Appendix D
Wenatchee Subbasin Plan

Summary of Artificial Production In the Wenatchee Subbasin

I. Introduction

Various processes are underway within the Columbia Basin that direct hatchery program implementation. The listing of certain populations of fish under the ESA has also dictated hatchery program modifications and reform.

Some of the principal processes are:

Federal:

Hatchery and Genetic Management Plans:
The Hatchery and Genetic Management Plan (HGMP) process was initiated to identify offsite mitigation opportunities associated with operation of the Federal Columbia River Power System. The HGMP process is designed to describe existing propagation programs, identify necessary or recommended modifications of those programs, and help achieve consistency of those programs with the Endangered Species Act. The HGMP process only addresses anadromous salmon and steelhead programs.

Hatchery and Genetic Management Plans are described in the final salmon and steelhead 4(d) rule (July 10, 2000; 65 FR 42422) as a mechanism for addressing the take of certain listed species that may occur as a result of artificial propagation activities. NOAA Fisheries will use the information provided by HGMPs in evaluating impacts on anadromous salmon and steelhead listed under the ESA. In certain situations, the HGMPs will apply to the evaluation and issuance of section 10 take permits. Completed HGMPs may also be used for regional fish production and management planning by federal, state, and tribal resource managers.

The primary goal of the HGMP process is to devise biologically-based artificial propagation management strategies that ensure the conservation and recovery of listed Evolutionarily Significant Units (ESUs). The HGMP process also seeks to document and implement hatchery reform in the Columbia Basin. Much of the initial work on the HGMP process was coordinated and combined with efforts to complete the Artificial Production Review and Evaluation (APRE – see below)) analysis, which looked at the same sorts of information.

Artificial Production Review and Evaluation (APRE)
The APRE process seeks to document progress toward hatchery reform in the Columbia Basin. The NPCC used consultants and representatives of the Columbia Basin fishery managers to analyze existing programs and recommend reforms; a draft report that will

go to the Council and the region has been prepared. The APRE process includes both anadromous and non-anadromous fish in its analysis.

Pacific Coastal Salmon Recovery Fund

The Pacific Coastal Salmon Recovery Fund (PCSRF) was established in FY2000 to provide grants to the states and tribes to assist state, tribal and local salmon conservation and recovery efforts. The PCSRF was requested by the governors of the states of Washington, Oregon, California and Alaska in response to Endangered Species Act (ESA) listings of West Coast salmon and steelhead populations. The PCSRF supplements existing state, tribal and federal programs to foster development of federal-state-tribal-local partnerships in salmon recovery and conservation; promotes efficiencies and effectiveness in recovery efforts through enhanced sharing and pooling of capabilities, expertise and information. The goal of the Pacific Coastal Salmon Recovery Fund is to make significant contributions to the conservation, restoration, and sustainability of Pacific salmon and their habitat.

The PCSRF's enhancement objective is*: To conduct activities that enhance depressed stocks of wild anadromous salmonids through hatchery supplementation, reduction in fishing effort on depressed wild stocks, or enhancement of Pacific salmon fisheries on healthy stocks in Alaska. This includes supplementation and salmon fishery enhancements.*

US v. OR

United States v Oregon, originally a combination of two cases, Sohappy v. Smith and U.S. v. Oregon, legally upheld the Columbia River treaty tribes reserved fishing rights. Specifically the decision acknowledged the treaty tribes reserved rights to fish at "all usual and accustomed" places whether on or off the reservation, and were furthermore entitled to a "fair and equitable share" of the resource. Although the Sohappy case was closed in 1978, U.S. v. Oregon remains under the federal court's continuing jurisdiction serving to protect the tribes treaty reserved fishing rights. This case is tied closely to U.S. v. Washington, which among other things defined "fair and equitable share" as 50 percent of all the harvestable fish destined for the tribes' traditional fishing places, and established the tribes as co-managers of the resource.

In 1988, under the authority of U.S. v. Oregon, the states of Washington, Oregon and Idaho, federal fishery agencies, and the treaty tribes agreed to the Columbia River Fish Management Plan (CRFMP), which was a detailed harvest and fish production process. There are no financial encumbrances tied to the process. Rather, the fish production section reflects current production levels for harvest management and recovery purposes, since up to 90% of the Columbia River harvest occurs on artificially produced fish. This Plan expired in 1998, and has had subsequent annual rollover of portions in which agreement has been reached. However, a newly negotiated CRFMP is forthcoming.

Hatchery production programs in the upper Columbia sub-basins are included in the management plans created by the fishery co-managers identified in the treaty fishing rights case *United States v Oregon*. The parties to *U.S. v Oregon* include the four Columbia River Treaty Tribes – Yakama Nation, Warm Springs, Umatilla, and Nez Perce tribes, NOAA-Fisheries, U.S. Fish and Wildlife Service, and the states of Oregon, Washington, and Idaho. The Shoshone-Bannock Tribe is admitted as a party for

purposes of production and harvest in the upper Snake River only. These parties jointly develop harvest sharing and hatchery management plans that are entered as orders of the court that are binding on the parties. The "relevant co-managers" described in the *U.S. v Orego*n management plans are, for the mid-Columbia sub-basins, the federal parties, Yakama Nation, and Washington Department of Fish and Wildlife.

Hatchery programs are viewed by the Yakama Nation as partial compensation for voluntary restrictions to treaty fisheries imposed by the tribe to assist in rebuilding upriver populations of naturally-spawning salmonids. Because treaty and non-treaty fisheries are restricted on the basis of natural stock abundance, the tribal priority is to use hatcheries in a manner that supplements natural spawning and increases average population productivity. Perspectives on the appropriate use of hatchery-origin fish for supplementation vary between federal, state, and tribal fish co-managers. Federal and, to a lesser degree, state co-managers place a higher priority on managing the genetic risks of hatchery supplementation of natural populations, while the tribe sees the demographic threats of habitat loss and degradation as the greater risk to natural populations. In general, however, all parties agree that hatcheries can and should be operated as integral components of natural populations where the survival benefits of the hatchery can result in a significant increase in net population productivity.

Federal ESA

Current ESA Section 10 Permits for listed summer steelhead (Permit #1395); listed spring chinook (Permit #1196) and non-listed anadromous fish (Permit # 1347) also direct artificial production activities associated with the habitat conservation plans. Douglas PUD, Chelan PUD and WDFW are co-permittees, therefore provisions within the permits and associated Biological Opinions are incorporated into the hatchery programs undertaken in the HCP's.

State:
The state, along with the federal government has various forums in which they are active. All have some role in determining or balancing artificial production programs, as well as the ones that follow under "other". Essentially no specific action would occur until the action is determined to be warranted in the already established processes.

Other:

<u>FERC processes:</u>
Under current settlement agreements and stipulations, the three mid-Columbia PUDs pay for the operation of hatchery programs within the Columbia Cascade Province. These programs determine the levels of hatchery production needed to mitigate for the construction and continued operation of the PUD dams.

<u>Habitat Conservation Plans:</u>

In 2002, habitat conservation plans (HCPs) were signed by Douglas and Chelan PUDs, WDFW, USFWS, NOAA Fisheries, and the Colville Confederated Tribes. The overriding goal of the HCPs are to achieve no-net impact[1] on anadromous salmonids as they pass Wells (Douglas PUD), Rocky Reach, and Rock Island (Chelan PUD) dams. One of the main objectives of the hatchery component of NNI is to provide species specific hatchery programs that may include contributing to the rebuilding and recovery of naturally reproducing populations in their native habitats, while maintaining genetic and ecologic integrity, and supporting harvest.

Biological Assessment and Management Plan:
The biological assessment and management plan (BAMP) was developed by parties negotiating the HCPs in the late 1990s. The BAMP was developed to document guidelines and recommendations on methods to determine hatchery production levels and evaluation programs. It is used within the HCP as a guiding document for the hatchery programs.

All of these processes affect the hatchery programs within the Upper Columbia Basin in one way or another.

Historic and current programs and facilities

Historic programs

The first hatchery that released salmonids in the Wenatchee Basin began operation in 1899 on the Wenatchee River (Chiwaukum Creek). This hatchery was built to replenish the salmon (primarily Chinook, and coho) runs, which had virtually been eliminated by the 1890s (Gilbert and Evermann 1895; WDFG 1898). The Wenatchee facility was closed from 1904 to 1913 because of severe weather, logistics of the location, but primarily because it lacked adequate brood stock.

The biggest problems encountered in the early years of the hatcheries were lack of fish for broodstock, and because of irrigation diversions that entrained large numbers of juveniles (both naturally- and artificially produced).

Most of the fish planted from the Wenatchee facility in the first few years of production were probably coho (WDFG 1904-1920; Craig and Suomela 1941). For the first few years, species were not differentiated, with almost 8 million fry planted per year from the Wenatchee facility. Beginning in 1904, when species were differentiated, by far the majority of fish released were coho. After the Wenatchee hatchery was moved downstream near the town of Leavenworth in 1914, Chinook production began again,

[1] NNI refers to achieving a virtual 100% survival of anadromous salmonids as they pass the mainstem projects. This is achieved through 91% survival of adults and juveniles (or 93% for juveniles) passing the projects, and 7% compensation through hatchery programs and 2% contribution through a tributary fund, which will fund projects to improve salmonid habitat in the tributaries.

with supplementation of eggs from other hatcheries as far away as the Willamette and McKenzie rivers of Oregon (WDFG 1914; Craig and Suomela 1941).

Success of the releases of fish from these hatcheries is unknown, but not thought to have been large.

Current programs

Current program overview:

Artificial production of anadromous fish in the Wenatchee Subbasin includes spring Chinook, summer Chinook, summer steelhead, sockeye, and reintroduction of coho salmon (Table 1). Spring Chinook and summer steelhead are currently ESA-listed as endangered through the Endangered Species Act of 1973. Summer Chinook are considered a depressed population. Once extirpated from the Wenatchee Subbasin, small numbers of coho salmon have been reintroduced, and plans are currently in the feasibility stage for larger scale reintroduction. Hatchery intervention in the Wenatchee Subbasin is guided by a two-pronged approach that encourages local adaptation, preservation and enhancement of specific populations while simultaneously spreading the risk through selection of several artificial production alternatives.

Table 1. Artificial anadromous fish production in the Wenatchee Subbasin

Fish Species	Facility	Funding Source	Production level goals
Spring Chinook	Eastbank Fish Hatchery Complex (Chiwawa acclimation pond) (Operated by WDFW)	Chelan County PUD	672,000
	Leavenworth National Fish Hatchery (Operated by USFWS)	Bureau of Reclamation	1,625,000
Steelhead	Eastbank Fish Hatchery Complex (Operated by WDFW)	Chelan County PUD	400,000
Summer Chinook	Eastbank Fish Hatchery Complex (Dryden acclimation pond) (Operated by WDFW)	Chelan County PUD	864,000
Sockeye	Eastbank Hatchery (Operated by WDFW)	Chelan County PUD	200,000
Coho	Leavenworth NFH (Operated by USFWS)	BPA (Fish & Wildlife Program)	> 500,000
	Acclimation sites at Nason Creek and Icicle Creek (YN)	BPA (Fish & Wildlife Program)	< 500,000

Federal programs

Grand Coulee Fish Maintenance Project (GCFMP)

The USFWS operates the Leavenworth NFH Complex in the CCP region constructed by the U.S. Bureau of Reclamation (BOR) to replace fish losses that resulted from construction of Grand Coulee Dam. These programs were authorized as part of the Grand Coulee Fish Maintenance Project (GCFMP) on April 3, 1937, and re-authorized by the

Mitchell Act (52 Stat. 345) on May 11, 1938. The complex consists of three hatchery facilities, Leavenworth, Entiat, and Winthrop NFHs.

Leavenworth NFH

Leavenworth National Fish Hatchery (NFH) was originally authorized by the Grand Coulee Fish Maintenance Project (GCFMP) on April 3, 1937, and reauthorized by the Mitchell Act (52 Stat. 345) on May 11, 1938. It began operations in 1942. Leavenworth NFH is one of three mid-Columbia hatcheries constructed by the Bureau of Reclamation (BOR) as mitigation for the Grand Coulee Dam-Columbia Basin Project. It is currently used for adult collection, egg incubation and rearing of spring Chinook salmon. It also provides juveniles and/or adults for re-establishing spring Chinook runs in other Columbia River tributaries, as needed (e.g., Peshastin Creek adult out-plants). The hatchery complex (Complex) consists of Leavenworth, Entiat, and Winthrop NFH's.

Facility description: Leavenworth NFH is situated on Icicle Creek, 2.8 miles from its confluence with the Wenatchee River. Fish returning to LNFH must travel about 497 miles to and from the ocean, and must pass seven Columbia River hydroelectric dams on their migrations.

Rearing facilities include two – 15 x 150 foot adult holding ponds, 45 – 8 x 80 raceways, 14 – 10 x 100 covered raceways, 72 troughs, 108 starter tanks, plus 40 small and 22 large Foster-Lucas ponds (not used for hatchery production).

The primary water source for the hatchery is Icicle Creek. The water right allows for the diversion of up to 42 cubic feet per second (cfs) for production. During low flows in the summer, the hatchery water supply (Icicle Creek) is supplemented with water from Snow and Nada lakes (up to 16,000 acre feet; these lakes are located in the upper Icicle Creek watershed). The hatchery also has seven wells, with a total water right of 6,700 gallons per minute. The well water is mainly used for egg incubation and early rearing.

State programs

Rock Island Fish Hatchery Complex

The Rock Island Fish Hatchery Complex (RIFHC) began operation in 1989 as mitigation for salmonids lost as a result of operation of Rock Island Dam. The facility was constructed by, and operates under funding from, Chelan PUD originally through the Rock Island Settlement Agreement. Currently, Chelan PUD and fisheries agencies and the Colville Confederated Tribes have signed a habitat conservation plan (HCP). When the HCP is incorporated into Chelan PUD's FERC license, it will supersede the Settlement Agreement. Production levels and evaluation programs are outlined within the HCP (Table 1)**.**

Facility description: The RIFHC has one main incubation and rearing hatchery (Eastbank) and five satellite rearing/acclimation facilities, and four broodstock trapping sites. The main hatchery, Eastbank, has two adult holding ponds, 70 half-stacks of

vertical incubators equipped with a chilled water supply (4.5 gpm per half-stack), eight 3,750 cu. ft. raceways and five 22,200 cu. ft. raceways. Eastbank has four wells that supply 53 cfs. This water varies in temperature from a low of 46° F in May to a high of 57° F in December. Rearing space at Eastbank was designed to maintain maximum loading densities below the criteria of Piper et al. (1982), as modified by Wood (Chelan PUD and CH2MHILL 1988).

Three satellite facilities of the RIFHC are found within the Wenatchee River Basin; Lake Wenatchee net pens (sockeye), Chiwawa rearing ponds (spring Chinook), and the Dryden pond acclimation site (summer/fall Chinook). Steelhead are currently scatter planted in Nason Creek, and the Wenatchee and Chiwawa rivers.

At Lake Wenatchee, there are six floating net pens for juvenile rearing (about 20 x 20 x 20 ft) and two adult holding pens (about 16 x 16 x 20). The Chiwawa facility has two 50 x 150 x 5 ft ponds (water source from the Chiwawa and Wenatchee rivers), and the Dryden facility has one 864,000 ft^3 pond (water source from the Wenatchee River).

II. Program Goals and Objectives

Federal programs

Leavenworth National Fish Hatchery (NFH)**:**
Specific fishery objectives which were originally established for Leavenworth NFH were (from Calkins et al. 1939):

1) *"…to bring, by stream rehabilitation and supplemental planting, the fish populations in the 677 miles of tributary streams between Grand Coulee Dam and Rock Island Dam, up to figures commensurate with earlier undisturbed conditions and with the natural food supply in the streams."*

2) *"…to produce, in addition, by the combination of artificial spawning, feeding, rearing and planting in these streams, a supplemental downstream migration equivalent to that normally produced by the 1,245 miles of streams and tributaries above Grand Coulee Dam."*

Shelldrake (1993) updated the objectives of the mid-Columbia NFHs:

- *Hatchery production* [specific to each facility].
- *Minimize interaction with other fish populations through proper rearing and release strategies.*
- *Maintain stock integrity and genetic diversity of each unique stock through proper management of genetic resources.*
- *Maximize survival at all life stages using disease control and disease prevention techniques. Prevent introduction, spread or amplification of fish pathogens.*

- *Conduct environmental monitoring to ensure that hatchery operations comply with water quality standards and to assist in managing fish health.*
- *Communicate effectively with other salmon producers and managers in the Columbia River Basin.*

The USFWS's current mission for the Leavenworth complex is (USFWS 2002a):

> *"To produce high quality spring Chinook salmon and summer steelhead smolts*
> *commensurate with the production goals established by the Columbia River Fisheries Management Pla*n"

Original production consisted of Chinook salmon trapped at Rock Island Dam (1940 – 43), but since then has included several resident and anadromous salmonid species, including spring, summer, and fall Chinook, coho, sockeye, summer steelhead, rainbow trout, and kokanee.

Early spring Chinook salmon stocks used for the program came from several lower Columbia River locations. These include McKenzie River, OR (1941); Willamette River, OR (1965); Eagle Creek NFH (1966); Cowlitz River (1974, 76); Little White Salmon NFH (1974, 77-79), and the current stock originated from Carson NFH (1970-73, 75-81, 85). The Carson stock developed from adults, trapped at large, from Bonneville Dam in the 1950's. No eggs or fry have been imported into LNFH for almost 20 years.

State programs

Rock Island Fish Hatchery Complex

The goal of the RIFHC is to use artificial production to replace adult production lost due to smolt mortality at mainstem hydroelectric projects, while not reducing the natural production or long-term fitness of salmonid stocks in the area (WDF 1993). Specific goals of the WDFW hatcheries (WDF 1993) are:

- *Hatchery production* [in terms of number of fish released from each site],
- *minimize interactions with other fish populations through rearing and release strategies, maintain stock integrity and genetic diversity of each population or unique stock through proper management of genetic resources.*
- *maximize survival at all life stages using disease control and disease prevention techniques. Prevent introduction, spread or amplification of fish pathogens,*
- *conduct environmental monitoring to ensure that the hatchery operations comply with water quality standards and to assist in managing fish health,*
- *communicate effectively with other salmon producers and managers in the Columbia River basin, and with implementers of local and regional flow and spill programs, and*
- *develop a Conservation Plan and conduct a comprehensive monitoring/evaluation program to determine that the program meets mitigation obligations, estimate survival to adult, evaluate effects of the program on local naturally producing*

populations, and evaluate downstream migration rates in regards to size and timing of fish released.

III. Program Operations

Federal

Leavenworth National Fish Hatchery

Brood stock collection and spawning:
Adult spring Chinook salmon return to the hatchery beginning in late April – early May. The adult escapement goal for the hatchery (number of adults needed to meet the production goal) is 1,000. Beginning in 2001, an additional 350 adults have been collected for transfer and release into Peshastin Creek for natural spawning.

All brood stock used for production are volunteers to the facility. Adults swim up the collection ladder and into one of two holding ponds. The holding ponds measure 15 x 150 feet, and are joined in the middle by an adjustable slide-gate. The gate is opened and adults are allowed to enter the second pond during sorting, counting, etc. The holding ponds supply attraction water for the ladder. Adults are secured from throughout the run spectrum, which results in excess brood. Excess fish are periodically donated to various tribes and a local non-profit group (TU).

The ladder typically operates from May into July. Because of limited space in the holding ponds, coupled with the desire to keep surplus adults in the river for harvest, the ladder in some years is "pulsed" (opened a few days per week).

The adult pre-spawning survival goal is 98%, and for years 1993 to 2002, averaged just over 95% (87-97%; D. Davies, pers. comm.).

Spawning usually begins in mid-August, and can continue into early-September. Approximately two weeks prior to initial spawning, all adult females are injected with an antibiotic (erythromycin), to help combat the vertical transmission of Bacterial Kidney Disease (BKD) from the mother to the eggs.

Pathogen and disease monitoring start with adult testing of captured populations for all reportable aquatic viruses and bacteria at the minimum assumed pathogen prevalence level of 5% (i.e. 50 individuals). Since approximately 1994, the actual sampling has been a minimum of 210 adults (60 males and 150 females) for these pathogens. In addition, all females spawned are specifically and individually tested for *Renibacterium salmoninarum*, the causative agent of BKD. This is essential to determine the pathogen levels and eliminate or segregate the resulting eggs from different risk levels. This process greatly reduces the likelihood of transmitting the disease from infected females to progeny. All eggs and accompanying containers are disinfected with iodine solution during the water hardening process following fertilization.

Juvenile releases: Juveniles are released annually as yearlings in mid-April. The yearlings are forced from the ponds, directly into Icicle Creek, when the majority is in a smolt or pre-smolt stage. Timing of release is coordinated with Columbia mainstem project operations to help maximize downstream migration survival. All juveniles released from LNFH are adipose fin-clipped. With 100% marked juveniles, subsequent adult harvest can be maximized while also strengthening the ability to evaluate ecological effects. The current release goal is 1,625,000 smolts annually. From 1971 to 2001, annual releases of spring Chinook from LNFH have averaged 1,649,074 fish.

Hatchery Barrier: Built in 1938 – 1940, the barrier was designed to exclude ascending adults from areas upstream of the hatchery and to help insure sufficient adults for brood. In recent years, the USFWS, along with other entities, have investigated the potential of providing passage for certain fish species to areas above the barrier. The effects of, and potential solutions to the barrier issue are currently being addressed in a Final Environmental Impact Statement (FEIS) that has been drafted and issued. Current plans are to provide passage in the next few years (2005 or 2006).

Hatchery water intake system: The hatchery's water delivery system consists of three major components and conveyance systems: 1) the gravity intake on Icicle Creek, 2) the Snow Lake Supplementation Water Supply Project and, 3) the well system on hatchery property.

The intake is located at RM 4.5, approximately 1.5 miles upstream of the hatchery. Water is conveyed to the hatchery through a buried 31-inch pipe system. This water enters a sand-settling basin and on through two screen chambers prior to its arrival at the hatchery. The water intake structure consists of a diversion dam, fish ladder, wide bar trash rack (6 inch spacing) and another narrower bar trash rack (1 1/2 inch spacing) located in a building. This structure is currently not properly screened, but plans are underway to bring it into compliance.

Entrained fish in the system can return to the river several ways: 1) the Cascade irrigation diversion, which branches off the system below the intake, has a drum screen to divert fish into a sluiceway back to the river, 2) the overflow area at the sand-settling basin can pass fish back to the river via effluent and, 3) the two screen chambers. One is within a building and is equipped with 1/8 inch x 1/8 inch plastic coated screens which divert fish into a bypass pipe to the river. The other screen chamber is covered and is equipped with 3/32-inch round-holed screens, which divert fish into an overflow channel leading back to the river. From both screen chambers, water is delivered to the rearing ponds and back to the river. Both screen chambers meet the standards for screening criteria described in the *1994 Policies and Procedures for Columbia Basin Anadromous Salmonid Hatcheries* developed by NMFS.

During construction of the hatchery, it was recognized that surface flow in Icicle Creek might at times be insufficient to meet production demands. A supplementary water supply project in Snow and Nada Lakes was therefore developed and a water right to

16,000 acre feet of Snow Lake was obtained. These lakes are located approximately 7 miles from the hatchery and about one-mile above it in elevation. A _ mile tunnel was drilled and blasted through granite to the bottom of Snow Lake and a control valve was installed at the outlet of the tunnel. Operation of the control valve is determined by Icicle Creek flow and water temperature. The control valve is typically opened mid-July or as soon as the creek water consistently reaches 58°F (D. Davies, USFWS, pers. comm.). Water drained from Snow Lake enters Nada Lake, which drains into Snow Creek, a tributary to Icicle Creek that enters at RM 5.5. Thus, supplemental flows, ranging from 45 to 60 cfs from Snow Creek, enter Icicle Creek one-mile above LNFH's intake system.

During critical periods of the rearing cycle, well water is used to cool/warm stream water, and stream water to temper well water. The intake and water delivery systems are currently being addressed under a separate Biological Assessment and consultation process.

Evaluation: The Mid-Columbia River Fishery Resource Office (MCRFRO) provides monitoring, evaluation, and coordination services concerning Leavenworth NFH production. MCRFRO staff monitors hatchery returns, biological characteristics of the hatchery stock, fish marking, tag recovery, and other aspects of the hatchery program, and they maintain the database that stores this information. MCRFRO also cooperates with the hatchery, fish health and technology centers, and co-managers to evaluate fish culture practices, assess impacts to native species, and coordinate hatchery programs both locally and regionally.

The Leavenworth NFH Complex has a team comprised of staff from the hatcheries, Fish Health, and the MCRFRO (Hatchery Evaluation Team). Current evaluation practices/studies include: bio-sampling of returning adults, 100% external marking of released juveniles, application of PIT tags, assessment of stray rates, travel-time of released juveniles through the Columbia River corridor, assessment of potential of hatchery fish to transfer diseases to wild stocks, success/failure of hatchery produced adults to reproduce naturally, use of NATURE's type rearing[2], raceway density studies, genetic comparisons of hatchery and wild stocks, and feed (fish food) evaluations, among others. The sport harvest in Icicle Creek is also closely monitored to measure potential impacts to the listed stocks.

State program

Program operations for the various species raised under the RIFHC are as follows:

Sockeye
Broodstock is captured at Tumwater Dam on the Wenatchee River. Adults are hauled to Lake Wenatchee, where they are held and spawned. Eggs are then incubated and early reared at Eastbank Hatchery. The hatchery production level is currently 200,000

[2] NATURE's rearing is a "hands off" approach where artificial substrate and woody debris is added to the raceways. Automatic feeders are also utilized, negating the need to "hand feed".

subyearlings, reared in net pens in Lake Wenatchee from July through November. Sockeye are released at two different times (August and November) in an effort to reduce post-release mortality.

Under the Chelan PUD's HCP, compensation for sockeye for the Wenatchee independent population could be increased, but not until 2013.

Spring Chinook

Returning spring Chinook adults are collected at a weir on the Chiwawa River and a ladder trap at Tumwater Dam. Fish are then hauled to Eastbank Hatchery, where they are spawned, incubated and reared until the following October.

Production at Eastbank Fish Hatchery has varied considerably since the program began with brood year 1989. The variability in production is a function of poor adult returns, inefficient traps, and different broodstock collection strategies stemming from adaptive management strategies for this population. Smolt production from the Eastbank Fish Hatchery has averaged 116,012 smolts annually, representing 17.3% of the interim production level (672,000) identified in the BAMP (1998). Under the Chelan PUD's HCP, compensation for spring Chinook for the Wenatchee independent population could be decreased, possibly prior to 2013.

Summer Chinook

Artificial production of summer Chinook for the Wenatchee Subbasin is run under the RIFHC. Summer Chinook production at Eastbank Hatchery is intended to mitigate for summer Chinook losses at Rock Island Dam. The production level for the Wenatchee River is a total of 864,000 yearling summer Chinook at 10 fish/lb (BAMP 1998).

Broodstock (492 adults) are collected at the left and right bank Dryden traps and Tumwater Dam trapping facility and transported to the Eastbank Hatchery. Incubation, spawning, and initial rearing of Wenatchee summer Chinook take place at the Eastbank facility. The fish are then transferred to the Dryden Acclimation Pond towards the end of their second winter, where they are volitionally released at smolt size (10fish/lb.) into the Wenatchee River in April-May.

Summer Steelhead

Adult Wenatchee River summer steelhead are collected for broodstock from the run-at-large at the right and left bank Dryden Dam traps and Tumwater Dam. The program goal is to collect a minimum of 50% natural origin adults and to exclude progeny of HxH matings in the hatchery component. Due to adult steelhead holding temperatures at Eastbank FH, steelhead are transferred to, held, and spawned at Wells FH. Incubation and final rearing occurs at Eastbank FH facilities.

The annual release goal For Eastbank FH is 400,000 smolts into the Wenatchee River, Nason Creek, and Chiwawa River basins however, smolt production from the Eastbank

Fish Hatchery has averaged 266,632 smolts annually, representing 66.7% of the interim production level identified in the BAMP (1998).

Coho

Adult coho salmon are collected from the run-at-large primarily from the right and left bank Dryden Dam traps. In years when insufficient numbers of coho are taken at Dryden Dam, supplemental broodstock may be collected at Tumwater Dam, Dam 5 on Icicle Creek, and/or the LNFH fishway. Currently the program collects naturally produced coho in the proportion in which they occur within the run. Adult coho are transferred to Entiat National Fish Hatchery where they are held and spawned. Coho eggs are incubated at Entiat National Fish Hatchery, YN's Peshastin Incubation Facility, and in some years, Leavenworth NFH. Upon reaching between 500 and 600 temperature units, the coho eggs are transferred to Willard National Fish Hatchery and Cascade FH for rearing. Eagle Creek National Fish Hatchery was a rearing facility for coho released in mid-Columbia tributaries brood years 1998 and 2000. Eagle Creek National Fish Hatchery may be used as a rearing facility again in the future. Coho smolts produced from adult returns to the Methow River have been released in the Wenatchee Basin. Currently in the feasibility phase, changes in rearing, incubation, and acclimation facilities may continue to occur. Details on mating protocols, rearing and acclimation strategies, size at release and monitoring and evaluation can be found in the Yakama Nation's mid-Columbia coho HGMP (YN 2002).

Under the feasibility study, the Wenatchee River coho release goal is 1,000,000 smolts. Over one-half of smolts are currently released into Icicle Creek from Dam 5 and/or LNFH small Foster Lucas Ponds, for the purpose of broodstock development. The remainder of the coho smolts are acclimated and released from small natural ponds near suitable coho spawning and rearing habitat in Nason Creek, Beaver Creek, and the Little Wenatchee River. The actual numbers locations of coho release are re-evaluated annually.

Non-anadromous fish releases

Non anadromous fish have been planted within the Wenatchee Basin since the early 1900s. Rainbow trout, cutthroat trout, brook trout, and a few brown trout have all been planted at various times through multiple hatchery programs.

Following micro-habitat work in the 1980s that showed negative effects on pre-smolt steelhead from "catchable" releases of rainbow trout, all releases of rainbow were shifted from streams to various lakes within the basin which did not have connectivity to anadromous areas.

Conservation of the Species: The capture of endangered UCR spring Chinook salmon and summer steelhead by WDFW for artificial propagation efforts are designed to benefit the species. The primary objectives of these efforts are to preserve extant spring Chinook and steelhead populations in the region, and to boost the abundance of remaining stocks. There are risks of ecological and genetic impacts to the ESA-listed juvenile and adult spring Chinook salmon and steelhead resulting from the proposed programs. However,

the risk of extinction to natural populations is high enough that aggressive intervention is required.

Genetic and Ecological Effects on Natural Populations: The genetic risks to naturally produced populations from artificial propagation include reduction in the genetic variability (diversity) among and within populations, genetic drift, selection, and domestication which can contribute to a loss of fitness for the natural populations (Hard *et al.*1992; Cuenco *et al.* 1993; NRC 1996; and Waples 1996).

Disease interactions between hatchery fish and listed fish in the natural environment may be a source of pathogen transmission. Because the pathogens responsible for diseases are present in both hatchery and natural-origin populations, there is some uncertainty associated with determining the extent of disease transmission from hatchery fish (Williams and Amend 1976; Håstein and Lindstad 1991).

To address concerns of potential disease transmission from hatchery to natural fish, the Pacific Northwest Fish Health Protection Committee (PNFHPC) has established guidelines to ensure hatchery fish are released in good condition, thus minimizing impacts to natural fish (PNFHPC 1989). Also, the IHOT (1995) developed detailed hatchery practices and operations designed to prevent the introduction and/or spread of any fish diseases with the Columbia River Basin.

Direct competition for food and space between hatchery and listed fish may occur in spawning and/or rearing areas, the migration corridor, and ocean habitat. These impacts are assumed to be greatest in the spawning and nursery areas and at points of highest fish density (release areas) and to diminish as hatchery smolts disperse (USFWS 1994).

Competition for space and cover in the Wenatchee River probably occurs between hatchery and natural fish shortly after release and during downstream migration, but based on the smolt travel times the duration of interaction is minimal in the river (WDFW 1998a). Rearing and release strategies at all WDFW salmon and steelhead hatcheries are designed to limit adverse ecological interactions through minimizing the duration of interaction between newly liberated hatchery salmon and steelhead and naturally produced fish.

Hatchery fish may prey upon listed fish. Due to their location, size, and time of emergence, newly emerged Chinook salmon fry are likely to be most vulnerable to predation by hatchery released fish. Their vulnerability is believed to be greatest as they emerge and decreases somewhat as they move into shallow, shoreline areas (USFWS 1994). Emigration out of hatchery release areas and foraging inefficiency of newly released hatchery smolts may minimize the degree of predation on Chinook salmon fry (USFWS 1994).

Hatchery salmonids that do not emigrate after release are said to have residualized. These fish that residualize can adversely affect naturally produced fish through competition and predation. Chinook salmon do not tend to residualize (Groot and Margolis 1991), thus no

effects are expected on natural UCR spring Chinook salmon or steelhead in the Wenatchee River.

Harvest Management: Fish harvest in the Columbia River basin affects the listed species by incidentally taking them in fisheries that target non-listed species. The largest potential impacts on UCR spring Chinook and steelhead come from treaty Indian and non-tribal fisheries in the Columbia River mainstem and potentially tributaries (Icicle Creek) (Myers *et al.* 1998).

A sport fishery for steelhead in the UCR has been authorized under Section 10 Permit 1395. In years when the escapement of hatchery origin steelhead is greater than expected (i.e., over-escapement) the fishery was specifically designed to remove excess hatchery fish from the spawning grounds with minimal impacts to the natural origin steelhead.

Domestication of Hatchery Fish: Another concern of the artificial propagation of salmon is domestication, which is the change in quantity, variety, and combination of alleles within a captive population or between a captive population and its source population in the wild that are the result of selection in an artificial environment (Busack and Currens 1995). Domestication occurs because putting fish into an artificial environment for all or part of their lives imposes different selection pressures on them than does the natural environment. The concern is that domestication effects will decrease the performance of hatchery fish and their descendants in the wild. The concern is that hatchery fish selected to perform well in a hatchery environment tend to not perform well when released into the wild due to the difference between the hatchery and the wild environments. Potential impacts to the natural population occur when the hatchery fish spawns in the wild and the resulting performance of the natural population is reduced due to outbreeding depression (Busack and Currens 1995). The selection of broodstock is a common source of biased sampling. In general, broodstock selection should be random but bias occurs when selection is based on particular traits. Genetic changes due to unintentional selection can be caused by the hatchery environment, which allows more fish to survive compared to the natural environment. The elimination of all risks due to genetic diversity loss and domestication is not possible, but NOAA Fisheries believes that these risks can be minimized through the following measures proposed for the adult supplementation program:

- Address genetic concerns regarding selectivity, the collection of adult broodstock at traps for the supplementation program shall be representative of the run-at-large with respect to natural and hatchery parentage, migration timing, age class, morphology, and sex ratio;
- Provide that a proportion of each population that will not be subjected to artificial propagation and the associated potential risk of negative genetic effects, upstream escapement goal of approximately 80 adults per population will be maintained as a minimum level for natural spawning when escapement to Wells Dam is greater than 668 adults;
- An effective population size (N_e) of 500 fish per population per generation should be the *long-term* program production objective to maintain an adequate genetic

base, even thought an N_e of at least 50 adults per generation is required to reduce the risk of inbreeding depression and genetic drift in the short term (fewer than 5 salmon generations) (BAMP 1998). If fewer adults are available, production can be scaled to ensure that hatchery-origin progeny do not overwhelm the population as a whole;

- Rear fish at minimum pond loading densities to reduce the risk of domestication effects and;
- Eliminate of Carson-stock spring Chinook (a highly domesticated stock) that will further reduce potential genetic effects.

Monitoring and Evaluation*:* The evaluation plan includes genetic monitoring of the hatchery and naturally produced fish, migration timing and survival of the hatchery releases, and studies to evaluate interaction between hatchery and naturally produced fish. Monitoring and evaluation of the hatchery programs in the Methow River is on-going. The plan for the adult-based supplementation program addresses three critical uncertainties associated with the program:

- whether the hatchery facilities can safely meet their production objectives;
- the effect of the programs on the long-term reproductive success of the population in the natural environment;
- the identification of ways to operate the facilities to reduce the short-term ecological impacts to the naturally produced fish (WDFW 1998a).

Adaptive Management
The monitoring and evaluation program will also provide data that can be used to change the program if the results suggest doing so. The monitoring and evaluation programs will also provide invaluable data on the use of supplementation to conserve and recover ESA-listed salmon species.

Tribal Harvest Allocations
All hatchery programs in the Methow Basin are currently included in the Columbia River Fish Management Plan (i.e., US *v.* Oregon).

IV. Program Success

Federal program

Adult returns: Chapman et al. (1995) compared the number of smolts[3] released to the number of adults returning to the Wenatchee, Entiat, and Methow rivers. For fish

[3] They did not account for fry or parr releases in our estimates, or fish released in the fall or winter. While it is probable that these fish have made some contribution to the returning adults, they were unsure how to represent post release mortality (i.e., how many of the fish actually migrated downstream). Considering this, the estimates of smolt-to-adult survival that they derived should be considered biased upward.

returning to the Wenatchee River, the smolt-to-adult survival averaged 0.45% (range: 0.14 - 0.99%, corrected for inter-dam loss, and incidental in-river and ocean harvest) between release year 1978 and 1990. Shelldrake (1993) lists the smolt-to-adult survival goal as 0.5%, which he shows as the five year average (range 0.12-0.92%). Mullan et al. (1992) report the mean smolt-to-adult survival of fish from Leavenworth NFH from 1976 - 1988 as 0.55% (range: 0.21-0.70%). They conclude,

> *The universal presence of bacterial kidney disease (BKD) in hatchery stocks is a prime suspect for the poor returns of Chinook salmon. Equally obvious is that the behavior of Chinook salmon in hatcheries is conditioned differently from that of wild fish. Large age-0 and yearling Chinook salmon smolts released to Icicle Creek were not cover-oriented, remained at the water surface and drifted downstream in the thalweg regardless of season or time of day, and had no apparent social structure, and were hyperactive . . . Recently hatched fry released to Icicle Creek, by contrast quickly removed themselves from the strong currents and mimicked the behavior of naturally produced Chinook . . . Behavior and BKD in hatchery Chinook is related . . .*

While the return per release of adult Chinook may be low, hatchery fish have still made up the majority of returning fish to the Wenatchee River in most years since the 1960s. Hatchery fish have made up greater than 50% of the run in practically every year since 1980. The percentage of hatchery fish in the spring Chinook run in the Wenatchee River appears to be increasing in recent years, probably as a result of increased smolt-to-adult survival in the early 1990s.

The sport and tribal harvest in Icicle Creek, which is entirely attributed to LNFH, is the only fishery on spring Chinook in the upper-Columbia Region. For years 1984 to 2001, an average of 6,005 adults (range= 484 to 15,082) of LNFH origin have returned to the Wenatchee River Basin.

State program

Viable Populations:

Spring Chinook
Based on parr production, supplementation appears to be improving the Chiwawa spring Chinook population to some degree (Hillman and Miller 2002). However, it is difficult to quantify because the potential trends observed by Hillman and Miller need to be combined with population estimates and survival rates from reference areas before the total "picture" is known.

Summer Chinook
High escapements of summer Chinook in the Wenatchee Basin in recent years have been positively influenced in part by the hatchery program at Dryden Pond. A goal of a supplementation program is to increase the number of spawners by allowing hatchery fish

to spawn naturally. Subsequent increases in the number of naturally produced fish on the spawning grounds would support the hypothesis that hatchery fish contributed to future adult returns.

Steelhead
An increase in the number of wild fish incorporated into the broodstock would reduce any potential genetic impacts to the wild fish. In the Wenatchee Basin, near equal proportions of hatchery and naturally produced adults allows for a broodstock composition that minimizes potential genetic impacts.

Sockeye
Poor post release survival (i.e., predation) likely reduced the survival rates of the Wenatchee sockeye program. Recent changes to the size and time of release have significantly increased the post release survival of the hatchery fish. Subsequent adult returns are not complete, but are expected to be much greater than previously reported.

Contribution of adults to recovery or harvest:
Returning adults from these programs are intended to increase to naturally spawning populations. The hatchery programs have successfully contributed adults to the naturally spawning populations. However, harvest does occur in years of high abundance on summer chinook and sockeye.

Smolt to adult return rates for Chiwawa spring chinook averaged 0.33 for brood years 1989 through 1997 (range: 0.04-0.96). For Wenatchee steelhead, smolt to adult returns averaged 0.47 for brood years 1996 through 2000 (range: 0.12-1.24). Wenatchee sockeye averaged 0.6 for brood years 1989 through 1997, ranging from 0.0-2.14. Wenatchee summer chinook have averaged 0.29 for brood years 1989 through 1997, ranging from 0.03-0.98.

Effects on Wild and Native Populations and Environment: Effects on the wild populations (target and non-target) will be assessed at the juvenile stage using smolt traps and when fish return as adults. The relative productivity of the spawning population will be monitored over time using smolt traps located within the Basin. Relationships between smolt production and spawner abundance (% hatchery fish on the spawning grounds) will provide information related to reproductive potential of the stocks and habitat. Relationships in productivity between stocks would also provide some information regarding competition in the freshwater environment. Smolt traps also provide information regarding trends in other species not directly associated with hatchery programs (i.e., non-target taxa of concern).

Spawning ground surveys will not only be used to develop smolt-to-adult return rates (SARs) for hatchery and wild fish, but provide information on spawn timing and distribution. Biological data collected from carcasses will also provide data concerning age and size at maturity.

Comparisons of any these parameters (juvenile or adult) between hatchery and wild fish would provide insight on the effects hatchery fish may have on wild populations. Any effects that are detected (greater than acceptable levels) would be addressed in subsequent changes in the respective hatchery program.