900	170,500
1981	84,000	247,700
1982	79,900	208,100
1983	71,700	203,400
1984	70,100	148,100
1985	66,200	147,600
1986	72,600	136,200
1987	81,000	153,200
AVERAGES	77,085	165,638

PART II. HABITAT PROTECTION NEEDS

History and Status of Habitat

Water quality information within this reach is available from the Washington Department of Ecology's ambient monitoring program, with a station located below Rock Island Dam (ST.44A070). Information is available from 1971 through the present. Temperature data is also available throughout this period. Average monthly temperatures ranged from about 38 degrees Fahrenheit to the upper 60s F (Fig. 1). High temperatures occur during August and September. The highest recorded temperature occurred in September 1987 with a 73.4-degree reading. Dissolved oxygen concentrations are generally above 10 parts per million. Alkalinity, pH and ionic concentration fall within normal ranges.

Mainstem Columbia River habitat in this reach is composed of five reservoirs with relatively high flushing rates, (one to six days). The dominant system features limiting anadromous fish production are the mainstem dams, which remain as major obstacles. Mortality at these projects probably substantially over shadows inbasin habitat limitations.

Mainstem Columbia River habitat, by virtue of the dams, has been transformed from a free-flowing unregulated river to a series of impoundments. The heterogenous pool-riffle sequence of alternately slow and fast waters that form the basic production units of stream environments were permanently altered to relatively homogeneous slow-moving impoundments. The cross sectional changes and profile modifications have altered pre-development biological communities and trophic structure.

The inundation of spawning habitat by the reservoirs limited mainstem production immediately after completion of the dams. In the upper Columbia, the lack of mainstem spawning habitat remains a major limiting factor for all anadromous fish. All species have been severely affected by juvenile mortality at the dams and delay and loss of adults.

Impoundments have also dramatically altered the rearing environment and migratory conditions in the mainstem Columbia River. Projects located within the subbasin have had large effects on the rearing environment because they changed the rivers cross-sectional area and profile. Major storage reservoirs on the Columbia and Snake rivers have had a greater effect on the flow regime, which directly changed spring and early summer migratory conditions.

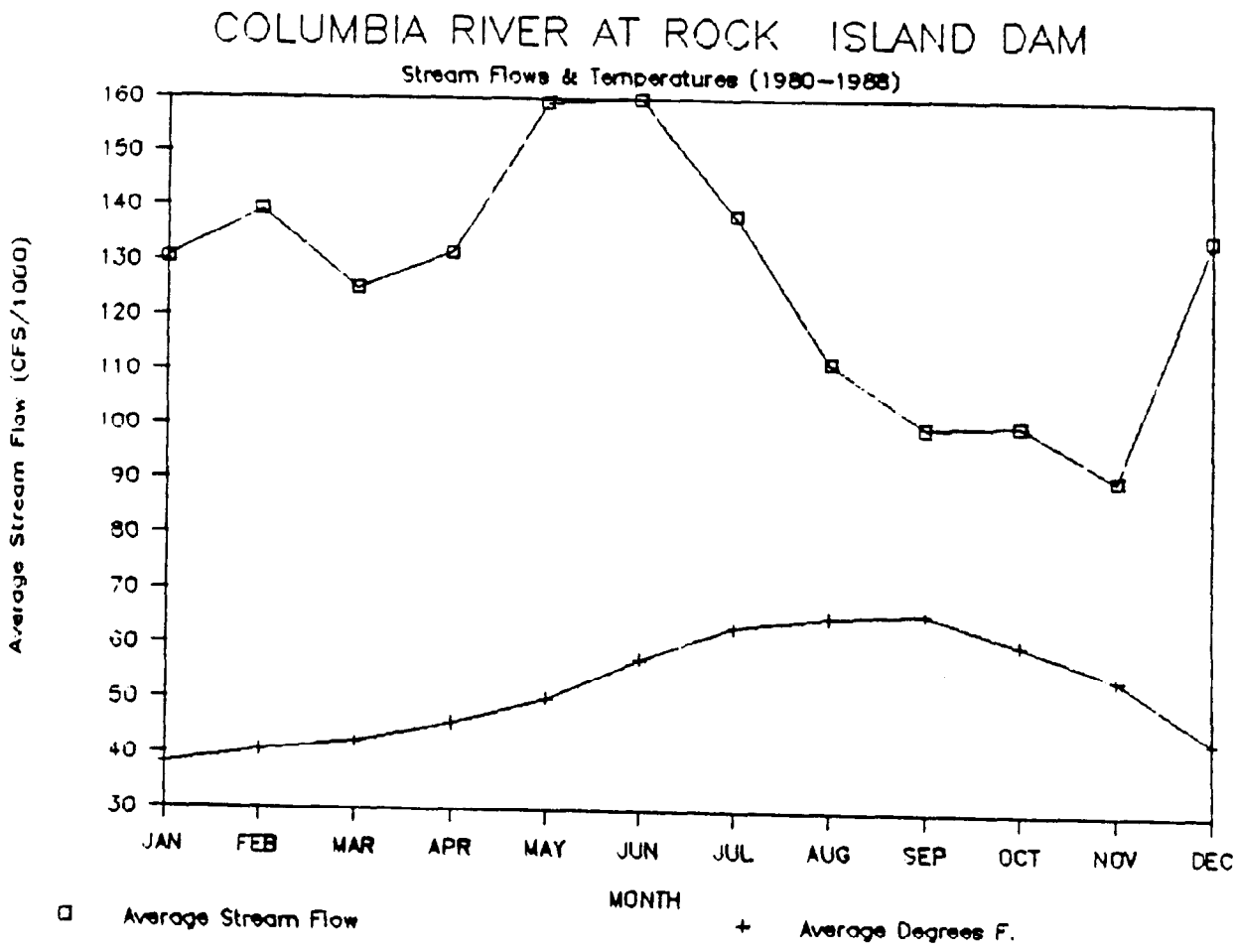


Figure 1. Stream flows and temperatures (1980-1988) of Columbia River at Rock Island Dam.

Increased travel time has been an extremely detrimental consequence of hydro development on the Columbia. Post-development migration rates for yearling chinook are approximately three times those observed in the free-flowing river prior to impoundment (Raymond 1968). In the low water year of 1977, managers estimated that only about 10 percent of the smolts originating upstream from Bonneville Dam successfully migrated out of the river. A trip that formerly could be made in two to seven days now may take up to a month. Delayed travel time exposes juvenile salmonids to higher water temperatures and longer periods of predation, and upsets estuary arrival timing.

Constraints and Opportunities for Protection

Legal Considerations

A patchwork of sometimes overlapping regulation designed to limit impacts to the public's stream and shoreline resources in the state of Washington exists. This body of rules is generally poorly understood by the public. Environmental laws that set standards and restrict actions that could impact stream and shoreline resources are listed below along with the responsible agency.

1) Clean Water Act, Section 404, River and Harbor Act, Section 10, U.S. Army Corps of Engineers with state of Washington, Dept. of Ecology certification.

2) State Water Quality Laws RCW 90.48, WA Dept. of Ecology

3) State Surface Water Codes RCW 90.03, WA Dept. of Ecology

4) State Groundwater Codes RCW 90.44, WA Dept. of Ecology

5) Shorelines Management Act, local government with state oversight by WA Dept. of Ecology

6) Hydraulics code RCW 75.20.100 and 103, WA Dept. of Fisheries or Dept. of Wildlife

7) Instream Resources and Water Allocation Program, WA Dept. of Ecology

8) State Environmental Policy Act (SEPA), local government or WA Dept. of Ecology

9) National Environmental Policy Act (NEPA), federal agency taking action

10) Flood Control Management, RCW 86-26, WA Dept. of Ecology and local government

11) Forest Practices Act, WA Dept. of Natural Resources.

Since the adoption of the 1917 Water Code, the state of Washington has allocated water based on the Prior Appropriations Doctrine. In many cases, the amount of water allocated has resulted in many overappropriations and the reduction in corresponding anadromous fish runs. Instream flow protection started with Chapter 75.20 RCW (1949), with Department of Fisheries and Department of Wildlife recommendations for low flow conditions and stream closures to further appropriations of water. Since 1969, beginning with passage of the Minimum Water Flows and Levels Law (RCW 90.22), the state law has acknowledged a greater need to protect instream flows for fisheries and other instream values through developing basinwide flow protection programs. In addition, the 1917 Water Code provided that water permits would not be granted that could prove "detrimental to the public welfare" (RCW 90.03.290).

Both the Minimum Water Flows and Levels Law and the Water Resources Act of 1971 (RCW 90.54) direct the Department of Ecology to set minimum or base flows that protect and preserve fish and other instream resources. Because minimum or base flow regulations do not affect existing water rights, reductions in anadromous fish runs in overappropriated streams will continue to be a problem. The Water Resources Act specifically lists fish and wildlife maintenance and enhancement as a beneficial use. It further directs the Department of Ecology (DOE) to enhance the quality of the natural environment where possible.

The state statutes, however, do not define the extent of instream resource protection, leaving to the DOE the task of determining adequate protection levels for instream flows. This has caused increasing controversy in recent years and resulted in an attempt by the Ecology Department to define the level of flow that was to be provided for fish in the state's streams. The Department of Ecology's 1987 effort to set a standard of "optimum" flows for fish was challenged by out-of-stream water users via the Washington Legislature in 1988. The 1988 Legislature put a moratorium (which has now been lifted) on the DOE's recommended standard and established a Joint Legislative Committee on Water Resources Policy to address Washington's water future. To date, the committee has yet to define the level of protection that will be afforded fish resources.

Lacking any legislative direction on instream flow protection levels, water continues to be allocated from state streams under past practices. All water right applications are reviewed by the Department of Fisheries (WDF) and the Department

of Wildlife (WDW), under RCW 75.20, prior to issuance by the Department of Ecology. The DOE considers Washington Wildlife and Fisheries comments before making a decision regarding the issuance of a permit for withdrawal. Washington Wildlife and Fisheries comments are recommendations only, and can be accepted or ignored by the Department of Ecology. Current DOE practice is to issue water permits if water, above that recommended to be retained instream, is available for allocation. Virtually all domestic use requests are approved as are many non-domestic requests. The impacts of specific withdrawals on fish resources is often unclear, however, the cumulative impact of the new withdrawals is less instream water and negative impacts on fish populations.

The majority of Washington's streams do not have minimum flows established. Yet the DOE continues to issue permits for diversion and water withdrawal. It is unlikely that the current system will change until the Joint Legislative Committee on Water Resources Policy defines state policy in this area. The committee's decision could have a major impact on the future of the state's fisheries resources.

The fisheries agencies have requested that for most streams, instream flows be protected at levels that would maintain existing fish production, including the full range of variations that occurs naturally due to environmental conditions. For some streams, like the Yakima River, the fisheries agencies request flows to levels that would achieve potential production. This potential production would be determined by analyzing what could reasonably and practically be expected to return to the stream in the future.

In those streams that have already been overappropriated, establishment of instream flows may limit losses of fish resources to that which has already occurred. In many of these streams, restoration of instream flows is requisite for increasing or reestablishing fish runs.

In support of the continuing investments by the Northwest Power Planning Council's Columbia River Basin Fish and Wildlife Program, the following recommendations are made relative to instream flows and fisheries resources:

1) No new out-of-stream appropriations of any kind should be issued unless appropriate instream flow levels are established for the stream to be impacted either through comment on the water right application or through the adoption of an instream flow regulation.

2) There should not be any exceptions to the minimum flow levels, including domestic use.

3) Minimum flows should be impacted only if concurrence is obtained from the state and federal fish resource agencies and tribes and adequate mitigation is provided.

4) Minimum instream flow levels should be adequate to protect existing and potential (where appropriate) fish production.

5) State law should be changed so that saved, purchased or donated water can be dedicated to instream flows.

Institutional Considerations

In many cases, important factors affecting the quantity and quality of aquatic habitat are outside the direct regulatory authority of the fisheries management agencies. Agency cooperation is critical to the protection of aquatic resources.

A good example of how agency cooperation strengthens a regulatory program is the procedure the Washington Department of Natural Resources uses to review forest practice applications. These new rules and agreements, commonly referred to as the Timber/ Fish/Wildlife (TFW) agreement, encourage interdisciplinary review of individual forest practice applications. Another example is the attempt to coordinate permits for streambank stabilization through the memorandum of understanding signed by the Washington departments of Fisheries, Wildlife and Ecology, the conservation districts, and the U.S. Soil Conservation Service. Better interagency communication of goals and objectives within watersheds and cooperative administration and enforcement of rules in pursuit of these goals could improve habitat protection.

All agencies have different management mandates and objectives. Some, such as the Department of Fisheries, have specific management objectives. Others, such as the Department of Wildlife, have more complex management responsibilities (some of the WDW programs depend on voluntary cooperation of those they must also regulate). In general, all the fisheries management agencies subscribe to a management goal of "no net loss" of existing habitat. Even though this goal is difficult to attain, it is an appropriate policy, one that subbasin planning supports and the only one that will protect the production potential of entire river systems for the long term.

In spite of the best efforts of numerous state and federal agencies and regulatory programs, much of which the public deems onerous and excessive, a gradual loss of aquatic habitat occurs. This cumulative loss is occasioned by the routine development of natural resources and dedication of shoreline and water resources to uses other than natural. These incremental impacts have

resulted in reduced anadromous fish production in Columbia River subbasins. Subbasin planning must address the problem of cumulative habitat loss if the goals of the Northwest Power Planning Act are to be achieved.

Critical Data Gaps

Developing strategies that will accomplish specific production objectives requires a detailed knowledge of the aquatic system and the biology and behavior of the fish. Parts of both data bases exist, but significant gaps remain.

To improve resiliency of a natural stock through habitat manipulation, an action must rely on an understanding of micro-habitat use over the freshwater residence period. Some of this information for chinook has been collected (Hillman et al. 1986), but it is likely that much more must be known.

The role of the mainstem Columbia River reservoirs in chinook production is poorly understood. For summer chinook this is an especially important topic and one that needs to be understood if these stocks are to be enhanced efficiently.

Development has and continues to impose a variety of shoreline treatments in this subbasin that alter the natural conditions. For habitat management purposes it is important to know how these treatments effect habitat productivity.

Habitat Protection Objectives and Strategies

Objectives

The following objectives pertain primarily to the protection of existing habitat, but to a lesser degree, address general habitat improvement. Specific habitat improvement projects will appear in individual species sections.

1) Maintain existing habitat.

2) Maintain existing water quality.

3) Maintain existing surface water quantity. Identify minimum flows necessary to optimize fish production.

4) Increase security for existing habitat.

5) Increase use of existing underutilized habitat.

6) Enhance production potential of existing habitat.

7) Increase levels of habitat quality through selected cost-effective enhancement programs.

8) Eliminate entrainment into diversions.

Strategies

Strategies for securing the preceding kinds of habitat objectives generally are outside the direct influence of the Northwest Power Planning Council. As such, implementation must, to a large degree, remain the responsibility of the fisheries agencies and Indian tribes. The Northwest Power Planning Council has already used its authority to recommend limiting the proliferation of hydroelectric impacts by developing the "protected areas" program, which identifies stream reaches where hydroelectric development would be inappropriate. Unless these general habitat objectives can be realized basinwide, the subbasin plans and the interim goal of doubling fish production in the Columbia River will ultimately be jeopardized by the cumulative loss of habitat. The agencies and Indian tribes must take an aggressive, pro-active and cooperative approach to habitat protection. Community and local government support must be cultivated for their assistance.

The Northwest Power Planning Council could support the regulatory habitat protection work of the agencies and tribes and become more involved by:

1) Continuing to broaden the public education and information program it already supports.

2) Providing funds for long-term habitat monitoring activities in support of fish and wildlife program production strategies.

3) Funding additional habitat management positions within the agencies and tribes.

4) Hosting a habitat protection symposium entitled, "Are the Investments Being Protected?"

5) Purchasing riparian property adjacent to critical habitat.

6) Testifying at state legislative hearings when habitat protection laws are threatened, as has been the case in Washington for the past four years.

7) Purchasing water rights if they can revert to instream uses.

8) Publishing additional inventories of "key" habitat for specific stocks that must receive absolute protection if the goals of the Northwest Power Act are to be realized.

9) Working with state and federal governments for the development and passage of improved habitat protective legislation.

Habitat protection is an area that does not lend itself to neatly engineered strategies. As a result, the danger exists that this portion of subbasin planning will be given less consideration than it should receive during the implementation phase. The struggle to prevent cumulative loss of habitat is ultimately one of public policy and administration of carefully crafted state and federal statute.

The agencies and Indian tribes could bolster their habitat protection programs by initiating a cooperative review of regional programs. Such a review would identify specific common goals, specify cooperative action to achieve those goals, and monitor and periodically modify actions in pursuit of those goals.

State and federal habitat protection efforts could be enhanced by better interagency communication of goals and objectives. A well coordinated approach to imposing different existing regulatory programs is needed because no one statute is broad enough in scope to succeed alone. Anything the Northwest Power Planning Council can do to encourage a cooperative approach to habitat protection will be important.

Any plan should attempt to identify general strategies and participants responsible for implementing actions.

PART III. CONSTRAINTS AND OPPORTUNITIES FOR ESTABLISHING PRODUCTION OBJECTIVES

Institutional Considerations

A number of federal, state, and local agencies and organizations are involved and/or related in some way to anadromous fish production within the upper Columbia. The names of these agencies are listed below. Some of the more specific information will be brought out in later sections of this report.

Federal Land and Water Managers

- Department of Agriculture
  - U.S. Forest Service
  - U.S. Soil Conservation Service
- Department of the Interior
  - U.S. Geological Service
  - U.S. Fish and Wildlife Service, including Leavenworth National Fish Hatchery and Entiat National Fish Hatchery
- Federal Energy Regulatory Commission
- U.S. Army Corps of Engineers

Tribes

- Yakima Indian Nation
- Confederated Tribes of the Colville Reservation
- Confederated Tribes of the Umatilla Indian Reservation (intervenor in upper Columbia proceedings)

State Land and Water Managers

- WA Department of Fisheries
- WA Department of Wildlife
- WA Department of Natural Resources
- WA Department of Ecology
- Oregon Department of Fish and Wildlife (intervenor)

County Land and Water Managers

- Chelan County PUD
- Douglas County PUD
- Grant County PUD

Since the construction of the mainstem Columbia dams, the public utility districts and fishery agencies have undertaken various mitigation efforts. Recently, the Rock Island and Wells Settlement agreements have been negotiated regarding mitigation measures for juvenile migrant mortality. The Rock Island Agreement was signed April 1987, establishing Chelan's

obligations with respect to development, installation, and operation of juvenile downstream migrant bypass facilities, juvenile fish passage through spill, hatchery compensation for fish losses, and fish ladder operation (FERC 1987).

Legal Considerations

Indian Treaties

With the Yakima Indian Treaty (1855) and the subsequent Executive Order of July 2, 1872, most of the original native Americans who inhabited regions that are presently Chelan, Kittitas, Yakima, Okanogan, and Douglas counties resettled onto the Yakima and Colville reservations. As guaranteed by the Yakima Treaty of 1855, the Yakima Nation reserved the right to continue to hunt and fish outside of the established reservation without interference from states or the federal government absent express acts of Congress. The majority of the Wenatchee Basin was encompassed within lands ceded by the Yakima Indian Nation to the U.S. government.

The area of the Columbia River north from Priest Rapids Dam to the Canadian border, including tributaries, is part of the original territory of numerous Indian tribes. Those tribes include, but are not limited to, the Chelan, Wenatchee, Entiat, Columbia (Moses band), Yakima, Palouse, Okanogan and Nespelem tribes. Indians used this entire area extensively for hunting and fishing; the area was an integral part of their cultural and religious way of life. It is still a significant resource area and includes many places considered sacred by Indian people today. The use of this area by Indian people is not questioned. There is, however, a dispute among existing Indian nations as to the nature and extent of rights within the subbasin.

Among those tribes that signed the treaty at Walla Walla and reserved the rights to fish off the reservation were the Yakima, Chelan, Wenatchee, Entiat and Columbia tribes. The Confederated Tribes and Bands of the Yakima Indian Nation and its members, as the legal successors in interest to those tribes, reserved those rights for itself and its members. Today members of those tribes reside on and off reservation.

As a result of the treaty right to fish, tribes that were party to the treaties retain substantial governmental authority over the activities that affect hunting and fishing. Thus, treaty tribes have a right to co-manage and to participate equally in fishery management decisions affecting the Columbia River, including its tributaries. Such co-management responsibilities include harvest management, habitat development or modification, fish culture and enhancement projects, as well as habitat use and restoration.

Colville Tribe

The Colville Indian Reservation occupies territory that includes the Columbia River from Chief Joseph Dam to the confluence of the Columbia and Okanogan rivers, and the Okanogan River north to the Colville Reservation boundary.

Those portions of the Columbia and Okanogan rivers within the Colville Reservation as well as the Okanogan north of the reservation are within the jurisdiction of the Colville Tribes and tribal law applies to fishing activities on those waters.

Yakima Indian Nation

As is noted above, the subbasin area is virtually all within the lands ceded by the Confederated Tribes and Bands of the Yakima Indian Nation to the United States in the Yakima Treaty of 1855. The Yakima Indian Nation formed the confederation of the tribes and bands occupying and using this region. Since before treaty times, the Yakimas have exercised management authority over their fisheries and fishermen from Bonneville Dam to the headwaters of the areas in this subbasin. The Yakima Nation, pursuant to the Treaty of 1855, retained this authority as a confederation and on behalf of the tribes that were joined into the Yakima Confederation under the Treaty of 1855.

State Laws

All of the following Washington state laws potentially affect fish production.

- Hydraulic Code, RCW 75.20
- State Environmental Policy Act, RCW 43.21C
- Water Quality Certification
- Forest Practices
- Shoreline Management Act - local decisions reviewed by Department of Ecology
- Water Resource Program, Implementing Water Rights
- Department of Natural Resources Land Lease Agreements

PART IV. ANADROMOUS FISH PRODUCTION PLANS

Four species of anadromous salmonids are present within the upper Columbia Subbasin: chinook (Oncorhynchus tshawytscha), coho (Oncorhynchus kisutch), sockeye (Oncorhynchus nerka) and steelhead (Oncorhynchus mykiss). Among these, fisheries biologists have identified various stocks that have specific management implications, which will be addressed in the following subsections.

To compensate for the loss of anadromous salmonid spawning areas as a result of Grand Coulee Dam, fisheries managers attempted two basic approaches. One was the interception of adult fish at Rock Island Dam and transfer to various spawning locations including the Wenatchee and Entiat rivers. Managers began the program in 1939, with the completion of Grand Coulee, establishing "displaced" fish in tributaries below the dam. Success of the program is questionable, especially considering maintenance of genetic integrity and competition of native fish with the "refugees." Certainly this mitigation effort never did replace lost spawning and rearing habitat located above Grand Coulee, since there is no anadromous passage above this dam.

A second enhancement measure was the construction of various spawning channels and hatcheries throughout the mid and upper-Columbia. Three of these were located within the upper Columbia mainstem -- Priest Rapids, Wells, and Rocky Reach spawning channels (Turtle Rock is an annex of Rocky Reach).

The Priest Rapids Hatchery, although not in this reach, was built as mitigation for losses in this reach. The station currently has a fall chinook egg-take goal of 9.5 million to 10 million eggs with on-site capture. The hatchery's on-station planting goal is 7 million to 7.7 million fingerlings; managers transfer up to 14.5 million eggs out of system. A spawning channel with 24 sections at this site was built for mitigation, but the project was unsuccessful. Some of these channel sections are available for modification into rearing ponds. River water is limited to 100 cfs and usable at all times of the year depending on temperatures (Columbia River water varies from 33 degrees Fahrenheit to 68 F annually.) Total availability of well water is limited to 14 cfs to 18 cfs. Additional increases of well water (5 percent to 10 percent) would cost up to $1 million. Starting ponds and incubation facilities would also expand production, but are limited by availability of well water.

The most recent Federal Energy Regulatory Commission settlement stipulation (1984 to 1988) with the public utility districts calls for maintaining the present 100,000-pound capacity for fall chinook fingerling releases. The parties also agreed to "...determine optimum usage of existing water supplies

and facilities at Priest Rapids Hatchery to define the maximum operating capacity of the existing facilities" and determine "...potential for expansion of Priest Rapids facilities including additional ground water supplies." Since little additional well water is available, testing was restricted to 25,000 yearling fall chinook. Summer chinook are not presently under consideration for rearing at Priest Rapids due to the disease and limited well water constraints.

Rocky Reach Hatchery currently works with fall chinook and coho, with planting goals of 200,000 yearling fall chinook and 500,000 yearling coho. The present operation is constrained by the water supply. The potential exists for increased well water supply and room for expansion with additional rearing ponds below the annex, along with an unused channel section on Turtle Rock. Incubation facilities are limited, but could be expanded. Transferring fish from Turtle Rock for off-station release is difficult.

According to the stipulated agreement, the public utility district will "...continue existing hatchery program at Rocky Reach and Turtle Rock of 35,000 lbs of coho, 25,000 lbs of yearling chinook..." (and approximately 30,000 pounds of steelhead).

Wells Hatchery currently rears summer chinook, with an egg-take goal of 1.8 million eggs and a planting goal of 1,440,000 fingerlings and 250,000 yearlings, all for on-station release. Also included is 400,000 summer chinook released into the Methow. Yearling production and adult holding capability are constrained by a well water shortage. Additional well water may be available, but needs to be developed. A critical need exists for additional starting facilities. Additional rearing space is possible with the development of new water and the modification of existing rearing areas.

The stipulation calls on the public utility district to "maintain the annual supplement of 25,000 pounds of steelhead at the Wells Hatchery facility." Further, the Bureau of Reclamation has a five-year agreement with the PUD to rear 150,000 steelhead at Wells Hatchery for release into the Okanogan.

The Federal Energy Regulatory Commission's stipulation with the PUD includes investigating the feasibility of increasing the summer chinook brood stock program and releasing an additional 400,000 summer chinook into the Methow and Okanogan rivers. Wells Hatchery could potentially rear additional yearling summer chinook.

Additional mitigation plans addressing passage losses are now under way involving a number of public utility districts. Some negotiations have been agreed to, while others are still a

few years away. These settlements involve passage improvements at each of the dams, in addition to mitigation for lost production, particularly in the tributaries.

The Rock Island Project Settlement Agreement was the first of these, signed April 1987. It established Chelan PUD's obligations with respect to development, installation, and operation of juvenile downstream migrant bypass facilities, juvenile fish passage through spill, hatchery compensation for fish losses, and fish ladder operations. The production phase includes establishing a central facility, juvenile rearing and release facilities and one net pen station for sockeye salmon. Specifically, the agreement calls for the Phase I production levels shown in Table 3.

Table 3. Production levels for Phase I of the Rock Island Project Settlement Agreement, April 1987.

Stock	Tributary	Production Capacity
Spring Chinook	Wenatchee River System (Chiwawa River)	56,000 lbs. at 12 fish/lb.
Summer Chinook	Okanogan River System (Similkameen River)	57,600 lbs. at 10 fish/lb.
Summer Chinook	Wenatchee River System (Dryden diversion)	86,400 lbs. at 10 fish/lb.
Summer Chinook	Methow River System (Twisp River)	40,000 lbs. at 10 fish/lb.
Sockeye	Lake Wenatchee or Osoyoos (Net Pens)	10,000 lbs. at 20 fish/lb.
Summer Steelhead	Wenatchee River System	30,000 lbs. at 6.5 fish/lb.

The Eastbank Hatchery is now under construction, while the initial satellite rearing and release facilities located in the Chiwawa, Wenatchee and Similkameen rivers should be completed by early 1990 for mechanical testing. The first releases are scheduled to take place in 1990. The plans involve the use of native brood stock to be captured at selected sites. Incubation and rearing will take place at the Eastbank Hatchery, where managers will transfer juveniles to their respective satellite facilities for rearing, acclimation and release.

This "in-place, in-kind" compensation is also planned for the Wells Settlement Agreement with Douglas County, with objectives to achieve the highest possible mitigation for juvenile loss and to reduce mortality to the lowest levels. The central hatchery will be located about a mile from the Winthrop Hatchery, which will deal primarily with spring chinook and sockeye. Chelan County PUD and Douglas County PUD have tentatively agreed to trade responsibilities for production of Methow River spring and summer chinook. Under the original Rock Island Settlement Agreement, Chelan was to produce 28,800 pounds of Methow River Spring chinook for acclimation and release into the Twisp River, while Douglas PUD had tentatively agreed with the fishery parties to produce 40,000 pounds (at 10 fish per pound) of Methow River summer chinook. Because Douglas PUD is planning to construct a major central hatchery facility for spring chinook on the Methow River near Winthrop, the two PUDs have agreed to trade these obligations.

A number of water rights issues have arisen, especially with regard to hatchery and satellite facilities in the Methow River and tributaries. Hence, production under the Wells compensation package may be delayed until a workable solution to the water rights issue is found. Acclimation facilities for spring chinook are slated for the Chewack and Methow rivers; summer chinook on the Methow (Carlton and Twisp); and sockeye on the Okanogan. Negotiations have commenced for mitigation of fishery impacts from Rocky Reach to Priest Rapids and Wanapum dams.

In addition to mainstem habitat, other minor tributaries contribute to fish production. These streams include:

Douglas Creek - chinook rearing

Rock Island Creek - chinook rearing, coho spawning and rearing

Trinidad Creek - chinook rearing

Johnson Creek - juvenile rearing for coho

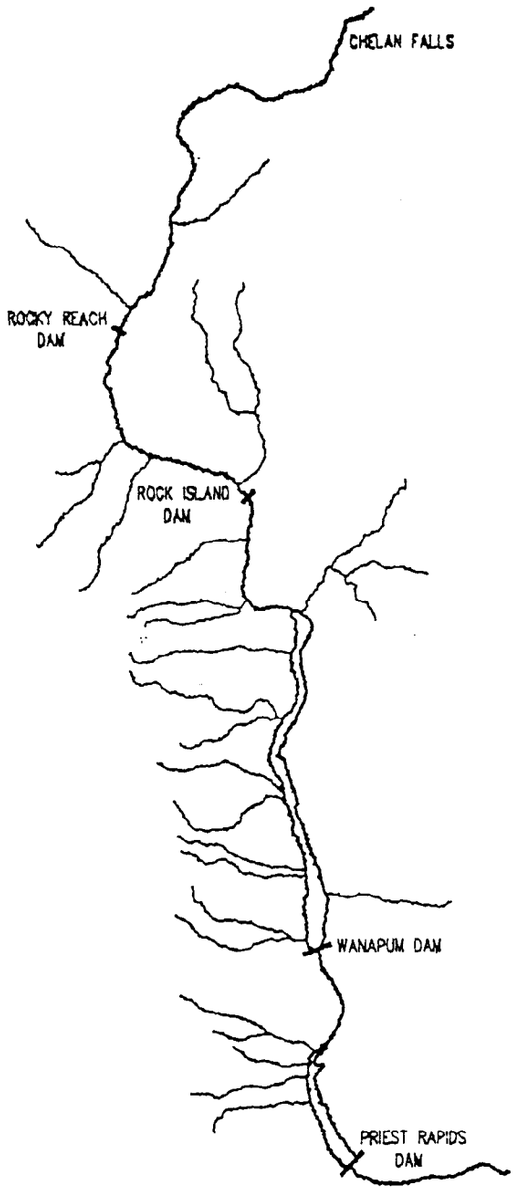
Sand Hollow Creek - fall chinook spawning

Additional minor tributaries where wild steelhead are known to exist are included below. Escapement to any one creek is likely to be fewer than 40 adults and in most cases only a dozen or so.

Crab Creek
Johnson Creek
Quilomene Creek
Brushy Creek
Tekison Creek
Colockum Creek
Douglas Creek
Trinidad Creek
Rock Island Creek
Stemilt Creek
Squilchuck Creek
Chelan River
Chelan Hatchery Creek

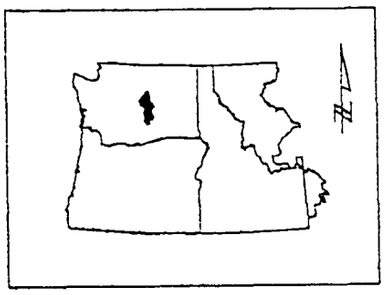
These systems contribute incidentally toward mainstem production. Levels of production, of course, are highly dependent on local conditions, which vary from year to year. Fall chinook also spawn between the mainstem and the powerhouse on the Chelan. A natural barrier exists at the site of the powerhouse.

COLUMBIA RIVER



PRIEST RAPIDS DAM

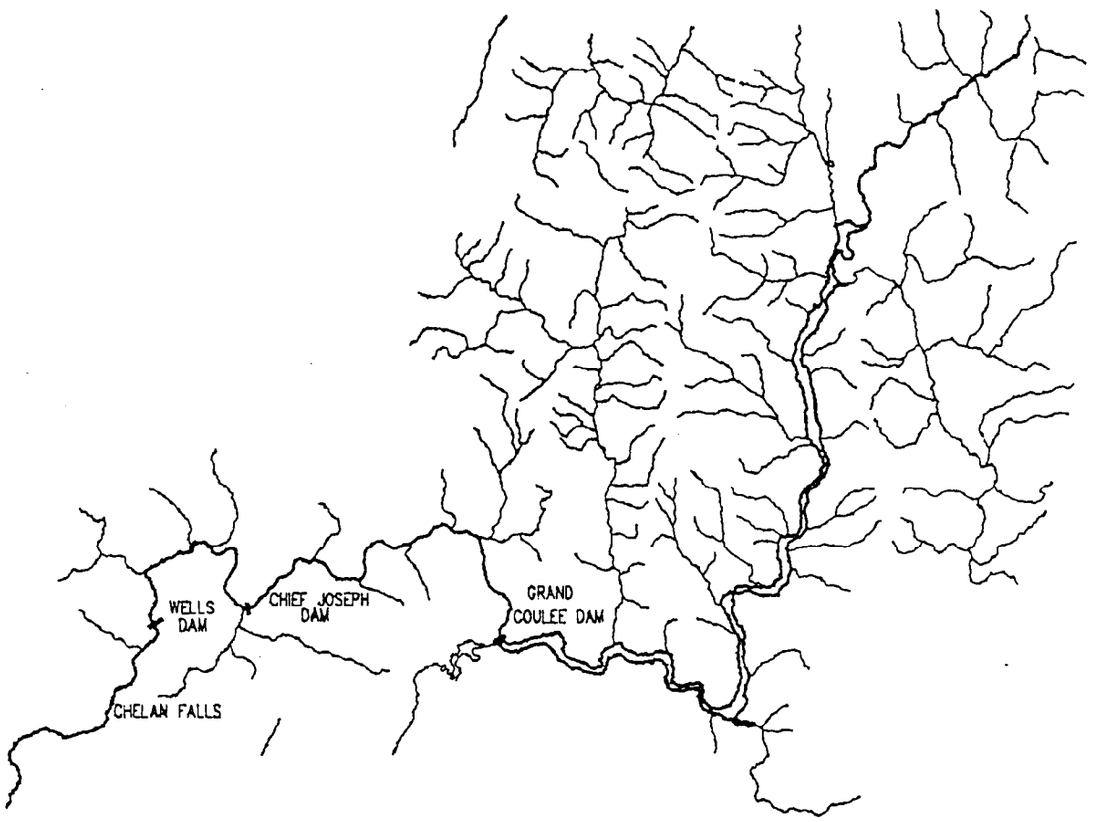
TO CHELAN FALLS



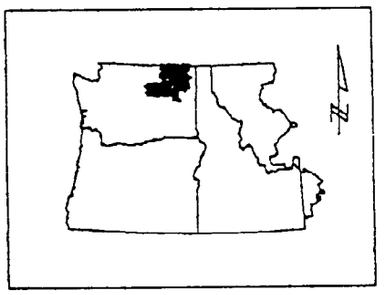
GIS GEOGRAPHIC INFORMATION SYSTEM

BONNEVILLE POWER ADMINISTRATION

UPPER COLUMBIA RIVER



CHELAN FALLS TO THE CANADIAN BORDER



GIS GEOGRAPHIC INFORMATION SYSTEM

BONNEVILLE POWER ADMINISTRATION

SUMMER CHINOOK SALMON

Fisheries Resource

Historical entry timing of chinook into the Columbia River extended from early spring in to late autumn. The summer run, peaking in mid-June, was the most abundant. Early fisheries deferentially harvested this component, reducing it relative to the spring and fall runs.

Today calendar dates are used to separate the runs for management purposes. At Priest Rapids Dam, spring chinook arrive from April 15 to June 13; summer chinook, June 14 to August 13; and fall chinook, August 14 to November 30. At Rock Island Dam spring chinook are defined as those fish arriving by June 27. Summer chinook arrive from the beginning of July to August 27, while fall fish are those that reach Rock Island Dam after August (Mullan 1987). From 1977 through 1987, summer chinook counts at Wells Dam ranged from about 2,100 fish to 6,700 fish. No apparent trends are evident.

The reservoirs of this subbasin serve as rearing habitat for summer chinook fry that emigrate out of the major subbasin tributaries such as the Okanogan, Methow and Wenatchee rivers. The rearing capacity of these reservoirs is likely an important determinant of summer chinook production in these rivers. Little is known about how this habitat interacts with early rearing habitat in tributary rivers. There may be other habitat features occurring in the tributaries that impose earlier limitations and fix smolt production. An understanding of limiting factors to summer chinook production is critical to the choice of rebuilding strategies and should be accorded highest monitoring and evaluation priority for this stock.

No directed harvest of summer chinook in the upper Columbia by recreational and tribal fisheries has occurred in recent years. An Indian snag fishery occurs below Chief Joseph Dam that takes sockeye and steelhead as well as chinook. The total catch in 1987 was about 800 fish.

Age of summer chinook has ranged from 2- to 6-year-old fish, with ocean duration lasting from one to five years. From 1976 through 1982 scale samples taken at Wells Hatchery, 2-year-old fish occurred 4 percent of the time and averaged 16 inches; 3-year-olds comprised 16 percent of the total, averaging 22 inches; 4-year-olds, 48 percent and 31 inches; 5-year-olds, 30 percent and 35 inches; and 6-year-olds, 2 percent and 36 inches. Fecundity averaged 4,885 eggs per female. Returns to all

fisheries and escapement averaged 0.3 percent for 10 tag groups of subyearlings released from Wells Dam Hatchery.

Recent summer chinook releases from Wells Hatchery ranged from 0.65 million to 2.6 million fingerlings. Yearling releases have not been consistent. However, 1985-1986 releases were about 200,000 fish (Table 5).

Specific Considerations

- Levels of main river spawning between Chief Joseph and Priest Rapids is undetermined, but not considered to provide any major production. Summer chinook spawning is concentrated in the major tributaries.

- Wells hatchery releases of subyearling summer chinook have ranged from 0.6 million to 2.6 million fish. Yearling releases range between 0.09 million and 0.3 million fish. Selection of brood stock must be done to avoid mixing fall chinook with the summers.

- The role of the reservoirs in rearing of summer chinook is poorly understood and must be evaluated to assist in ascertaining the limiting factors or summer chinook production.

- This stock has been severely limited by the elimination of mainstem spawning habitat.

Objectives

The objectives listed below represent an initial attempt to quantify harvest goals for the subbasin and describe the important biological goals for the stock.

Subbasin fishery needs are one part of a complex regime of existing fisheries management. The Columbia River Fish Management Plan, negotiated over several years by parties active in Columbia River fish management, describes a phased approach to initiating various fisheries as runs rebuild. This harvest management approach, must be reflected in realistic subbasin fishery goals. Lower mainstem fisheries and terminal fisheries are planned under the existing management plan. How responsive individual subbasin stocks are in rebuilding relative to their lower river harvest management aggregate stock, will influence the number of fish available for harvest in the terminal area.

Table 5. Summer/fall chinook Upper Columbia releases (1977-1987).

	WELLS HATCHERY		ROCKY REACH HATCHERY	
	FINGERLINGS	YEARLINGS	FINGERLINGS	YEARLINGS
1977	750,453	94,353		
1978	652,682	347,104		
1979	2,264,065			
1980	2,323,963	313,883		
1981	2,271,652		29,547	
1982	2,611,746			101,520
1983	1,432,900			
1984	1,240,865			
1985	1,549,000	186,000		
1986	1,791,617	200,440		

(a) Includes Wells Hatchery broodstock.

The subbasin utilization or harvest objective reflects the biological goals, subbasin potential and approximate level of fishery identified as desirable in open public meetings. It is expected that these objectives will be refined as additional information and more sophisticated modeling become available through the System Monitoring and Evaluation Program (SMEP).

Utilization Objective

Harvest 1,000 fish, to be shared between Indian and recreational fisheries according to the United States vs. Oregon agreement.

Biological Objectives

1. Increase productivity of upper Columbia summer chinook.

2. Reduce downstream juvenile salmonid mortality.

3. Maintain the genetic integrity of upper Columbia summer chinook and manage on a natural stock basis.

Alternative Strategies

Improving dam passage and screening diversion facilities alone will significantly contribute to the doubling goal and may lead to consistent and productive mainstem fisheries. However, managers need to understand more about how tributary and reservoir habitat interact to produce summer chinook. For these reasons two strategies are proposed, one that deals only with mainstem passage conditions and the second an experimental approach to learning more about the reservoirs as a production units.

Because of the lack of specific information about mainstem summer chinook and the inability to distinguish separate stocks, no attempt was made to model mainstem Columbia River summer chinook. Planners did not estimate costs.

STRATEGY 1: Natural Production. Increase passage survival.

Development and implementation of passage facilities and flow regimes are mandatory for increasing upper tributary production. Without such improvements, production increases in the upper tributaries will most likely be negated by continued high levels of mainstem passage mortality.

ACTIONS: 1, 2

1. Increase juvenile survival through improvement of juvenile bypass systems and flushing flows, and spill programs on mainstem Columbia dams.

2. Improve or repair screening, and improve design of water withdrawal sites. Repair or replace screening if necessary. Swan et al. (1986) located and inspected water withdrawal sites along the Columbia and Snake rivers to determine adequacy of intake screening. A total of 225 sites were inspected in 1979 and 1980. Results showed that the majority of intake pipes (70 percent) lack proper screening. Subsequent inspections a year later revealed that 36 percent still lacked adequate screening and/or proper design. The criteria used to determine adequacy were screens having openings not in excess of 6.35 mm and approach velocities not in excess 30.5 cm per second. (This approach velocity meets National Marine Fisheries Service criteria for fingerling, but not for fry.)

STRATEGY 2: Natural Production and Evaluation of Mainstem Reservoirs as Production Units.

ACTIONS: 1-4

1. -
2. -

3. Construct prototype mainstem reservoir spawning habitat. Loss of spawning habitat has been a significant limitation for summer chinook production in this subbasin. There is ample evidence that fall chinook are today using mainstem habitat for spawning where preferred velocities and substrate conditions exist (Mike Dell, Grant County PUD, and Steve Hays, Chelan County PUD, pers. commun.). These conditions only occur in local areas and are not common throughout Columbia River reservoirs.

   There may be sites in the reservoirs that could be modified to provide conditions similar to those already being used for spawning. Prototype development would include construction of fill structures that would create hydraulic conditions within preferred spawning habitat criteria under flows prevalent at the appropriate time and overlayment of suitable substrate. Colonization of these areas by spawning adults would need to be monitored for natural use, but could also be

assisted by the purposeful incubation of eggs in the substrate and perhaps special imprinting techniques.

Eggs incubated in this environment would probably emerge earlier than the fry entering the mainstem from the major tributaries due to temperature differences, giving them an advantage of early rearing.

4. Evaluate production and habitat utilization in selected reservoirs. Reservoirs where the mainstem spawning habitat is constructed should be selected for this evaluation. Modification of the Columbia River into a series of reservoirs has had a dramatic effect on the habitat, but managers still do not know what the potential for rearing anadromous salmonids under natural conditions is. Due to warm summer water temperatures, a species with a subyearling life history has the most potential to benefit from reservoir rearing, thus the selection of summer chinook for these investigations.

Recommended Strategy

The recommended strategy for summer chinook in the Priest Rapids to Chief Joseph Dam reach is Strategy 2 (a combination of mainstem actions to increase survival at dams and an approach to natural production options that considers the reservoirs as complete production units, through construction of reservoir spawning habitat). If mainstem spawning could be provided for summer chinook, such as is occurring naturally in localized situations for fall chinook, it could be a major tool for rebuilding natural stocks. Regardless of the selection of rebuilding strategies, managers need to know more about the rearing capacity of Columbia River reservoirs and how they interact with tributary habitat to produce summer chinook. Costs of this strategy are not known and it is recommended a detailed feasibility study be done to determine site availability.

FALL CHINOOK SALMON (UPRIVER BRIGHTS)

Fisheries Resource

Even after the major losses of habitat and completion of the mainstem dams, a small but persistent run of fall chinook has returned to the upper Columbia River. Little quantitative information exists on these fish except dam counts (Table 6). Migration timing has cast some doubt on the classification of these fish, some observers feeling that a number of summer chinook might have been included. Spawning locations, except for areas near the mouths of the Wenatchee and Chelan rivers went unnoticed until recently.

Table 6. Adult fall chinook (upriver brights) interdam counts, upper mainstem, 1977-1987[a].

Year	Priest Rapids & Wanapum Pools	Rock Island Pool[b]	Rocky Reach Pool[b]	Wells Pool[c]
1977	2,684	401	-176	1,151
1978	3,414	566	-49	856
1979	3,730	593	-535	1,070
1980	4,695	545	314	477
1981	3,019	202	786	438
1982	6,945	1,019	17	786
1983	6,630	566	499	593
1984	5,851	422	745	903
1985	7,037	1,922	1,091	1,083
1986	11,486	4,232	5,559	753
1987	20,776	5,676	9,210	2,822

[a] Tribal catch subtracted from PR-RI interdam count, 1986 and 1987. However, salmon punch-card statistics are not pool-specific and therefore could not be used to estimate sport catch. Escapements of fall chinook to tributary subbasin, if any, were not accounted for in this table.

[b] 56 adults and 28 jacks were killed at Rocky Reach Dam for tag recovery in 1986 and were subtracted from the count for Rocky Reach Pool.

[c] Used Wells Dam counts.

Upriver bright fall chinook run sizes to the Columbia River have increased dramatically since 1984. These increases have been reflected in sharply higher spawning escapements in the Hanford Reach, the free-flowing stretch of the Columbia between Priest Rapids Dam and the head of Lake Wallula. Coincident with these observations and the cessation of trapping for fall chinook at Priest Rapids Dam, scattered concentrations of spawners began to show up in locations like Sand Hollow Creek, a tributary of Wanapum Reservoir, selected locations in Wanapum and Priest Rapids reservoirs, in the tailrace of Wells Dam and the lower end of the Okanogan, Methow, Chelan, Entiat and Wenatchee rivers. These isolated concentrations were either a direct result of increased production in the Hanford Reach ("over runs" that actually originated from the Hanford Reach) or are just indications of improved production from existing populations that may have benefited from the same conditions that the Hanford population has. Regardless of the reason for the higher production in recent years, it remains to be seen if these production units persist beyond the current high levels of returns to the Hanford Reach.

The limited information available on these populations comes from spawning ground surveys. In most cases, these surveys are incomplete and probably underestimate numbers of redds. This is especially true of those done in the mainstem such as the Wells Dam tailrace where visible spawning locations are gradually obscured in the deeper water where additional redds likely exist (Steve Hays, Chelan County PUD, pers. commun.). In 1987, biologists observed 408 fall chinook redds in Priest Rapids pool, nine redds in Wanapum pool, and 106 redds in Rocky Reach Pool.

Recent fyke net catches taken above Rocky Reach Dam include newly emerged chinook fry, indicating successful reproduction is occurring above that site. It is assumed that these fish have a rearing strategy similar to summer chinook fry entering the mainstem from major tributaries in the spring and early summer.

Hatchery production in this subbasin occurs at the Rocky Reach Hatchery annex where yearling smolts are produced (Table 7).

Sport harvest of fall chinook is becoming more popular, especially during the last three years, and now includes a minor harvest in Priest Rapids, Wanapum and Rock Island reservoirs in this subbasin. Fisheries managers for the Colville Tribe have indicated a preliminary interest in developing a fall chinook fishery in the upper Columbia. However, it is unlikely that the existing natural production units could support consistent terminal fisheries of any size.

Table 7. Fall chinook Upper Columbia releases (1977-1987).

	PRIEST RAPIDS		ROCKY REACH HATCHERY	
	FINGERLINGS	YEARLINGS	FINGERLINGS	YEARLINGS
1977				
1978				
1979				
1980				
1981				
1982				226,276
1983			553,808	253,800
1984			533,800	226,276
1985			95,500	253,800
1986				252,268
1987				

(a) Includes Wells Hatchery broodstock.

The status of natural fall chinook production should be evaluated and monitored annually. This may require deep water surveys similar to what was done in the Hanford Reach (Swan et. al. 1986). It is possible that some of these small production units may be isolated and represent unique populations, such as those in the Chelan River near its mouth. This population seems to have an intermediate spawning timing between summer and fall chinook with annual spawning in the range of 30 to 80 redds.

Modeling of these fall chinook populations is not considered possible now for two reasons: 1) the paucity of data, and 2) uncertainty about their origin and continuity. If annual monitoring and new studies identify stock parameters and limiting factors to production, it would be desirable to model them at that time.

Specific Considerations

- Levels of main river spawning between Chief Joseph and Priest Rapids dams is undetermined and should be monitored.

- Although this subbasin appears to produce a relatively minor number of fall chinook, this stock is critically important in coastal salmon fisheries management and contributes widely to commercial and recreational fisheries.

- The Rocky Reach Hatchery could be made available for production of subyearling chinook, with a potential for about 2 million fish.

Objectives

Subbasin fishery needs are one part of a complex regime of existing fisheries management. The Columbia River Fish Management Plan, negotiated over several years by parties active in Columbia River fish management, describes a phased approach to initiating various fisheries as runs rebuild. This harvest management approach, must be reflected in realistic subbasin fishery goals. Lower mainstem fisheries and terminal fisheries are planned under the existing management plan. How responsive individual subbasin stocks are in rebuilding, relative to their lower river harvest management aggregate stock, will influence the number of fish available for harvest in the terminal area.

Biological Objectives

1. Identify the scope and character, and monitor the status of fall chinook production in the subbasin. Reduce downstream juvenile mortality and upstream adult losses due to mainstem passage problems.

2. Develop a hatchery stock at the Rocky Reach Hatchery.

Utilization Objective

Initially provide harvest opportunities for 1,000 adult fish. This harvest goal can be revised as the stock is developed and evaluated.

Alternative Strategies

STRATEGY 1: Natural Production. This strategy relies on existing natural production to accomplish the objectives.

ACTIONS: 1

1. Improve mainstem passage conditions for juvenile and adult fish.

STRATEGY 2: Combination of Natural and Hatchery Production.

ACTIONS: 1-3

1. -

2. Release coho for the last time in the spring of 1990 at Rocky Reach Hatchery. Surplus eggs or fry on hand for release in spring of 1991 could possibly be used for natural population augmentation in the lower Columbia River hatcheries.

3. Reprogram Rocky Reach Hatchery with fall chinook. It has been estimated that the existing level of coho production (500,000 yearlings) could be replaced with about 3.6 million subyearling chinook (Steve Hays, Chelan County PUD, pers. commun.). Adjustments to the capacity of the Rocky Reach annex could increase the program significantly. Brood stock could come from Wells Hatchery where only early fish are selected for the summer chinook program to reduce the risk of mixing with fall chinook. The late group of fish, which is excluded, would be nearly enough for brood stock

requirements for a fall chinook program at Rocky Reach. Fish should not be removed from fish ladders at dams above McNary without regard for their destination since that could affect the small concentrations of fall chinook that may represent isolated populations and also create a stock with unknown genetic background. Homing of the returning adults from this program may not be precise as they would be reared on river water.

Recommended Strategy

Planners recommend Strategy 2. If the Rocky Reach coho stock were indigenous, it would be a most valuable resource. However, the stock is replenished annually with eggs from various lower river hatcheries and there is no recognizable upper Columbia River coho stock remaining. The hatchery facilities at Rocky Reach Hatchery (the Annex and Turtle Rock Rearing Ponds), do not lend themselves readily to culture of yearling anadromous salmonids. It is thought that use of the facilities for rearing and release of subyearlings before warm water temperatures cause disease would be a more successful program.

The intent of recommending this strategy is to increase production that would be better suited to the existing hatchery facilities and contribute better to local fisheries. Consideration needs to be given to the rearing potential of the reservoirs for subyearling chinook. Since fall chinook have the same rearing strategy as summer chinook, competition could ensue and retard rebuilding efforts for summer chinook. This would not be a desirable result and evaluation of reservoir rearing potential is one of the most urgent information needs in this reach of the Columbia.

COHO SALMON

Fisheries Resource

Native stocks of early coho were once abundant in the Yakima River (50,000 to 700,000 fish), Wenatchee River (6,000 to 7,000 fish), Entiat River (9,000 to 13,000 fish), Methow River (23,000 to 31,000 fish), and Spokane River (32,000 to 45,000 fish) (Mullan 1983). Irrigation diversions, mill dam construction and overharvest reduced these natural runs. With the construction of Grand Coulee Dam and subsequent dams, many of these coho runs disappeared.

Beginning in the 1940s, managers heavily supplemented coho runs to the Wenatchee, Entiat, and Methow rivers with hatchery releases of non-local stocks. These supplementation programs were discontinued by the late 1960s (Howell 1985). Today, the upper Columbia coho stocks above Priest Rapids are primarily the result of releases from the Rocky Reach area. Run sizes for coho returning to Rock Island Dam from 1977 through 1986 ranged from 260 to 2,179 fish. No apparent trends exist (Table 8).

Recreational harvest of coho within the upper Columbia is not available, but managers believe that annual catches are normally less than 50 fish. When the coho program at Rocky Reach began in the 1970s, a significant sport fishery existed, which several times exceeded a harvest of 3,000 fish. The fishery declined in the 1980s, with complaints from fishermen that the fish did not readily bite. No tribal harvest occurs.

Today, fisheries managers consider coho production in the upper Columbia a very minor component and actively manage lower river fisheries for lower river hatchery escapement only. The United States vs. Oregon agreement excludes coho from allocation, but the Columbia River Fish Management Plan requires coho from two lower river hatcheries to be released into the Yakima and Umatilla rivers.

Rocky Reach Hatchery presently receives eggs from a number of sources -- Lower Kalama, Elochoman, Washougal and Cowlitz (Table 9). As such the Rocky Reach coho returns do not represent a unique genetic resource. Juveniles are released as yearling smolts. From 1980 through 1986, releases ranged from about 48,500 to 550,000 fish. Return rate information is not available at this time.

Table 8. Rock Island Dam coho returns (1977-1986).

SPAWNING	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
HATCHERY	518	1229	465	783	826	1915	260	2179	1096	503

Table 9. Upper Columbia coho releases, Rocky Reach Hatchery (1977-1987).

YEAR	EGG SOURCE	RELEASES
1977		
1978		
1979		
1980	LOWER KALAMA	48,478
1981	ELOKOMIN	296,127
1982	WASHOUGAL	428,690
1983	WASHOUGAL	515,605
1984	COWLITZ	517,116
1985	WASHOUGAL	128,100
1986	WASHOUGAL	554,563
1987	ELOKOMIN	

Fish generally return as 3-year-olds, although some 2-year-old males are present. From 1985 and 1986 information, the percent female return was 46 percent and 41 percent, respectively for 3-year-old fish. Length information is not available.

Specific Considerations

- Coho production at the Rocky Reach Hatchery is supported by eggs supplied from various lower Columbia River hatcheries.
- Rearing ponds at Rocky Reach Hatchery (Turtle Rock) have only a river water source making prophylactic treatment with medicated feed necessary to control columnaris from June through October.
- Columbia River coho are subject to a high cumulative harvest rate in ocean and lower river fisheries. The combination of an extremely high harvest rate and dam mortalities reduces the chance for successful production in the reach and makes reliance on outside egg sources a necessity.
- Culturing a species that has a subyearling freshwater life history would be easier at the Rocky Reach Hatchery than rearing coho.

Objectives

Eliminate hatchery coho production in the subbasin. The scope of natural coho production in the subbasin is not known, but presumed to be very minor.

Alternative Strategies

STRATEGY 1: Eliminate coho production at Rocky Reach Hatchery.

ACTIONS: 1, 2

1. Release coho for the last time in the spring of 1990. Surplus eggs or fry on hand for release in spring of 1991 could possibly be used for natural population augmentation in the lower river.

2. Reprogram Rocky Reach Hatchery with fall chinook. Brood stock could come from Wells Hatchery where brood stock for the summer chinook program are eliminated from production on a certain date to avoid mixing in later fall chinook. The late group of fish, which is excluded, would be nearly enough for brood stock requirements of the replacement fall chinook program. Fish should not be removed from fish ladders at dams above McNary without regard for their destination since that could affect the small concentrations of fall chinook that may represent isolated populations and also create a stock with unknown genetic background. Homing of the returning adults from this program may not be precise as they would be reared on river water.

STRATEGY 2: Maintain current level of coho production at Rocky Reach Hatchery.

ACTIONS: 3

3. Release approximately 500,000 yearling coho annually. Maintain current brood stock practices of receiving eggs from lower river hatcheries. Other brood stock practices that might develop a stock that performs better are considered impractical under existing fishery regimes.

Recommended Strategy

Planners recommend Strategy 1. If the Rocky Reach coho stock were indigenous, it would be a most valuable resource. However, the stock is replenished annually with eggs from various lower river hatcheries and there is no recognizable upper Columbia River coho stock remaining. The hatchery facilities at Rocky Reach Hatchery (the Annex and Turtle Rock Rearing Ponds), do not lend themselves readily to culture of yearling anadromous salmonids. It is thought that use of the facilities for rearing and release of subyearlings before warm water temperatures cause disease would be a more successful program. Coho, by the time they reach the upper reaches of the Columbia, are not a desirable subject for recreational fisheries and are poorly utilized now.

The intent of recommending this strategy is to eliminate production that contributes little to the local area and replace it with production that would be better suited for the existing hatchery facilities and contribute more to local fisheries. This strategy places no additional risk on coho genetic resources.

STEELHEAD

Fisheries Resource

With the exception of one small remaining stretch of free-flowing river below Priest Rapids Dam, the Columbia River has no known significant populations of wild, river-bred and reared steelhead. The Hanford Reach may produce wild fish (see the mainstem Columbia plan, Bonneville Dam to Priest Rapids Dam, for more information). The primary value of this region, with regard to steelhead, is as a migratory passageway for tributary anadromous fish stocks. Steelhead angling opportunities exist, nevertheless, on fish bound for upper tributaries and rearing stations. The primary steelhead angling areas are at Ringold Springs (Hanford Reach), the mouth of the Wenatchee River (Rock Island Pool), the mouth of the Methow at Pateros (Wells Pool), and to a lesser extent, at Azwell Bar (below Wells Dam) and the mouth of the Entiat River. Additional steelhead opportunities occur at Wells, Rocky Reach, Rock Island, Wanapum, Priest Rapids and McNary dams, primary in tailrace or faster flowing sections. The most important fishery in the free-flowing Columbia between Priest Rapids Dam and the Tri-Cities area (Hanford Reach) is in the vicinity of the Ringold Springs Rearing Pond, located across from Hanford and upstream in the free-flowing Columbia along White Bluffs.

Hatchery steelhead smolt releases are programmed directly for the upper Columbia Ringold Spring, where annual production is about 215,000 smolts. Additional smolt releases occur at Turtle Rock above Rocky Reach Dam, but only amounts to 10,000 to 20,000 smolts from rearing pond clean-out. The intensive fishery at Pateros (Wells Pool) results from large plants into the lower Methow River.

Wild steelhead escapement goals at Priest Rapids should include escapement goals for the Wenatchee (4,718 fish), Entiat (1,471 fish), Methow (3,200 fish), Okanogan (160 fish), and minor mainstem tributaries (approximately 500 fish).

The rebuilding trend for natural and wild steelhead consistent with United States vs. Oregon and other applicable policies should be maintained.

Specific Considerations

- The primary production opportunities are passage and mainstem water flow improvements to reduce mortality rates.

- Various small tributaries need to be evaluated for potential production.

Objectives and Strategies

Planners have not developed quantitative objectives since this portion of the mainstem river is primarily a passage area with limited production opportunities. Consequently, planners have not identified strategies for increasing steelhead production in this section of the mainstem.

PART V. SUMMARY AND IMPLEMENTATION

Objectives and Recommended Strategies

Summer Chinook

Summer chinook objectives include a relatively small subbasin harvest (1,000 fish), with a focus on enhancing natural populations. Planners recommend Strategy 2, which calls for improving mainstem passage; improving and repairing screens at water withdrawals sites; evaluating production and habitat use in selected reservoirs; and constructing and evaluate prototype reservoir spawning habitat, which if successful could provide a new tool for rebuilding natural summer or fall chinook populations.

Fall Chinook (Upriver Brights)

Fall chinook objectives include a relatively small subbasin harvest (2,000 fish), with a focus on maintaining small natural populations and development of a new hatchery stock. Planners recommend Strategy 2, improving mainstem passage, releasing coho at Rocky Reach Hatchery for the last time in spring 1990, and reprogramming of the Rocky Reach Hatchery to rear subyearling fall chinook rather than coho.

Coho

Planners recommend that hatchery coho be eliminated from production in the upper Columbia at Rocky Reach Hatchery. The facility does not lend itself to the culture of yearling anadromous salmonids and, under existing fishery regimes, brood stock must be made up from lower river hatcheries. As such the stock does not represent either an important genetic resource or a good fisheries benefit to the local area.

Steelhead

Planners have not developed quantitative objectives since this portion of the mainstem river is primarily a passage area with limited production opportunities.

Implementation

In the summer of 1990, the Columbia Basin Fish and Wildlife Authority submitted to the Northwest Power Planning Council the Integrated System Plan for salmon and steelhead in the Columbia Basin, which includes all 31 subbasin plans. The system plan attempts to integrate this subbasin plan with the 30 others in

the Columbia River Basin, prioritizing fish enhancement projects and critical uncertainties that need to be addressed.

From here, the Northwest Power Planning Council will begin its own public review process, which will eventually lead to amending its Columbia River Basin Fish and Wildlife Program. The actual implementation schedule of specific projects or measures proposed in the system plan will materialize as the council's adoption process unfolds.

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APPENDIX A
NORTHWEST POWER PLANNING COUNCIL
SYSTEM POLICIES

In Section 204 of the 1987 Columbia River Basin Fish and Wildlife Program, the Northwest Power Planning Council describes seven policies to guide the systemwide effort in doubling the salmon and steelhead runs. Pursuant to the council's plan, the basin's fisheries agencies and Indian tribes have used these policies, and others of their own, to guide the system planning process. The seven policies are paraphrased below.

1) The area above Bonneville Dam is accorded priority.

Efforts to increase salmon and steelhead runs above Bonneville Dam will take precedence over those in subbasins below Bonneville Dam. In the past, most of the mitigation for fish losses has taken the form of hatcheries in the lower Columbia Basin. According to the council's fish and wildlife program, however, the vast majority of salmon and steelhead losses have occurred in the upper Columbia and Snake river areas. System planners turned their attention first to the 22 major subbasins above Bonneville Dam, and then to the nine below.

2) Genetic risks must be assessed.

Because of the importance of maintaining genetic diversity among the various salmon and steelhead populations in the Columbia River Basin, each project or strategy designed to increase fish numbers must be evaluated for its risks to genetic diversity. Over millions of years, each fish run has evolved a set of characteristics that makes it the best suited run for that particular stream, the key to surviving and reproducing year after year. System planners were to exercise caution in their selection of production strategies so that the genetic integrity of existing fish populations is not jeopardized.

3) Mainstem survival must be improved expeditiously.

Ensuring safe passage through the reservoirs and past the dams on the Columbia and Snake River mainstems is crucial to the success of many efforts that will increase fish numbers, particularly the upriver runs. Juvenile fish mortality in the reservoirs and at the dams is a major cause of salmon and steelhead losses. According to estimates, an average of 15 percent to 30 percent of downstream migrants perish at each dam, while 5 percent to 10 percent of the adult fish traveling upstream perish. Projects to rebuild runs in the tributaries have and will represent major expenditures by the region's ratepayers -- expenditures and long-term projects that should be protected in the mainstem.

4) Increased production will result from a mix of methods.

To rebuild the basin's salmon and steelhead runs, fisheries managers are to use a mixture of wild, natural and hatchery production. Because many questions still exist as to whether wild and natural stocks can coexist with significant numbers of hatchery fish, no one method of production will be solely responsible for increasing fish numbers. System planners were to take extra precaution when considering outplanting hatchery fish into natural areas that still produce wild fish. The council is relying on the fish and wildlife agencies and tribes to balance artificial production with wild and natural production.

5) Harvest management must support rebuilding.

Like improved mainstem passage, effective harvest management is critical to the success of rebuilding efforts. A variety of fisheries management entities from Alaska to California manage harvest of the Columbia Basin's salmon and steelhead runs. The council is calling on those entities to regulate harvest, especially in mixed-stock fisheries, in ways that support the basin's efforts to double its runs.

6) System integration will be necessary to assure consistency.

The Northwest Power Planning Council intends to evaluate efforts to protect and rebuild Columbia River Basin salmon and steelhead from a systemwide perspective. Doubling the runs will require improvements in mainstem passage, fish production and harvest management -- three extremely interdependent components. System planners from all parts of the basin are to coordinate their efforts so, for example, activities in the lower Columbia are consistent with and complement the activities 800 miles upstream in Idaho's Salmon River. The fisheries management organizations and their plans vary from subbasin to subbasin, but the council is calling upon the agencies and tribes to help resolve conflicts that arise.

7) Adaptive management should guide action and improve knowledge.

System planners were to design projects so that information can be collected to improve future management decisions. By designing projects that test quantitative hypotheses and lend themselves to monitoring and evaluation, managers can learn from their efforts. This learning by doing is called "adaptive management." Using such an approach, managers can move ahead with plans to rebuild the Columbia Basin's salmon and steelhead runs, despite many unanswered questions about how best to accomplish their goal. With time, the useful information revealed by these "experiments" can guide future projects.

APPENDIX B
SMART ANALYSIS

To help select the preferred strategies for each subbasin, planners used a decision-making tool known as Simple Multi-Attribute Rating Technique (SMART). SMART examined each proposed strategy according to the following five criteria. In all cases, SMART assumed that all of the Columbia River mainstem passage improvements would be implemented on schedule.

1) Extent the subbasin objectives were met

2) Change in maximum sustainable yield

3) Impact on genetics

4) Technological and biological feasibility

5) Public support

Once SMART assigned a rating for each criteria, it multiplied each rating by a specific weight applied to each criteria to get the "utility" value (see following tables). Because the criteria were given equal weights, utility values were proportional to ratings. The confidence in assigning the ratings was taken into consideration by adjusting the weighted values, (multiplying the utility value by the confidence level) to get the "discount utility." SMART then totaled the utility values and discount utility values for all five criteria, obtaining a "total value" and a "discount value" for each strategy.

System planners used these utility and discount values to determine which strategy for a particular fish stock rated highest across all five criteria. If more than one of the proposed strategies shared the same or similar discount value, system planners considered other factors, such as cost, in the selection process. Some special cases arose where the planners' preferred strategy did not correspond with the SMART results. In those cases, the planners provide the rationale for their selection.

SUBBASIN: Columbia River (Priest Rapids Dam to Chief Joseph Dam

STOCK: Summer chinook

STRATEGY: 1. mainstem passage improvements and pump station screening

CRITERIA	RATING	CONFIDENCE	WEIGHT	UTILITY	DISCOUNT UTILITY
1 EXT OBJ	6	0.9	20	120	108
2 CHG MSY	6	0.9	20	120	108
3 GEN IMP	9	0.9	20	180	162
4 TECH FEAS	7	0.6	20	140	84
5 PUB SUPT	7	0.9	20	140	126

TOTAL VALUE 700

DISCOUNT VALUE 588

CONFIDENCE VALUE 0.84

SUBBASIN: Columbia River (Priest Rapids to Chief Joseph Dam)

STOCK: Summer chinook

STRATEGY: 2. supplementation

CRITERIA	RATING	CONFIDENCE	WEIGHT	UTILITY	DISCOUNT UTILITY
1 EXT OBJ	7	0.9	20	140	126
2 CHG MSY	7	0.9	20	140	126
3 GEN IMP	6	0.6	20	120	72
4 TECH FEAS	8	0.9	20	160	144
5 PUB SUPT	9	0.9	20	180	162

TOTAL VALUE 740

DISCOUNT VALUE 630

CONFIDENCE VALUE 0.85135135

SUBBASIN: Columbia River (Priest rapids Dam to Chief Joseph Dam)

STOCK: Coho

STRATEGY: 1. mainstem passage

CRITERIA	RATING	CONFIDENCE	WEIGHT	UTILITY	DISCOUNT UTILITY
1 EXT OBJ	6	0.9	20	120	108
2 CHG MSY	6	0.9	20	120	108
3 GEN IMP	6	0.6	20	120	72
4 TECH FEAS	7	0.9	20	140	126
5 PUB SUPT	7	0.9	20	140	126

TOTAL VALUE 640

DISCOUNT VALUE 540

CONFIDENCE VALUE 0.84375

SUBBASIN: Columbia River (Priest Rapids dam to chief Joseph Dam)

STOCK: Coho

STRATEGY: 2. Hatchery

CRITERIA	RATING	CONFIDENCE	WEIGHT	UTILITY	DISCOUNT UTILITY
1 EXT OBJ	6	0.9	20	120	108
2 CHG MSY	6	0.9	20	120	108
3 GEN IMP	6	0.6	20	120	72
4 TECH FEAS	7	0.6	20	140	84
5 PUB SUPT	5	0.6	20	100	60

TOTAL VALUE 600

DISCOUNT VALUE 432

CONFIDENCE VALUE 0.72