



U.S. Fish and Wildlife Service - Pacific Region
Columbia Basin Hatchery Review Team

Columbia River Basin, Columbia Gorge Province

Little White Salmon, Big White Salmon, and Wind River Watersheds



**Carson, Spring Creek, Little White Salmon, and Willard
National Fish Hatcheries**

Assessments and Recommendations

Final Report

December 2007

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Summary

Long-term conservation needs of natural salmonid populations and their inherent genetic resources require a reexamination of the role of hatcheries in basin-wide management and conservation strategies. Hatcheries must be viewed as part of the environmental and ecological landscape to help achieve both conservation and harvest goals. These goals need to be part of a holistic and integrated strategy that combines habitat, hydropower and harvest needs for conserving and managing fishery resources. These strategies must establish short- and long-term goals for both hatchery-propagated and naturally-spawning populations.

To ensure that its hatchery programs are best meeting conservation and harvest goals, the US Fish and Wildlife Service (Service) began, in October 2005, a four-year review of 21 salmon and steelhead hatcheries that the Service owns or operates in the Columbia River Basin. The goal of this review is to ensure that Service hatcheries operate in accordance with best scientific principles, and contribute to sustainable fisheries and the conservation of naturally-spawning populations of salmon, steelhead and other aquatic species. The Service's review process is modeled after the recent Puget Sound and Coastal Washington Hatchery Reform Project¹. The Service plans to complete its reviews by the end of 2009.

The report presented here provides benefit/risk assessments and recommendations for salmon and steelhead propagation programs conducted at four National Fish Hatcheries in the Columbia River Gorge region of Washington State: Carson National Fish Hatchery (NFH), Little White Salmon NFH, Willard NFH, and Spring Creek NFH.

The Review Team considered, as a foundation for its assessments, four characteristics of each salmonid stock in each watershed potentially affected by the four hatcheries: *biological significance*, *population viability*, *habitat* conditions, and *harvest* goals or contributions. The Review Team attempted to use both short- (1-15 years) and long-term (50–75 years) goals for each salmonid stock, as identified by the fishery comanagers², as a foundation for assessing the benefits and risks of the Service's hatchery programs. Source documents not readily available to the general public, including appendices and background documents for this report, are accessible via the Service's hatchery review website.³

Carson NFH

Facility Overview: Carson NFH is located at river mile (RM) 18 of the Wind River, north of the town of Carson, WA. The hatchery was authorized by Special Act 50 Stat. 220, May 28, 1937, and placed into operation in December, 1937 to mitigate for the effects of federal water projects in the Columbia River, primarily Bonneville Dam. The hatchery was reauthorized by the Mitchell Act (16 USC 755-757; 52 Stat. 345) May 11, 1938 as amended on August 8, 1946, (60 Stat. 932) for

¹ www.lltk.org/HRP.html

² *Comanagers in the Washington state side of the Columbia River Gorge region are the Washington Department of Fish and Wildlife (WDFW), Yakama Nation, National Marine Fisheries Service (NOAA Fisheries), and the U.S. Fish and Wildlife Service (USFWS). Comanagers on the Oregon side include the two federal partners (NOAA Fisheries and USFWS), Oregon Department of Fish and Wildlife (ODFW), Confederated Tribes of the Warm Springs Reservation in Oregon (CTWSRO), and the Confederated Tribes of the Umatilla Indian Reservation (CTUIR).*

³ www.fws.gov/Pacific/fisheries/HatcheryReview/

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conservation of fishery resources in the Columbia River Basin. The hatchery was remodeled in 1956 to establish a hatchery-supported run of spring Chinook in the Wind River, and is currently used for adult collection, egg incubation, rearing, and release of spring Chinook. The hatchery also provides eggs and fish for reintroducing spring Chinook to other Columbia River tributaries, as desired.

Carson NFH is upstream of a natural barrier falls (Shipherd Falls) located approximately two miles upstream of the mouth of the Wind River. Those falls historically precluded all anadromous salmonids, except summer-run steelhead, from the upper watershed. A fishway ladder around the falls was constructed in 1955 to allow Carson NFH spring Chinook access back to the hatchery.

The current personnel plan for the hatchery lists seven full-time employees. The annual operation and maintenance (O&M) budget (FY2006) for the hatchery is \$538,124 from NOAA Fisheries (via Mitchell Act) plus \$50,668 from the Service's Fisheries Program. Costs for monitoring and evaluation (M&E) activities in FY2006 were approximately \$108,000 and include \$83,377 for tagging and marking. Capital improvements to Carson NFH totaled \$1,757,085 during the period 2000- 2006.

Spring Chinook salmon

Program overview: The program is intended to operate as a *segregated harvest* program within the Wind River watershed with returning hatchery-origin adults used exclusively for broodstock. The broodstock objective at Carson NFH is to collect 1,400 adults and spawn a minimum of 1,000 adults (500 females) with an on-station release of 1.17 million yearling smolts into the Wind River. Those on-station releases support recreational and tribal fisheries in the Wind River, the lower Columbia River, and the pool behind Bonneville Dam. In addition, Carson NFH is scheduled to provide 250,000 yearling spring Chinook to the Confederated Tribes of the Umatilla Indian Reservation (Umatilla Tribe) for reintroduction of spring Chinook to the Walla Walla River. The spring Chinook broodstock at Carson NFH was originally developed in the late 1950's and early 1960's from natural-origin adults trapped at Bonneville Dam (1955-1964) during their upstream migration. Based on molecular genetic analyses, Carson NFH spring Chinook are believed to represent a composite stock derived from both upper Columbia and Snake river populations. NOAA Fisheries excludes Carson NFH spring Chinook from the *Lower Columbia River Chinook Salmon ESU*⁴ and other Chinook ESUs representing natural populations.

Benefits: Spring Chinook from the Carson NFH provide significant harvest benefits to recreational and tribal fishers in the Wind River. Mean sport and tribal harvests of spring Chinook in the Wind River representing brood years 1989-1998 were 2,615 and 868 adults, respectively. In 2001, almost 5,000 and 1,900 spring Chinook were harvested in the Wind River in recreational and tribal fisheries, respectively, with an escapement of 12,075 adults back to the hatchery. In addition, a mean of 2,575 adult spring Chinook were surplused to tribes from Carson NFH, 1989-1998. Carson NFH has also been a principal source of eyed eggs and fish for spring Chinook reintroduction programs in rivers where they have been extirpated, as well as the source of fish for successful spring Chinook hatchery programs elsewhere (e.g., Little White Salmon NFH, Leavenworth NFH).

⁴ *Evolutionarily Significant Unit.* NOAA Fisheries defines "distinct population segments" (DPS) of Pacific salmon under the U.S. Endangered Species Act as geographic subsets of populations that collectively represent "evolutionarily significant units" of the taxonomic species. NOAA Fisheries has retained the DPS designation for steelhead populations to be consistent with similar designations for non-anadromous populations of *Oncorhynchus mykiss* (a.k.a., rainbow trout).

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Risks: The Review Team did not identify any major or significant risks of the spring Chinook program at Carson NFH. The Team was initially concerned that Carson NFH spring Chinook may be posing a significant ecological risk to natural populations of steelhead in the Wind River, but ongoing field studies have not revealed significant ecological impacts of introduced spring Chinook to native populations of steelhead. Spring Chinook have not established a naturalized population in the Wind River despite nearly 50 years of hatchery propagation and natural spawning of hatchery-origin fish.

Recommendations for current program: The Review Team identified 22 specific recommendations to reduce risks and/or improve benefits of the current spring Chinook program at Carson NFH. These recommendations include: (a) working with the local watershed group to develop additional (or improved) fishing access sites to the Wind River because of the high proportion of returning adults that escape the fishery and are recaptured at the hatchery; (b) installation of a fish counter and trap at the entrance of the hatchery ladder to enumerate returning adults and prevent them from exiting the facility, respectively; (c) continuation of ongoing studies to evaluate potential ecological interactions between hatchery-origin spring Chinook and natural populations of steelhead in the Wind River; and (d) improved public outreach facilities.

Alternatives to Current Program: The Review Team considered the pros and cons of six alternatives to the existing spring Chinook program at Carson NFH. These alternatives range from the current program with full implementation of all program specific recommendations (Alternative 1) to termination of the existing program and decommissioning of the facility (Alternative 6). As a *short-term* goal (up to 15 years), the Review Team recommends continuation of the existing program (Alternative 1) but with a reduction of on-station releases by up to 250,000 yearling smolts (from 1.17 million to 920,000 smolts) to accommodate a conservation program (Alternative 5) that would assist with reintroduction of native species, particularly spring Chinook, in the Big White Salmon River after removal of Condit Dam in that watershed. This reintroduction program would be limited to three generations or 15 years. However, this reintroduction program would not be necessary if conducted at Little White Salmon NFH (see below); in which case, the current on-station release of 1.17 million yearling smolts would be retained as a short-term goal. The Review Team also supports the current, spring Chinook reintroduction program in the Walla Walla River. As a long-term goal (15+ years), the Team recommends resumption of a 1.42 million on-station smolt release (Alternative 1) contingent upon successes of spring Chinook reintroduction efforts in the Big White Salmon River, Walla Walla River, and potential program changes at Little White Salmon, Willard, and Spring Creek NFHs (see following sections on those programs).

Spring Creek NFH

Facility Overview: Spring Creek NFH is located at RM 167 along the north (Washington) shore of the Columbia River, 20 miles upstream of Bonneville Dam and approximately two miles downstream of the Big White Salmon River. Spring Creek NFH was authorized by Special Act 24 Stat. 523, March 03, 1887 and Special Act 30 Stat. 612, July 01, 1898, and placed into operation in September 1901 to support the commercial fishing industry in the Columbia River. The hatchery was reauthorized by the Mitchell Act (16 USC 755-757; 52 Stat. 345) May 11, 1938 as amended on August 8, 1946, (60 Stat. 932) for mitigation of Bonneville Dam and conservation of fishery resources in the Columbia River Basin. The hatchery was remodeled in 1938 to prevent inundation by the pool behind Bonneville Dam. The hatchery was again remodeled in 1970 to

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expand operations to meet commitments under the John Day Dam Mitigation Act. The hatchery is currently propagating tule fall Chinook salmon and includes adult broodstock collection, egg incubation, juvenile rearing, and an annual on-station release of 15.1 million subyearling smolts. A private utility dam (Condit Dam), built in 1913 and located at RM 3.4 of the Big White Salmon River, is scheduled for removal in 2008. All upstream migration of salmon and steelhead has been blocked at Condit Dam since its construction in the early 1900's. Approximately eight miles of fall Chinook habitat exists upstream of the dam. Tule fall Chinook currently propagated at Spring Creek NFH represent the stock of choice for reintroducing fall Chinook upstream of Condit Dam in the Big White Salmon River.

The current personnel plan for the hatchery lists ten full-time employees. An information and education manager for the Service's Columbia River Gorge hatcheries is also located at Spring Creek NFH. The annual operation and maintenance (O&M) budget (FY2006) for the hatchery is \$943,871 and includes \$559,141 from the Army Corps of Engineers (John Day Dam Mitigation), \$353,007 from NOAA Fisheries (Mitchell Act), and \$31,723 from the Service's Fisheries Program. Costs for monitoring and evaluation (M&E) activities in FY2006 were approximately \$1,196,178, primarily for personnel and equipment for tagging, marking, sampling, data management, and reporting. Capital improvements to Spring Creek NFH totaled \$1,114,396 during the period 1998-2006.

Tule Fall Chinook Salmon

Program overview: The program is intended to operate as a *segregated harvest* program within the Bonneville pool with returning hatchery-origin adults used for broodstock. The broodstock objective at Spring Creek NFH is to collect 10,000 adults and spawn a minimum of 8,000 adults (4,000 females) with an on-station release of 15.1 million subyearling smolts into the Bonneville pool. At the present time, approximately 7.6 million smolts are released in March and the remaining fish are released in late April and early May. Those on-station releases support commercial, tribal, and recreational fisheries in the ocean, lower Columbia River, and Bonneville pool. The tule fall Chinook broodstock propagated at Spring Creek NFH was developed from wild fish native to the Big White Salmon River. The hatchery has reared this stock since 1901. NOAA Fisheries includes Spring Creek NFH tule fall Chinook within the *Lower Columbia River Chinook Salmon ESU*, which is currently listed as *threatened* under the U.S. Endangered Species Act (ESA).

Benefits: Tule fall Chinook from Spring Creek NFH provide significant harvest benefits to commercial, tribal, and recreational fishers in the ocean, lower Columbia River, and Bonneville pool. Mean harvests of Spring Creek NFH tule fall Chinook for brood years 1990-1999 were approximately 18,000 and 19,000 fish in the ocean and Columbia River, respectively, with a mean annual return of greater than 19,000 adult fish back to the hatchery. Adult fish recaptured at the hatchery in excess of broodstock needs are provided to tribes and food banks. Tule fall Chinook propagated at Spring Creek NFH are considered a genetic repository for the original stock native to the Big White Salmon River; consequently, the hatchery confers a conservation benefit towards long-term maintenance of that stock. Natural spawning habitat for this stock was first reduced in the early 1900s after construction of Condit Dam and further reduced in the early 1940s when the pool behind Bonneville Dam inundated the lower portion of the Big White Salmon River.

Risks: The long history of hatchery propagation as a *segregated* broodstock (hatchery-origin fish used for broodstock) poses domestication risks to this stock, particularly considering its genetic repository role and anticipated restoration role for the Big White Salmon River. Early releases

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from the hatchery in March – necessary to prevent overcrowding of growing pre-smolts prior to the scheduled April-May release – has required Bonneville Power Administration to spill water at Bonneville Dam to bypass smolts around the turbines and facilitate their rapid downstream passage through the project. This spill can contribute to super-saturation of the tailwater with nitrogen gas, thus posing a demographic risk to chum salmon eggs incubating in redds downstream from the dam (lower Columbia River chum are currently listed as *threatened* under the ESA), although the spill is managed to limit those risks. In addition, the lack of automated electronic monitoring of water chemistry associated with a water reuse system (90% of the water used for rearing at the hatchery is reuse) poses a demographic risk to the hatchery stock when fish are on station (August-May). The physical location of the freshwater intake for the hatchery, a spring immediately adjacent to a major highway, also poses a demographic risk to the hatchery stock from possible vehicle intrusions, spills, and vandalism.

Recommendations for current program: The Review Team identified 19 specific recommendations to reduce risks and/or improve benefits of the current tule fall Chinook program at Spring Creek NFH. These recommendations include: (a) reduction of the size of the program from 15.1 million to 10.5 million smolts to reduce on-station risks and the potential need for a March release; (b) installation of electronic meters and equipment to continuously monitor water chemistry parameters associated with the water reuse system; (c) replumbing of the hatchery building to allow effluent water to be discharged into a settling pond instead of the water reuse system or directly into the Columbia River; (d) construction of a physical barrier and cover that would protect the hatchery's fresh water supply; and (e) continuation of ongoing studies to evaluate genetic contributions of hatchery origin fish to natural-origin fall Chinook smolts in the Big White Salmon River.

Alternatives to Current Program: The Review Team considered the pros and cons of four alternatives to the existing tule fall Chinook program, ranging from (a) the current program with full implementation of all program specific recommendations (Alternative 1), including reduction of on-station releases from 15.1 to 10.5 million smolts, to (b) termination of the existing program with decommissioning of the facility (Alternative 4). As a *short-term* goal (up to 15 years), the Review Team recommends continuation of the existing program with implementation of all recommendations (Alternative 1), but with a further reduction of on-station releases to approximately 10.1-10.2 million smolts to accommodate rearing of up to 350,000 subyearling tule fall Chinook for restoration of natural populations in the Big White Salmon River after removal of Condit Dam (Alternative 2). Spring Creek NFH could also be used to assist with reintroduction of chum salmon because of their short-term freshwater requirements and the limited water supply for the hatchery. As a *long-term* goal, the Team recommends continuation of the tule fall Chinook mitigation program (Alternative 1), but including a revaluation of regional management priorities and continued implementation of methods for managing tule fall Chinook strays in the Bonneville Pool so that the program is consistent with conservation and recovery objectives of the region. This includes continued monitoring of the restoration of fall Chinook in the Big White Salmon River.

Little White Salmon NFH

Facility Overview: Little White Salmon NFH is located on the Little White Salmon River one mile upstream of its confluence with the Columbia River. The Little White Salmon River joins the Columbia River at RM 162. Drano Lake, a natural depression at the mouth of the river flooded by

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the pool behind Bonneville Dam, is a popular sport and tribal fishing area at the confluence of the Little White Salmon and Columbia Rivers. The Little White Salmon NFH was placed in operation following Congressional authorization in 1898 with the intent to support the commercial fishing industry. The hatchery's role expanded during the 1930's under the Mitchell Act to mitigate for loss of habitat due to the completion of Bonneville Dam in 1938. The hatchery currently propagates *upriver bright* (URB) fall Chinook and *Carson-strain* spring Chinook. A natural barrier falls immediately upstream of the hatchery precludes upstream migration by salmon and steelhead. In 1975, the Little White Salmon NFH and Willard NFH were administratively combined to form the Little White Salmon/Willard NFH Complex (LWS/Willard Complex).

The current personnel plan for the hatchery lists nine full-time employees, which includes the complex manager and deputy complex manager. The annual operation and maintenance (O&M) budget (FY2006) for the LWS/Willard Complex was \$1,211,424 with \$774,376 from NOAA Fisheries (Mitchell Act), \$207,389 from Bonneville Power Administration, \$63,699 from the Army Corps of Engineers (John Day Dam Mitigation), and \$165,960 from the Service's Fisheries Program. Costs for monitoring and evaluation (M&E) activities in FY2006 were approximately \$422,227 and include \$274,966 and \$122,261 for tagging/marketing at Little White Salmon and Willard NFHs, respectively. Capital improvements to LWS/Willard Complex totaled \$7,055,475 during the period 2000- 2006.

Upriver Bright (URB) Fall Chinook Salmon

Program overview: The program is intended to operate as a *segregated harvest* program within the lower Little White Salmon River with returning hatchery-origin adults used exclusively for broodstock. The broodstock objective at Little White Salmon NFH is to collect and spawn a minimum of 1,940 adults (930 females) to yield a minimum of 4.46 million green eggs for an on-station release of 2.0 million subyearling smolts into the Little White Salmon River. The program also transfers 1.7 million subyearling pre-smolts to the Yakama Nation for acclimation and release into the Yakima River. On-station releases support commercial, recreational and tribal fisheries in the ocean, lower Columbia River, and Bonneville pool, particularly recreational and tribal fisheries in Drano Lake. Releases in the Yakima River support tribal fisheries and restoration of natural populations in the Yakima River. The URB fall Chinook broodstock at Little White Salmon NFH was originally developed in the late 1970's from natural origin adults trapped at Bonneville Dam. The URB fall Chinook program was established at the LWS/Willard Complex in 1988. The natural population origin of those fish is unknown. NOAA Fisheries excludes Little White Salmon NFH URB fall Chinook from the *Lower Columbia River Chinook Salmon ESU* and other Chinook ESUs representing natural populations.

Benefits: URB fall Chinook released from Little White Salmon NFH provide significant harvest benefits to recreational and tribal fishers in Drano Lake. Tribes harvested 3,571 and 3,866 URB fall Chinook from Drano Lake in 2004 and 2005, respectively. In 2006, 600 fish were harvested in the recreational fishery in Drano Lake. Mean harvests in the Columbia River and ocean fisheries for brood years 1990-1999 were 1,227 and 1,973 adults, respectively, and accounted for 15% and 24% of all CWT recoveries. Ocean harvest occurs predominantly in Alaska and British Columbia. URB fall Chinook transferred to - and released from - the Prosser Tribal Hatchery on the Yakima River contributed an average of 1,605 (32% of returns) and 1,677 (33% of returns) adults to harvests in the Columbia River and ocean respectively, with an additional 1,750 adults (35%) escaping to natural spawning areas of the Yakima River.

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Risks: URB fall Chinook released from Little White Salmon NFH stray into the Big White Salmon River and spawn after fish representing the ESA-listed *Lower Columbia River Chinook ESU* have spawned. This natural spawning and superposition of redds poses genetic (interbreeding) and demographic (disruption of redd produced by tule fall Chinook) risks to naturally spawning tule fall Chinook that are considered the native stock of the region. Similarly, URB fall Chinook released into the Yakima River do not represent a native or endemic population but, instead, represent a genetically segregated hatchery stock that has been propagated artificially in the Columbia River Gorge region for nearly 30 years. The Review Team concluded that the release and natural spawning of the Little White Salmon NFH stock of URB fall Chinook in the Yakima River may not be consistent with restoration goals for fall Chinook in the Yakima River or genetic conservation goals for naturally spawning populations upstream of McNary Dam. In general, the release of URB fall Chinook at Little White Salmon NFH appears to result in significant straying within the Bonneville pool, including straying to areas upstream of The Dalles Dam.

Recommendations for current program: The Review Team identified 14 specific recommendations to reduce risks and/or improve benefits of the current URB fall Chinook program at Little White Salmon NFH. These recommendations include: (a) meeting with the Yakama Nation to review natural population restoration goals in the Yakima River and broodstock management goals for fish released into the Yakima River; (b) installation of a fish counter between the hatchery ladder and the adult holding pond to assist with broodstock collection and surplusing of adult fish in excess of broodstock needs; (c) assess the feasibility of developing a terminal fishery on URB fall Chinook at the mouth of the Big White Salmon River, or reduce on-station releases, to reduce genetic and ecological risks to natural populations; and (d) develop a PIT tag program for on-station releases to assess downstream migration rates to Bonneville Dam and to detect returning adult fish at Bonneville Dam for managing terminal fisheries in the Bonneville pool.

Alternatives to Current Program: The Review Team considered the pros and cons of eight alternatives to the existing URB fall Chinook program. These alternatives range from the current program with full implementation of all program specific recommendations (Alternative 1) to termination of the existing program with decommissioning of the facility (Alternative 8). The Team recommends immediate implementation of Alternative 1, including concurrent discussions with co-managers for terminating the current program and replacing it with on-station rearing of URB fall Chinook from hatchery programs operated upstream of John Day Dam. A much smaller release program could be maintained at Little White Salmon NFH to support terminal fisheries in Drano Lake. The Review Team concluded that releases of hatchery-origin URB fall Chinook should be transferred from Columbia Gorge release sites to upriver areas consistent with the natural historic distribution of URB fall Chinook in the mid-Columbia region. Little White Salmon NFH could continue to rear URB fall Chinook for that purpose, but on-station releases would be reduced only to the level necessary to support a terminal fishery in Drano Lake. Eyed eggs or gametes would be transferred from the mid-Columbia region to Little White Salmon NFH annually, and the resulting subyearling smolts (or pre-smolts) transferred back to the source area for acclimation and release. This proposed long-term approach is expected to confer most of the benefits realized by the current URB fall Chinook segregated hatchery program while reducing risks to naturally spawning fall Chinook populations in the Big White Salmon River and elsewhere (e.g., Yakima River). This long-term approach will require cooperative agreements among co-managers.

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Spring Chinook Salmon (*Carson NFH strain*)

Program overview: The program is intended to operate as a *segregated harvest* program within the lower Little White Salmon River with returning hatchery-origin adults used exclusively for broodstock. The broodstock objective at Little White Salmon NFH is to collect and spawn a minimum of 1,170 adults (760 females) to yield a minimum of 1.11 million green eggs for an on-station release of 1.0 million yearling smolts into the Little White Salmon River. On-station releases support recreational and tribal fisheries in the lower Columbia River and Bonneville pool, particularly in Drano Lake. Little White Salmon NFH spring Chinook are derived from the Carson NFH, and NOAA Fisheries excludes the hatchery stock from the *Lower Columbia River Chinook Salmon ESU* and other Chinook salmon ESUs representing natural populations.

Benefits: Spring Chinook released from Little White Salmon NFH provide significant harvest benefits to recreational and tribal fishers in Drano Lake. Approximately 25% of all coded wire tag recoveries occurred in Drano Lake with a mean annual harvest of 1,289 spring Chinook. Approximately 20% of all recoveries occurred in the mainstem Columbia River with a mean return of 1,507 adults back to the hatchery (53% of adult returns). Adult spring Chinook trapped at the hatchery in excess of broodstock needs are provided to tribes and food banks.

Risks: The Review Team did not identify any significant risks of the spring Chinook program at Little White Salmon NFH. In general, these fish do not stray from the Little White Salmon River to a level that would be a concern.

Recommendations for current program: The Review Team identified seven specific recommendations to reduce risks and/or improve benefits of the current spring Chinook program at Little White Salmon NFH. These recommendations include: (a) phase out of the regularly-scheduled prophylactic use of erythromycin-medicated feed and development of criteria for the therapeutic treatment of bacterial kidney disease (BKD); (b) complete the three-year test of the new baffled raceways vs. standard raceways, plus include an evaluation of the current rearing density of 0.2 relative to a lower density of 0.1; and (c) PIT tag 15,000 fish prior to release to determine rate of outmigration to Bonneville Dam and to detect returning adults at the dam to assist with fisheries management in the Bonneville pool and Drano Lake.

Alternatives to Current Program: The Review Team considered the pros and cons of six alternatives to the current spring Chinook program. These alternatives range from the current program with full implementation of all program specific recommendations (Alternative 1) to termination of the existing program with decommissioning of the facility (Alternative 6). The Team recommends immediate implementation of Alternative 1 coupled with discussions with comanagers to transition to the Klickitat River hatchery stock of spring Chinook as a long-term goal (5-15+ years). Under this long-term alternative, the Klickitat Hatchery would develop an integrated Klickitat River broodstock by including wild spring Chinook captured at Lyle Falls on the Klickitat River. This integrated broodstock would then provide eyed eggs or gametes annually to Little White Salmon NFH to meet genetic broodstock requirements via a stepping stone approach. This “stepping stone” approach would not require direct take of wild fish for broodstock at Little White Salmon NFH but would require adequate genetic integration of the Klickitat Hatchery stock with the natural population of spring Chinook in the Klickitat River. The Klickitat River stock has been identified by the Washington Department of Fish and Wildlife (WDFW) as the appropriate stock for reintroduction of spring Chinook in the Big White Salmon River after removal of Condit Dam. This long-term approach at Little White Salmon NFH would continue to provide harvest benefits in Drano Lake and the lower Columbia River while, at the same time,

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assisting with the reintroduction of spring Chinook in the Big White Salmon River. This long-term goal is contingent upon infrastructure improvements at Klickitat Hatchery and fish collection facilities in the Klickitat River.

Willard NFH

Facility Overview: Willard NFH is located on the Little White Salmon River approximately five miles upstream of the Little White Salmon NFH. A barrier falls immediately upstream of Little White Salmon NFH precludes upstream migration of salmon and steelhead to the Willard NFH. However, Willard NFH can release juvenile salmonids which migrate downstream over the falls to the Columbia River.

The Columbia River Research Laboratory, a satellite research station of the Western Fisheries Research Center, U.S. Geological Survey (USGS), Seattle, WA, is co-located adjacent to Willard NFH (Cook, WA). Willard NFH was authorized by an amendment to the Mitchell Act to mitigate for fisheries lost due to the construction and operation of hydroelectric dams on the Columbia River. The earliest reports available indicate that the Willard NFH was initially planned and constructed as a fall Chinook facility. However, the very cold water temperatures at Willard NFH inhibited the rearing of fall Chinook, but those temperatures were adequate for rearing coho salmon and spring Chinook.

In 1975, the Little White Salmon NFH and Willard NFH were administratively combined to form the LWS/Willard Complex. Administration of the Complex occurs at Little White Salmon NFH. Complex facilities are managed, staffed, and budgeted as a single entity. The current personnel plan for Willard NFH lists four full-time employees, which includes the hatchery manager, two fish culturists, and a fish biologist.

For many years, 1.0 million yearling coho salmon were released from Willard NFH with brood stock collection at Little White Salmon NFH. Due to funding shortfalls in the Mitchell Act and shifting priorities, this coho program was discontinued in 2004. Since 2004, no fish have been released into the Little White Salmon River from Willard NFH.

Willard NFH currently rears coho salmon in support of the Yakama Nation's coho reintroduction program in the Wenatchee River.

Wenatchee River Coho Salmon

Program overview: The Yakama Nation, with assistance from the Service, conducts this program with the goal of reintroducing coho salmon to the Wenatchee River, Washington. The program was initiated in 1999 with the release of hatchery-origin coho from Eagle Creek and Willard NFHs (lower Columbia "early-returning" stocks) into the Wenatchee River. The initial goal of the program was to establish a self-sustaining hatchery-propagated stock in the Wenatchee River. That goal has been achieved (Phase I). At the present time, returning hatchery-origin adults are trapped in the Wenatchee River at Dryden Dam (near Cashmere, WA) and Tumwater Dam (upstream of Leavenworth, WA), and at Leavenworth NFH on Icicle Creek. Adult coho trapped in the Wenatchee River watershed are transported to Entiat NFH (on Entiat River) and spawned there. Fertilized eggs are incubated initially at Entiat NFH. Eyed eggs are transferred from Entiat NFH to Willard NFH for hatching and rearing. Yearling coho are transferred back to the Wenatchee River for acclimation and release from several locations, including Leavenworth NFH. At the present

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time, returning hatchery-origin adults in the Wenatchee River are used exclusively for broodstock. Current goals of the program are to establish naturally spawning populations and then integrate natural-origin fish into the broodstock as part of a naturalized, Wenatchee River stock. Willard NFH currently receives 670,000 eyed eggs annually and transfers back approximately 650,000 yearling pre-smolts (19-21 fish per pound) for acclimation and release in the Wenatchee River one year later. The long-term goal is to attain a level of abundance and viability sufficient to support tribal harvest and conservation goals in the Wenatchee River. The Wenatchee River coho program is reviewed here for the purpose of evaluating Service options and potential priorities for Willard NFH and the LWS/ Willard Complex.

Benefits: The program has successfully achieved its first major goal of establishing a self-sustaining hatchery-propagated population of coho salmon in the Wenatchee River basin.

Risks: The Review Team did not identify any significant risks of the current program, although the continued transfer of yearlings from Willard NFH to Leavenworth NFH does pose some disease risks to spring Chinook reared on station at Leavenworth NFH.

Recommendations for current program: The Review Team identified two specific recommendations for the current Wenatchee River coho reintroduction program at Willard NFH. The Service should continue to seek funding on behalf of the Yakama Nation and continue to provide facilities and logistic support for the program.

Alternatives to Current Program: The Review Team considered the pros and cons of six alternatives to the existing coho program. These alternatives range from the current program with implementation of all program specific recommendations (Alternative 1) to termination of the existing program with decommissioning of the facility (Alternative 6). The Team generally supports two alternatives contingent on Service and comanager priorities. As an immediate recommendation, the Team recommends implementation of Alternative 1 and continued support of the Yakama Nation's coho reintroduction program in the Wenatchee River. The team also supports establishment of a bull trout recovery program for the Big White Salmon River (or other locations) if artificial propagation is considered a priority in support of bull trout recovery (Alternative 3).

Little White Salmon, Willard NFH complex alternatives

The Review Team identified four additional alternatives for the current programs at Little White Salmon and Willard NFHs when treated together as a complex. Three of the four alternatives deal with various aspects of the White River spring Chinook captive breeding program. This is a new program designed to help recover endangered spring Chinook in the White River within the Wenatchee River basin. The fourth alternative includes use of an auxiliary incubation facility, Carson Depot Springs, for incubation and propagation of chum salmon, or other listed species, in support of ESA priorities in the Columbia River Gorge region.

Conclusions

The Review Team concluded that the current spring Chinook salmon program at the Carson NFH is providing a significant harvest mitigation benefit within the Wind River basin and in fisheries in the mainstem lower Columbia River. Recent ongoing studies and other available information

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indicate that ecological interactions between hatchery-origin spring Chinook and natural populations of steelhead within the Wind River basin are either minor or insignificant. In general, the spring Chinook program at Carson NFH appears to be providing significant harvest benefits with little biological risks to natural populations in the Wind River.

The Review Team similarly concluded that the current tule fall Chinook program at Spring Creek NFH is providing significant harvest mitigation benefits to tribal fisheries in the Bonneville pool and to recreational and commercial fisheries in the mainstem lower Columbia River and coastal waters of the United States and Canada. However, the current water supply and reuse system pose demographic and fish health risks to the hatchery stock, and the Team recommends that the size of the program be reduced from 15.1 million to 10.5 million fall Chinook subyearlings to reduce those risks via lowered rearing densities.

The fall Chinook stock at Spring Creek NFH was initially developed in the early 1900's from natural-origin adult spawners in the Big White Salmon River; consequently, the Review Team supports the use of this stock and facilities at Spring Creek NFH to assist with recovery of fall Chinook populations in the Big White Salmon River after removal of Condit Dam. The Team advises the Service to complete genetic stock identification work on present natural spawners in the Big White Salmon River and work with co-managers to develop a restoration strategy for the natural population in this watershed. The Team also recognizes that the presence of nearby large-scale hatchery production programs at Spring Creek and Little White Salmon NFHs require means of controlling or excluding most hatchery-origin adults from the natural production areas of the Big White Salmon River.

The Team was somewhat uncomfortable with the present lack of defined recovery strategies for listed fall Chinook, coho, and chum salmon in tributaries of the Bonneville Pool. The Big White Salmon River in particular was not addressed in the development of the state of Washington component of the Lower Columbia Recovery Plan. The Team understands that inter-agency discussions are ongoing concerning restoration of salmon and steelhead in the Big White Salmon River following the scheduled removal of Condit Dam, but a detailed restoration strategy has not yet been developed. The Team advises the Service to closely track completion of the Lower Columbia Recovery Plan and adjust future program goals for Gorge NFHs consistent with forthcoming recovery strategies.

The Review Team concluded that the current *upriver bright* (URB) fall Chinook program at Little White Salmon NFH is providing significant harvest mitigation benefits to tribal and recreational fisheries in the Bonneville pool, particularly Drano Lake, and recreational and commercial fisheries in the mainstem lower Columbia River and coastal waters of the United States and Canada. However, the Team was concerned with the genetic and ecological impacts of this introduced mid-Columbia stock on the viability and recovery of natural populations of fall Chinook that are included with the *Lower Columbia River Chinook ESU*. The Team was also concerned about biological and management inconsistencies between the current URB fall Chinook stock propagated at Little White Salmon NFH and conservation/restoration goals for URB fall Chinook in the Yakima River and mid-Columbia region. The Team concluded that the current program and on-station releases of URB fall Chinook at Little White Salmon NFH should be terminated and replaced with on-station rearing of URB fall Chinook from hatchery programs operated upstream of John Day Dam. A much smaller release program could be maintained at Little White Salmon NFH to support terminal fisheries in Drano Lake.

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As a long-term goal, the Team recommends reducing the number of URB fall Chinook released in the Bonneville pool region and increasing the number of fish released upstream within historic natural population areas of URB fall Chinook. Such a management adjustment would also serve the goal of providing *in-place* and *in-kind* mitigation for the loss of upriver bright fall Chinook spawning habitats inundated by the pools behind John Day Dam and other projects (e.g., McNary Dam). As noted above, this long-term approach will require cooperative agreements among co-managers.

Large hatchery fall Chinook mitigation programs, such as those at Little White Salmon and Spring Creek NFHs, release large numbers of juvenile fish into the lower Columbia River. The Team is aware of little information which allows fishery managers to assess any impacts which these programs may have on the continued viability of listed naturally spawning fall Chinook salmon in the lower Columbia River, including the Columbia River estuary. The Team encourages further assessment of this possible interaction and future adjustment to hatchery programs, as necessary, to reduce or eliminate possible adverse effects on natural populations.

The Review Team concluded that the current spring Chinook salmon program at Little White Salmon NFH is providing a significant harvest mitigation benefit within Drano Lake and in fisheries in the mainstem lower Columbia River. The Team proposes that the Service work closely with the Yakima Nation and the Washington Department of Fish and Wildlife to transition to a suitable local broodstock such as the Klickitat spring Chinook stock. This would allow the present mitigation program to proceed with reduced impact on nearby natural population areas and would allow this program to support the proposed reintroduction of spring Chinook into the Big White Salmon River.

The Review Team concluded that the current coho salmon reintroduction program at Willard NFH is providing a long-term conservation benefit to salmonid ecosystems in the Wenatchee River and tributaries of the upper Columbia River. The Team notes that the facilities and water supply at Willard NFH are capable of playing an important role in several proposed conservation and reintroduction programs. The Team expects that the current coho program at Willard NFH will eventually be phased out and supplanted by other conservation programs as upper river facilities are developed to support this reintroduction program and as natural reproduction of coho in the upper Columbia River increases.

Overall, the Team concludes that the four National Fish Hatcheries in the Columbia River Gorge region are playing a valuable and effective role in partially mitigating for the effects of habitat loss and mortality caused by hydroelectric development in this section of the Columbia River. These hatchery facilities are also uniquely situated to support reintroduction and restoration of native salmon species in tributary streams of the Columbia River Gorge and elsewhere while continuing to provide fishery benefits in the region.

I. Introduction

In the past 150 years, habitat alterations, hydroelectric development and consumptive fisheries have affected the productivity, abundance, spatial distribution, and diversity of natural populations of salmon and steelhead (*Oncorhynchus mykiss*) in the Pacific Northwest. To mitigate for those impacts, hatcheries have been used to increase the number of fish available for harvest. However, long-term conservation needs of natural salmonid populations and their inherent genetic resources now require a reexamination of the role of hatcheries in basin-wide management and conservation strategies.

Hatcheries need to be part of a holistic and integrated strategy that combines habitat, hydropower and harvest needs for conserving and managing fishery resources. These strategies must establish short- and long-term goals for both hatchery-propagated and naturally-spawning populations. However, modifying hatchery programs and operations to achieve both conservation and harvest goals in a coordinated manner is difficult and complex. Scientific uncertainties exist regarding the ability of hatcheries and hatchery-origin fish to directly assist with recovery of naturally-spawning populations while, at the same time, sustaining major fisheries. Uncertainties also exist regarding genetic and ecological interactions between natural- and hatchery-origin fish. Only an objective, collaborative, science-based approach can address these problems in a manner that is both scientifically defensible and accepted by the public.

In an effort to improve its hatchery programs and to ensure that existing facilities are best meeting conservation and harvest goals, the U.S. Fish and Wildlife Service (Service) initiated, in October 2005, a three-year review of the 21 salmon and steelhead hatcheries that the Service owns or operates in the Columbia River Basin. The goal of these reviews is to ensure that Service hatcheries are operated in accordance with best scientific principles, and contribute to sustainable fisheries and the recovery of naturally-spawning populations of salmon, steelhead and other aquatic species.

This internal review is modeled after the recent Puget Sound and Coastal Washington Hatchery Reform Project.⁵ That project provided a solid template and operational tools (e.g. software spreadsheets, population dynamic models) for reviewing Service hatcheries in the Columbia River Basin. Much of the background information necessary for reviewing hatcheries in the Columbia River Basin has already been compiled in Hatchery and Genetic Management Plans (HGMPs),⁶ Comprehensive Hatchery Management Plans (CHMPs),⁷ and the Artificial Propagation Review and Evaluation (APRE)⁸ database developed by the Northwest Power and Conservation Council (NWPCC).

Based on the recommendations of a Hatchery Review Working Group (Working Group),⁹ the Assistant Regional Director for Fisheries (ARD) has assembled a Columbia Basin Hatchery Review Team (Review Team). This Review Team, comprised of Service and other federal agency scientists, has adapted the Puget Sound and Coastal Washington Hatchery Scientific Review Group's (HSRG) scientific framework, principles and hatchery review tools and is applying them to create

⁵ For more information on this project, and for all project publications, see www.hatcheryreform.org.

⁶ For more information on HGMPs, visit www.nwr.noaa.gov/Salmon-Harvest-Hatcheries/Hatcheries/Hatchery-and-Genetic-Management-Plans.cfm.

⁷ For more information on CHMPs, visit www.fws.gov/pacific/Fisheries/CHMP.htm.

⁸ For more information on APRE, visit www.nwcouncil.org/fw/apre/.

⁹ The Working Group was appointed in November 2004 by the Service's Assistant Regional Director for Fisheries, Pacific Region. The Working Group's report and all other Columbia Basin Hatchery Review documents are available from the project's website, www.fws.gov/Pacific/fisheries/hatcheryreview/.

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recommendations for each hatchery program and facility. The team provides continuity with the HSRG because two members (including the chair) served on the HSRG, the vice chair served on the policy-makers' Hatchery Reform Coordinating Committee, and three other team members represented the Service at HSRG regional review meetings. The Service has contracted for project facilitation with Long Live the Kings (LLTK), a non-profit organization devoted to restoring wild salmon to the waters of the Pacific Northwest. LLTK has provided facilitation, communications and coordination for the Puget Sound and coastal Washington hatchery review process.

Review Team members include:

- **Don Campton** (Chair), Senior Scientist, USFWS, Abernathy Fish Technology Center, Longview, Washington.
- **Douglas DeHart** (Vice Chair), Senior Fishery Biologist, USFWS, Pacific Regional Office, Portland, Oregon.
- **Ray Brunson**, Fish Health Biologist, USFWS, Olympia Fish Health Center, Olympia, Washington.
- **Tom Flagg**, Supervisory Fish Biologist, NOAA Fisheries, Manchester Research Station, Manchester, Washington.
- **Joe Krakker**, Fishery Biologist, USFWS, Lower Snake River Compensation Plan Office, Boise, Idaho.
- **Larry Marchant**, Project Leader and Manager, USFWS, Spring Creek NFH, Underwood, Washington.
- **Doug Olson**, Hatchery Assessment Team Leader, USFWS, Columbia River Fisheries Program Office, Vancouver, Washington.
- **Larry Telles**, Fishery Biologist and Deputy Manager, USFWS, Quilcene NFH, Quilcene, Washington.
- **Dave Zajac**, Fish and Wildlife Biologist, USFWS, Western Washington Fish and Wildlife Office, Lacey, Washington.
- **David Carie** (alternate), Fisheries Management Biologist, USFWS, Mid-Columbia Fishery Resource Office, Leavenworth, Washington.
- **Susan Gutenberger** (alternate), Supervisory Microbiologist, USFWS, Lower Columbia River Fish Health Center, Willard, Washington.

Team support members include:

- **Michael Schmidt** (Facilitator), Director of Fish Programs, Long Live the Kings, Seattle, Washington.
- **Amy Gaskill and Cheri Anderson** (Outreach), External Affairs Specialists, USFWS, Pacific Region Fisheries Program, Pacific Regional Office, Portland, Oregon.

The Fisheries ARD has also appointed a Hatchery Oversight Team (Oversight Team), consisting of line supervisors with policy and managerial responsibilities, as the Service's primary internal mechanism to oversee the review process, monitor its progress, and transmit communications and reports from the Review Team to the ARD and project leaders within the Service's Pacific Region Fisheries Program. The Oversight Team, along with the ARD, will be the primary contact group

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between the Service and its partners for developing mechanisms and policies for implementing, or modifying, the Review Team's recommendations.

The review process began in October 2005 with the Warm Springs National Fish Hatchery (NFH). This hatchery is located on the Warm Springs River, in the Deschutes River watershed/Columbia Plateau province, in Oregon. This review was conducted as a pilot to help the Service test and refine the review process. Fishery co-managers and stakeholders were involved in the review process and asked to comment on draft reports and recommendations. The final report for Warm Springs NFH was released in May, 2006 (available at www.fws.gov/Pacific/fisheries/hatcheryreview/reports.html).

Following this pilot review, the Service adjusted the process for reviewing federal hatcheries in three regions: Mid-Columbia, Lower Columbia, and Lower Snake River (Fig. 1). Facilities in these regions include five NFHs in the Lower Columbia region (Eagle Creek, Carson, Little White Salmon, Willard and Spring Creek NFHs); three NFHs in the Mid-Columbia region (Leavenworth, Entiat and Winthrop NFHs); three NFHs in the Snake River region (Dworshak, Kooskia and Hagerman NFHs); and nine federally-owned hatcheries operated by the states of Washington, Oregon or Idaho as part of the Lower Snake River Compensation Plan (LSRCP). The Service plans to complete reviews of all National Fish Hatcheries by December 2007 and all federally owned facilities in the Snake River region by December 2008.

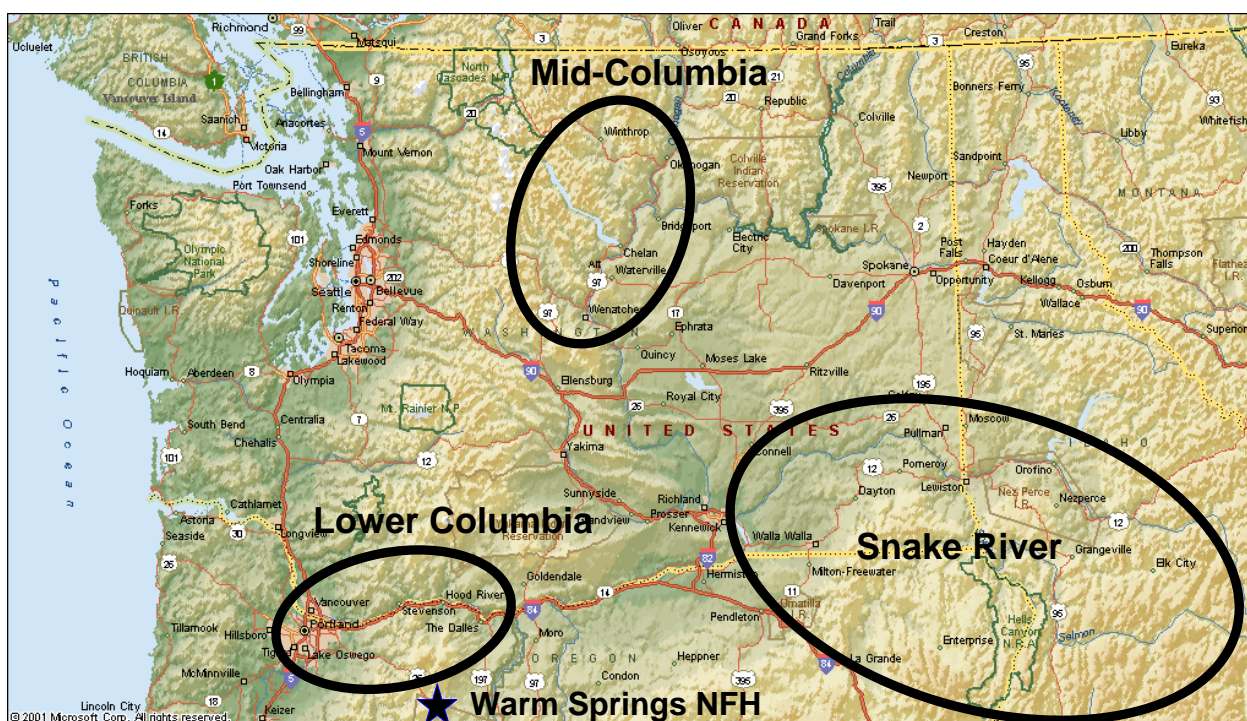


Figure 1. Regions of the Columbia River Basin Hatchery Review Project

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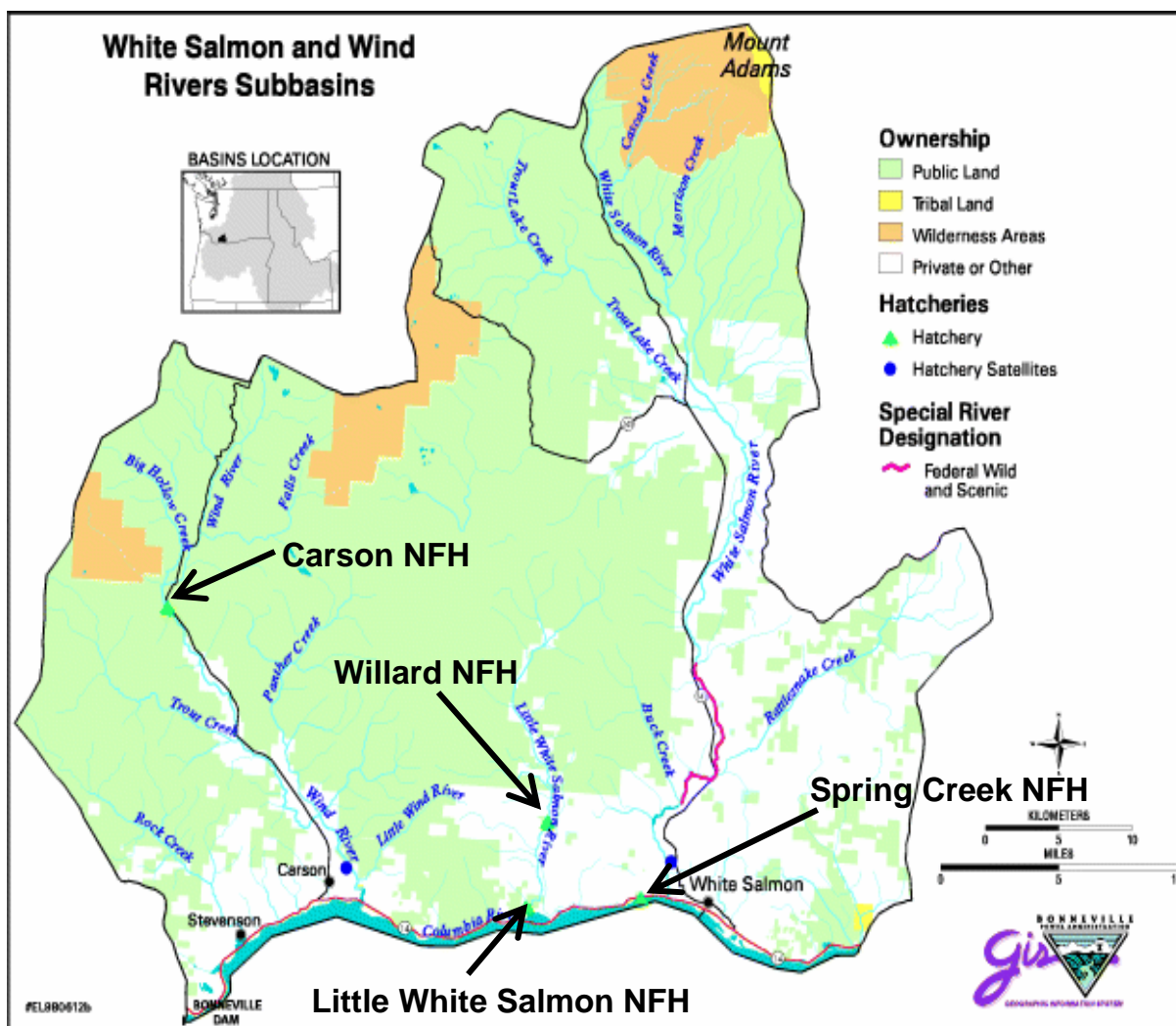


Figure 2. National Fish Hatcheries in the Columbia River Gorge reviewed in this report¹⁰

¹⁰ Modified figure from: Rawding (2000). Draft White Salmon River Subbasin Summary-
<http://www.cbfwa.org/FWProgram/ReviewCycle/fy2001cg/workplan/WhiteSalmon.doc>.

II. Components of this Report

This report provides assessments and recommendations developed from a comprehensive review of current propagation programs at four National Fish Hatcheries in the Columbia River Gorge Province (Carson NFH, Spring Creek NFH, Little White Salmon NFH and Willard NFH). Recommendations presented herein are based on the best scientific information available at the time of the review. This information includes peer-reviewed scientific information in published works (scientific journals, etc.), agency reports, and pertinent information directly accessible via electronic download. In its review, the Team followed three fundamental principles it adopted from the HSRG (Mobrand et al. 2005¹¹): (1) hatchery programs need to have well-defined goals in terms of desired benefits; (2) they must be scientifically defensible; and (3) they need to have programmatic flexibility to respond adaptively to new information.

The Review Team reviewed a large number of background documents, toured the four NFHs and other facilities (e.g. Condit Dam) and habitat features, and received presentations on a variety of Gorge salmonid management issues. The Team then met with biologists representing the co-managers and stakeholders to discuss the purpose of the review, hatchery operations, stock goals, and specific issues the co-managers and stakeholders wanted the Review Team to consider. Workshops for gathering that information used the recently-developed All-H Analyzer (AHA) decision support tool¹² to document goals, premises and explore alternatives (Appendix A). All source documents not readily available to the general public are accessible via the Service's hatchery review website¹³. Appendix B of this report summarizes the hatchery information on which the review and recommendations are based.

Based on the information gathered, the Review Team assessed benefits and risks of each hatchery program relative to current or short-term (10-15 years) goals and then drafted a set of preliminary recommendations that would increase or maintain benefits while minimizing or reducing risks, respectively. The Team also examined possible program alternatives at each of the four hatcheries to address long-term (15-50 years or greater) conservation and/or harvest goals. The review concluded with an oral presentation of these findings to the co-managers. The Review Team developed a draft report, circulated it to comanagers for initial comment, and then posted it on the Team's website for one month for public comment. The final report presented here was prepared after written comments on the draft report were received from co-managers and interested stakeholders. Review Team responses to those comments are presented in Appendix C. The complete texts of all written comments received are compiled in Appendix D.

Watershed Overview

The following report contains background overviews of the Wind, Big White Salmon and Little White Salmon river watersheds, and Bonneville pool area behind Bonneville Dam. Each overview includes information on geography, fisheries, conservation, habitat, and the current status of each salmonid

¹¹ Mobrand, L., J. Barr, L. Blankenship, D.E. Campton, T.T.P. Evelyn, T.A. Flagg, C.V.W. Mahnken, L.W. Seeb, P.R. Seidel, and W.W. Smoker. 2005. Hatchery reform in Washington State: principles and emerging issues. *Fisheries* 30(6): 11-23.

¹² For more information on AHA, see "AHA Technical Discussion Paper" on the Publications page of www.hatcheryreform.org and the Tools page of the "Managing for Success" website: http://www.managingforsuccess.us/site/tools_aha/321/aha.aspx

¹³ www.fws.gov/Pacific/fisheries/hatcheryreview/

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stock within the respective areas. Information on the status and hatchery propagation of each stock is summarized in a table for quick reference.

Stock Status

An understanding of the current status of each salmonid stock in each watershed was necessary for assessing the benefits and risks associated with each hatchery program. The Review Team summarized the current status of each stock in terms of four population parameters: *biological significance*, *viability*, *habitat*, and *harvest*. Each of those parameters was given a generalized rating of “high”, “medium”, or “low” as a foundation for assessing the benefits and risks of each hatchery program. The Review Team also needed to understand the short-term (10–15 years) and long-term (50 years or greater) goals for each salmonid stock within each watershed relative to the four population parameters. However, it was neither the mandate nor the responsibility of the Review Team to perform detailed, scientific assessments of population status. Instead, the Review Team relied on the consensus assessments of the co-managers: the Yakama Nation, Washington Department of Fish and Wildlife (WDFW), National Marine Fisheries Service (NOAA Fisheries), and our own Service biologists. The Review Team also relied on the subbasin plans of the Northwest Power and Conservation Council (NWPCC)¹⁴ and reports of the Willamette River and Lower Columbia Region Technical Recovery Team (WLC-TRT).¹⁵

Biological significance is a measure of the biological uniqueness of a particular stock relative to other stocks of the same species. This measure considers the genetic origins of the stock (e.g. native or non-native), biological attributes that are unique or shared with other stocks (e.g. life history, physiological, or genetic attributes), and the extent to which the stock may be considered one component of a larger population structure, including population subdivisions within the stock. In general, a stock is defined as having either a *low*, *medium* or *high* biological significance depending on its level of uniqueness and the ability of other stocks to potentially replace it in the occupying habitat if local extirpation were to occur. Stocks with *high* biological significance usually have one or more unique biological characteristics that may reflect local adaptations and would be difficult to replace by other stocks of the same species. Consequently, biological significance is not based on the degree to which the stock may be considered essential for recovery or harvest, but rather on its own innate biological attributes within the watershed in which the stock occurs. For example, a particular stock or population may be abundant and productive and, therefore, considered to have high *management* significance for harvest or recovery. However, that stock would not necessarily be considered to have high *biological* significance unless it possessed biological attributes not shared by other stocks of the same species or if all other stocks within the region or DPS/ESU¹⁶ were substantially less viable. This approach thus distinguishes the *evolutionary legacy* of a stock within a particular watershed from co-manager decisions regarding the potential *management value* of that stock. In this context, *biological significance* ratings are based on the factors described by Mobrand et al. (2005)¹⁷.

Population viability measures the ability of a stock to sustain itself under current environmental conditions. NOAA Fisheries has assembled several *Technical Recovery Teams* (TRT) to assess

¹⁴ <http://www.nwcouncil.org/fw/subbasinplanning/Default.htm>

¹⁵ <http://www.nwr.noaa.gov/Salmon-Recovery-Planning/Recovery-Domains/Willamette-Lower-Columbia/Index.cfm>

¹⁶ *Distinct Population Segment (DPS) and Evolutionarily Significant Unit (ESU)*. ESU is NOAA Fisheries designation for a Distinct Population Segment (DPS) of Pacific Salmon under the U.S. Endangered Species Act. NOAA Fisheries has retained DPS designations for steelhead (see also footnote #4).

¹⁷ Mobrand, L., et al. 2005. *Hatchery reform in Washington State: principles and emerging issues*. Fisheries 30(6): 11-23.

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viabilities and develop recovery criteria for ESA-listed salmon and steelhead populations throughout the Pacific Northwest. Those assessments involve significant mathematical modeling and attempt to predict extinction probabilities over the next 100 years based on four viability parameters: abundance, productivity, spatial structure, and diversity.¹⁸ Preliminary viability estimates for listed salmonid stocks in the lower Columbia region have been compiled by the WLC-TRT,¹⁹ and more rigorous updated estimates are currently available for populations of Lower Columbia coho.²⁰ Where available, the Review Team relied on those viability estimates, as developed by the Willamette River and Lower Columbia TRT; otherwise, the Review Team relied on the viability criteria of Mobrand et al. (2005)²¹. The goal here was to establish a qualitative understanding of the current viability for each salmonid stock potentially affected by each Service hatchery program as a foundation for assessing potential benefits and risks of those programs. However, estimating the viability of a natural population, including *integrated* hatchery stocks, is difficult because those estimations require detailed evaluations of natural reproductive output and enumeration of natural-origin adult returns over multiple generations. In contrast, the viability of *segregated* hatchery stocks is relatively simple and is determined primarily by the number of hatchery-origin adult recruits (R) recaptured in fisheries, the hatchery, or other areas per adult spawner (S) one generation earlier (R/S).

Habitat conditions for a particular stock are assessed quantitatively through estimates of the *capacity* and *productivity* of the habitat to support adult spawners and juveniles (e.g. via spawner-recruit models), and to subsequently produce smolts in sufficient numbers to yield returning adults. In this context, premises regarding habitat refer primarily to natural populations and the specific watersheds in which hatcheries are located. These premises are important for assessing the ability of the local habitat and watershed to support self-sustaining natural populations and genetically *integrated* hatchery broodstocks, including assessment of risks posed by hatchery-origin fish spawning naturally. The productivity and capacity of a watershed are difficult to estimate directly, but the *Ecosystem Diagnosis and Treatment* (EDT) model attempts to predict those parameters for a “focal species” based on empirical estimates of a variety of habitat parameters (www.mobrand.com/MBI/edt.html). Where available, the Review Team relied on EDT predictions of current and future habitat conditions (productivity and capacity) for each salmonid stock in the pertinent watersheds associated with a Service hatchery. Habitat and capacity parameters can also be adjusted iteratively in spawner-recruit population dynamic models to yield results that best fit empirical estimates of total adult returns and/or smolt output under current conditions (Appendix A). This latter approach allows co-managers and others to evaluate potential alternative strategies for improving long-term population viabilities via habitat enhancements or other management actions.

Harvest on salmonid fishes occurs at different locations and times and can be assessed by the mean number of adult fish harvested annually in mixed stock ocean fisheries, mainstem Columbia River fisheries, and/or terminal fisheries within the particular sub-basin or watershed under consideration

¹⁸ McElhany, P., M.H. Ruckelshaus, M.J. Ford, T.C. Wainwright, and E.P. Bjorkstedt. 2000. *Viable salmon populations and the recovery of evolutionary significant units*. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-NWFSC-42, Seattle, WA 156pp. Also see www.nwfsc.noaa.gov/trt/trt_Columbia.htm

¹⁹ Willamette/Lower Columbia Technical Recovery Team (Paul McElhany, Tom Backman, Craig Busack, Steve Kolmes, Jim Myers, Dan Rawding, Ashley Steel, Cleve Steward, Tim Whitesel, Chuck Willis). 2004. *Status evaluation of salmon and steelhead populations in the Willamette and Lower Columbia River Basins*. Available at: www.nwfsc.noaa.gov/trt/wlc_docs/wlc_pop_eval_7_28_04.pdf

²⁰ McElhany, Paul., Craig Busack, Mark Chilcote, Steve Kolmes, Bruce McIntosh, Jim Myers, Dan Rawding, Ashley Steel, Cleve Steward, David Ward, Tim Whitesel, Chuck Willis. 2006. *Revised viability criteria for salmon and steelhead in the Willamette and Lower Columbia Basins* (Review Draft, April 1, 2006). Available at: www.nwfsc.noaa.gov/trt/viability_report_revised.cfm

²¹ Mobrand, L., et al. 2005. *Hatchery reform in Washington State: principles and emerging issues*. Fisheries 30(6): 11-23.

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(Appendix A). Harvest parameters can be adjusted in a manner analogous to adjusting habitat parameters (as described above) to identify levels of harvest that are sustainable under a particular set of habitat conditions as measured by productivity and capacity.

Hatchery Programs

Hatchery programs are associated with many salmonid stocks. In general, hatchery programs can be classified according to their type and purpose.

Hatchery programs are classified as either *integrated* or *segregated* according to the genetic goals for the broodstock. Hatchery programs (or broodstocks) are classified as *integrated* if natural-origin fish are systematically included in the broodstock each year with the goal that the natural environment will primarily determine the genetic constitution of hatchery-origin fish. The integrated strategy manages hatchery and wild fish as one population (or one gene pool) that spawns in two different environments but recognizes that the phenotypic performances of hatchery and wild fish can be quite different even when the two components are genetically the same. *Segregated* programs or broodstocks are intended to maintain the hatchery population as a distinct, genetically segregated population via the exclusive use of hatchery-origin adults for broodstock. The segregated strategy creates a hatchery-adapted population that can facilitate management goals (e.g. harvest) but which can also increase genetic and ecological risks to natural populations.

Hatchery programs need to be defined also in terms of their intended benefits. The primary purpose of most hatchery programs is to achieve *conservation* or *harvest* benefits (or both). A secondary purpose can also be conservation or harvest, but often includes education, research, socioeconomic or cultural/ceremonial benefits. These purposes should be closely linked to the goals of hatchery programs. Although *mitigation* is often stated as a “purpose” of a hatchery program, mitigation typically refers to the replacement of wild fish with hatchery fish without defining specific goals in terms of desired benefits (e.g., *mitigate* for fish losses associated with hydropower dams).

Operational Considerations

The Review Team considered all components of each hatchery program. Major features and issues of each program were summarized into the following subcategories: (a) program goals and objectives; (b) broodstock choice and collection; (c) hatchery and natural spawning, including adult returns; (d) incubation and rearing; (e) release and outmigration; (f) facilities and operations; (g) research, monitoring, and accountability, and (h) education and outreach.

Benefit and Risk Assessment

In conducting this review, the Review Team considered a wide range of possible benefits and risks potentially conferred and imposed, respectively, by hatchery programs.

Benefits considered include:

- Contributions to tribal and non-tribal harvests (commercial and recreational).
- Short- and long-term conservation benefits (both demographic and genetic).
- Research opportunities afforded by the program.

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- Educational, cultural, ceremonial and socioeconomic benefits conferred by the program and the hatchery facility itself.

Risks considered include:

Genetic Risks

- Risks from artificial propagation on the genetic constitution and fitness of hatchery-origin fish representing the cultured stock.
- Risks from natural spawning by hatchery-origin adults on the mean fitness of natural-origin fish of the same species in target and non-target watersheds.

Demographic Risks

- Pre-release risks from the hatchery facility and operations on the abundance of the propagated stock including the following: pre-spawning mortality associated with trapping, holding and/or bypassing adults; disease risks associated with overcrowding or high rearing densities of cultured fish, inadequate fish health protocols and water flow alarms to prevent catastrophic fish losses in the hatchery; poaching by humans; and predation by birds, mammals and fish at the point of release or on the hatchery grounds (e.g. by otters and birds).
- Post-release risks to the abundance of the propagated stock, including congregation of released fish at the release point and/or unnatural surface feeding (conditioned by hatchery rearing) that may increase vulnerability of released juveniles to predators, thus decreasing smolt-to-adult survival.
- Demographic risks from the hatchery operations on the abundance of other stocks and species within the watershed in which the hatchery is located (e.g., effects of a barrier weir for trapping adults for hatchery broodstock).

Ecological Risks

- Competition, predation, and disease transfer from hatchery-origin adults and juveniles of the propagated stock to naturally spawning populations of the same species or stock in target and non-target watersheds.
- Competition, predation, and disease transfer from hatchery-origin adults and juveniles of the propagated stock to naturally spawning populations of different species in target and non-target watersheds, including non-salmonid fish species of particular concern (e.g. lamprey).
- Risks from the hatchery facility and operations on the aquatic biota and ecosystem within the target watershed, including the effects of hatchery effluent, water intake, use of chemicals, and upstream/downstream passage of fish and other aquatic species in the watershed.
- Risk of antibiotic use resulting in developing resistant strains of pathogenic organisms that infect salmonid fishes, other aquatic species, and humans.
- Producing fish that are not qualitatively similar to natural fish of the same species in size, growth rate, morphology, behavior, physiological status or health, which may adversely affect the performance of natural fish via competition or predation.

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- The Team recognizes that hatchery-origin juveniles and adults may ecologically impact other fish species and populations in the estuary and ocean environment; however, little information on these *cumulative effects* is currently available.

Physical Risks

- Risks from the hatchery facility and operations to human health and safety, including potential contaminants.

The Team evaluated the benefits and risks of all operational and physical components of the hatchery program. These components are the same as those outlined above under *Operational Considerations*. Those evaluations then formed the bases of the Team's recommendations.

Recommendations

After careful assessment of the benefits and risks conferred by a hatchery program, the Review Team developed a series of recommendations to increase the likelihood of achieving the desired goals and benefits of the program and/or reducing biological and other risks. Recommendations for the current hatchery programs are grouped into the same categories as listed above under *Operational Considerations*. Recommendations for current programs are intended to address short-term goals and needs.

Alternatives

The review team then identified several alternatives to the current program, as suggested by comanagers or inferred from long term goals for salmonid stocks within the region, with an overall assessment of the merits and shortcomings (pros and cons) of those potential alternatives relative to the current program. By default, the following alternatives were included in each assessment: (a) the current program with full implementation of all recommendations and (b) termination of the current program and decommission of the hatchery in favor of alternative mitigation strategies (e.g., habitat restoration, construction of a new hatchery elsewhere, etc). The Team then selected a recommended alternative, or combination of alternatives, that the Team concluded would provide the greatest benefit-risk ratio in support of long-term harvest and conservation goals in the future.

III. Bonneville Pool Overview

The major reach of the Columbia River through the Columbia River Gorge was impounded by Bonneville Dam after its construction in 1938. The Bonneville Pool contains several major tributaries including the Wind, Big White Salmon, Hood, and Klickitat rivers. ESA-listed populations of Chinook salmon, coho salmon, chum salmon, and steelhead occur in this area. An ESA recovery plan is under preparation and is expected to be complete for the lower Columbia River by early 2008. Bonneville Pool supports significant recreational and tribal treaty fisheries. Several non-federal salmon and steelhead hatcheries are present in the Bonneville pool and Gorge regions.

Bonneville State Hatchery (Oregon Department of Fish and Wildlife)

Bonneville Hatchery was constructed in 1909 immediately downstream from the present location of Bonneville Dam. In 1957 the facility was remodeled and expanded as part of the Columbia River Fisheries Development Program (Mitchell Act) -- a program to enhance declining fish runs in the Columbia River Basin. The hatchery underwent another renovation in 1974 as part of the U.S. Army Corps of Engineer's mitigation of fish losses from the construction of the John Day Dam. Tanner Creek and wells provide the water for the hatchery. The Bonneville Hatchery facility includes 4 adult holding ponds, 30 converted Burrows ponds, 30 raceways, and incubation facilities.

Oxbow State Hatchery (Oregon Department of Fish and Wildlife)

Oxbow Hatchery is located approximately 1 mile east of Cascade Locks, Oregon. The Oxbow Hatchery was originally constructed in 1913 to provide additional rearing facilities for Bonneville Hatchery. It was relocated to its present site in 1937 following the construction of Bonneville Dam. The hatchery facilities sit on 33.5 acres with water supplied from Oxbow Springs through gravity flow. Oxbow operated as a state-funded hatchery until 1952 when it was remodeled and expanded as part of the Columbia River Fisheries Development Program (Mitchell Act)—a program to enhance declining fish runs in the Columbia River Basin. The hatchery is presently used for interim egg incubation and early rearing of spring Chinook, coho, and sockeye salmon. The Oxbow Springs flow dwindles to about 300 gpm in the summer and fall and is not used for rearing fish during that period. No adult fish are collected or spawned at Oxbow Hatchery, and no fish are released from this facility.

Cascade State Hatchery (Oregon Department of Fish and Wildlife)

Cascade Hatchery is located along Eagle Creek, 2.5 miles west of Cascade Locks, Oregon. Cascade Hatchery was authorized under the Mitchell Act and began operating in 1959 as part of the Columbia River Fisheries Development Program – a program to enhance declining fish runs in the Columbia River Basin. The hatchery grounds occupy 3.8 acres. Water is supplied by gravity flow from Eagle Creek. The facility is used for egg incubation and rearing of coho. The Tanner Creek coho program is a segregated-harvest program used to mitigate for fish losses resulting from the Columbia Basin hydropower system. Adult collection and spawning takes place at Bonneville Hatchery. No adults return to Cascade Hatchery.

Parkdale Hatchery (Confederated Tribes of the Warm Springs Reservation in Oregon)

Parkdale Hatchery (a.k.a. Parkdale Fish Facility) is located at RM 3.5 on the Middle Fork of the Hood River, Oregon. Adult collection facilities for the Parkdale Hatchery are located at Powerdale Dam, which is located at RM 4.0 on the mainstem Hood River. The Parkdale Fish Facility is currently providing support facilities for a Warm Springs Tribal program to reintroduce spring Chinook to the

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Hood River. Deschutes River spring Chinook have been the source of the reintroduction effort. Broodstock representing returning adults are currently collected at Powerdale Dam, taken to Parkdale Fish Facility where they are held, spawned and their fertilized eggs incubated to the eyed stage. Eyed eggs are transported to Round Butte Hatchery on the Deschutes River for final incubation and rearing. Yearling pre-smolts are transported to two acclimation sites on the West Fork Hood River one acclimation pond at the Parkdale Fish Facility for final rearing and volitional release. Non-migrant fish are trucked and released at the mouth of Hood River. A new weir for broodstock collection and monitoring of the restoration effort is planned for the Punchbowl Springs area of the West Fork Hood River. The Parkdale Fish Facility also supports a steelhead supplementation and recreational fishery program with significant research components (see Araki et al. 2007a,b).²²

Klickitat Hatchery (Yakama Nation)

The hatchery is located on the Klickitat River at RM 42, near the town of Glenwood, Washington. Klickitat Hatchery was authorized and constructed under the Mitchell Act and began operation as part of the Columbia River Fisheries Development Program. The hatchery was transferred to the Yakama Nation in 2005 from the Washington Department of Fish and Wildlife and propagates a native population of spring Chinook. The hatchery also incubates and rears URB fall Chinook and coho that are imported as eyed eggs from other hatchery sources. The hatchery has four water sources: Indian Ford Springs, an unnamed spring (designated Indian Ford “B”), Wonder Springs, and the Klickitat River. Facilities included one concrete adult holding pond, 72 full stacks (14 trays/stack) of vertical tray incubators, 28 shallow troughs for early rearing, 22 concrete raceways, 12 vinyl raceways, and three rearing/release ponds. Hatchery facilities also include Lyle Falls Fishway and Broodstock collection facility, Castile Falls fishway, and McGreedy Creek acclimation site.

²² Araki, H., W.R. Ardren, E. Olsen, B. Cooper, and M.S. Blouin. 2007a. Reproductive success of captive-bred steelhead trout in the wild: evaluation of three hatchery programs in the Hood River. *Conservation Biology* 21:181-190; Araki, H., B. Cooper, and M.S. Blouin. 2007b. Genetic effects of captive breeding cause a rapid, cumulative fitness decline in the wild. *Science* 318: 100- 103.

IV. Wind River Watershed

Columbia Gorge Province Wind Subbasin

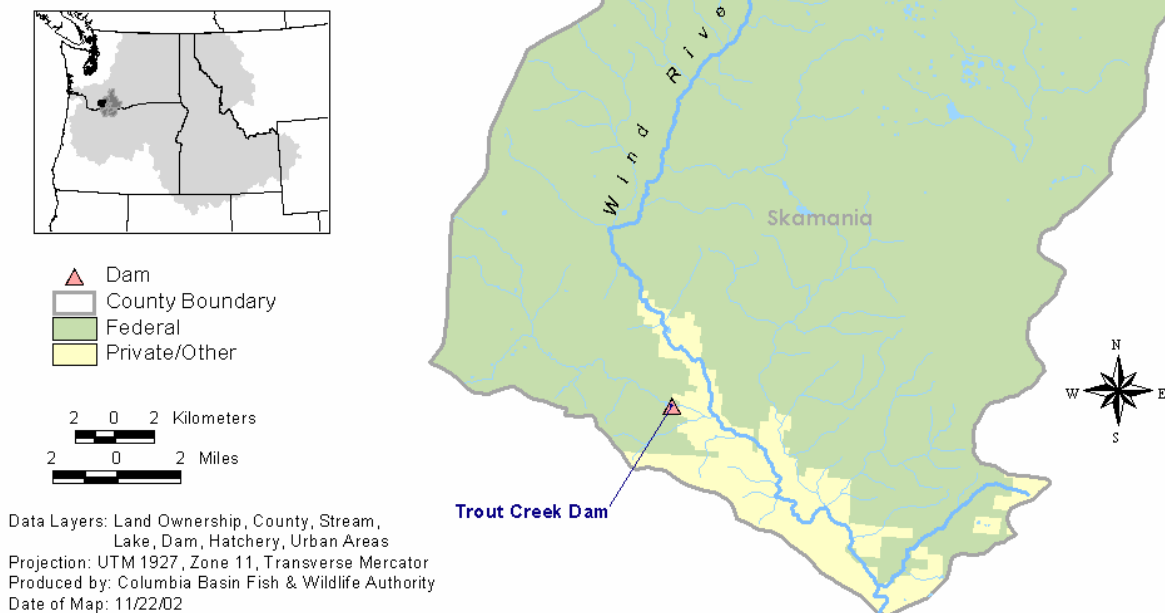


Figure 3. Wind River Watershed²³

²³ From: APRE Columbia Gorge Province Report -
<http://www.nwcouncil.org/fw/apre/provincereports/Columbia%20Gorge%20Province%20Report.doc>

Wind River Overview²⁴

Watershed Description

The Wind River subbasin covers approximately 143,504 acres (224 sq. miles) in central Skamania County, Washington State. The headwaters originate in the McClellan Meadows area in the southern Gifford Pinchot National Forest. The major tributaries in the basin include the Little Wind River, Bear Creek, Panther Creek, Trout Creek, Trapper Creek, Dry Creek, Falls Creek, and Paradise Creek. Elevation in the basin ranges from 80 to 3,900 feet above sea level. The northwest portion of the basin is steep and the northeast portion is relatively flat and consists of high elevation meadows. Trout Creek, a major tributary from the west, has a broad alluvial bench (Trout Creek Flats) in the upper central portion of the basin. A broad alluvial valley extends along several miles of the middle mainstem before entering into a steep V-shaped canyon in the lower 20 miles of stream. The lower southeast portion of the basin, including the Panther Creek and Little Wind River basins, has a comparatively high gradient. Shipherd Falls, consisting of four 10-15 foot falls, is located at approximately RM 2.0 and historically blocked the upstream migration of all anadromous fish except for summer-run steelhead (and possibly Pacific lamprey). A fishway ladder was constructed around the falls in the 1950's, thus allowing all anadromous fishes access to the upper Wind River. The basin has a volcanic, geologic history dating back 12 to 25 million years with more recent lava flows emanating from Trout Creek Hill are as recent as 300,000 years ago. Relatively recent glacial activity (15,000-70,000 years ago) has contributed glacial sediments and shaped river valleys. Alluvial deposits from the Bretz (aka Missoula) Floods during the late Pleistocene have resulted in highly erodible soils in portions of the lower basin.

Fisheries

The Wind River supports recreational and tribal fisheries on spring Chinook returning to the Carson NFH. Beginning in 2001, selective fisheries and an abundance-based management agreement (via *US vs. Oregon*) have permitted increased harvest of hatchery-origin spring Chinook in Columbia River fisheries. WDFW and the Yakama Nation negotiate an annual plan for sharing the harvest between recreational and tribal fisheries. Sport harvest of hatchery-origin spring Chinook in the Wind River averaged 5,130 fish per year, 1993-2002, with a record 18,036 fish harvested recreationally in 2002. Tribal harvests averaged 869 fish per year during that same time period, with a mean of 3,189 fish per year distributed directly to the tribe from surplus adult fish recovered at Carson NFH. A few fall Chinook (mean < 10 fish/year) are also harvested in the lower Wind River.

The Wind River also supports a popular recreational fishery on summer steelhead. No hatchery steelhead are currently released into the Wind River, but a catch-and-release on wild (unmarked) steelhead is allowed. Marked steelhead, representing hatchery-origin strays, can be harvested. Summer steelhead sport harvest in the Wind River averaged 1,373 fish per year from 1977-1982 but declined to an average annual harvest of 421 fish per year from 1983-1991. A catch-and-release fishery for wild steelhead, beginning in 2006, is allowed from September 16 to November 30. Summer steelhead are also harvested incidentally in the Columbia River mainstem fisheries during the fall months.

²⁴ From: *Lower Columbia Salmon Recovery and Fish and Wildlife Subbasin Plans, Vol. II-Subbasin Plans, Chapter J-Wind River, December 15, 2004. Lower Columbia Fish Recovery Board, Longview, Washington.*

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Fisheries on winter-run steelhead in the Wind River are very limited, due primarily to the relatively low amount of habitat capacity for winter steelhead downstream from Shipherd Falls. Approximately 25-50 wild winter steelhead are estimated to be harvested annually due to incidental interceptions. Since 1991, regulations have limited harvest to clipped hatchery-origin fish only. ESA limits fishery impact (tribal and non-tribal) of Wind River wild winter steelhead to 17% per year.

Conservation

Fall Chinook, coho salmon, chum salmon, summer-run steelhead, and winter-run steelhead are all native to the Wind River and are included with *threatened* listings under the U.S. Endangered Species Act (ESA). Bull trout, which are also listed as *threatened* under the ESA, do not occur in the Wind River subbasin. Salmon and steelhead numbers have declined to only a fraction of historical levels. Extinction risks over the next 100 years are considered significant for all ESA-listed salmonid species in the Wind River, except summer steelhead.

Other species of concern in the Wind River include coastal cutthroat trout and Pacific lamprey. These species have been affected by many of the same habitat factors that have reduced numbers of anadromous salmonids. ESA recovery actions targeting salmon and steelhead are expected to provide significant benefits for those other species.

Habitat

The U.S. Forest Service manages 89% of the land within the Wind River watershed. The President's Forest Plan (Record of Decision) categorizes the Wind River Basin as a Tier 1 Key Watershed that provides critical habitat for anadromous salmonids. Habitat is currently considered fair to excellent depending on the location. Some areas in the Trapper Creek wilderness are in pristine condition with excellent habitat. However, most habitat in the subbasin is degraded compared to historic conditions. Habitat problems noted in the subbasin plan are mainly related to timber harvesting practices and rural development. This is evidenced by maximum water temperatures exceeding 24° C (75° F) during summer, increased peak flows, increased sedimentation, lack of large woody debris, increased within-stream width-to-depth ratios, and lack of riparian vegetation (USFS 1996). A need exists to restore riparian vegetation, reduce sediment delivery to streams, enhance channel complexity, and ensure adequate recruitment of large woody debris into the system. The Washington Department of Ecology has designated stream segments of the Wind River subbasin as water quality impaired. The 303(d) list identifies segments that do not meet the standards of the federal Clean Water Act. DOE is presently conducting a TMDL for water temperature in this subbasin.

Current habitat conditions are the result of natural and anthropogenic events, including pre-Columbian volcanic eruptions, earthquakes, fire, erosion/sedimentation, loss of stream bank vegetation and large woody debris, and fluctuating peak water flows. Logging, "splash dams", hydropower development, water withdrawals, road construction, and rural development have negatively affected fish and wildlife habitat in the Wind River watershed. The single largest loss of habitat occurred with the flooding of the lower Wind River after the construction of Bonneville Dam. The dam inundated the primary spawning areas for fall Chinook and chum salmon and rendered the habitat unusable for this purpose.

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Current Status of Salmonid Stocks

The co-managers have identified 8 principal salmonid stocks in the Wind River watershed, two of which (chum and tule fall Chinook salmon) are severely depressed.

- Wind River hatchery spring Chinook salmon (introduced segregated harvest)
- Wind River tule fall Chinook salmon (natural; severely depressed)
- Upriver bright fall Chinook salmon (introduced strays from hatcheries outside the Wind River)
- Wind River coho salmon (natural; nearly extirpated)
- Wind River chum salmon (natural; nearly extirpated)
- Wind River summer steelhead (natural)
- Wind River winter steelhead (natural)
- Wind River cutthroat trout (natural)
- Wind River resident rainbow trout (natural)

The tables on the following pages summarize the current status and management premises of salmon and steelhead stocks in the Wind River. Habitat assessments were obtained from: *Northwest Power and Conservation Council. 2004. Wind River Subbasin Plan* (available at: www.nwcouncil.org/fw/subbasinplanning). Population viability assessments were obtained from: *Lower Columbia Technical Recovery Team, July 2004 report. Status evaluation of salmon and steelhead populations in the Willamette and Lower Columbia River* (available at: www.nwr.noaa.gov/salmon-recovery-planning).

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Table 1. Wind River hatchery spring Chinook (Carson NFH)

Management Premises and Goals	
<i>ESA Status</i>	<i>Not Listed.</i> Not included with the <i>Lower Columbia River Chinook Salmon ESU</i> .
<i>Biological Significance</i>	<i>Low to medium.</i> This is an introduced hatchery stock. Spring Chinook salmon were not native to the Wind River. This stock has been used for reintroducing spring Chinook salmon into watersheds where native populations were extirpated (e.g., Umatilla and Walla Walla rivers). It has also been the source of successful hatchery-propagated populations elsewhere (e.g., Leavenworth NFH).
<i>Population Viability</i>	<i>High.</i> A 10-year average of nine recruits per spawner (R/S) for brood years 1990-99.
<i>Habitat</i>	<i>Low.</i> Habitat capacity and productivity for naturally spawning, hatchery-origin spring Chinook salmon are considered very low (two to three smolts per redd). In 2005, all sampled naturally spawning spring Chinook (n=69) were of hatchery origin. A naturalized population of spring Chinook has not been established in the Wind River despite nearly 50 years of hatchery propagation and releases.
<i>Harvest</i>	<i>High.</i> For every fish returning to the hatchery another 1.1 was harvested. An average 5,487 fish were harvested for broodyears 1990-99 (10-year average). Nearly all harvest was in the Columbia and Wind rivers. The Carson NFH supports tribal and recreational fisheries in the Wind River.
Hatchery Program	
<i>Facilities</i>	Carson NFH. Shipherd Fall fishway ladder.
<i>Type</i>	Segregated.
<i>Authorization and Funding</i>	Mitchell Act.
<i>Primary Purpose</i>	Harvest. Mitigation for habitat and fishery losses associated with Bonneville Dam.
<i>Secondary Purposes</i>	Re-introduction to areas upstream of Bonneville Dam where native populations have been extirpated (e.g., Walla Walla River).
<i>Broodstock Origin(s)</i>	Natural-origin spring Chinook salmon trapped during upstream migration at Bonneville Dam, 1955-1964.

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Table 2. Wind River tule fall Chinook

Management Premises and Goals	
<i>ESA Status</i>	<i>Threatened.</i> Included with the <i>Lower Columbia River Chinook Salmon ESU.</i>
<i>Biological Significance</i>	<i>Medium to High.</i> There are few intact spawning areas remaining for Columbia River Gorge populations of fall Chinook (TRT 2004). Carson NFH released an average of 2 million tule fall Chinook (Spring Creek NFH stock) into the Wind River from 1952 to 1976, but hatchery releases were discontinued after 1976 (Wind River Subbasin Plan 2004). NOAA Fisheries considers Wind River tule fall Chinook as part of the Upper Gorge Population that includes all of the tributaries to the Bonneville Pool up to and excluding the Big White Salmon and Hood Rivers.
<i>Population Viability</i>	<i>Low.</i> Fall Chinook in the Wind River are currently influenced by spawning of stray hatchery fish from Spring Creek NFH (tule fall Chinook), Bonneville hatchery (upriver bright fall Chinook), and Little White Salmon NFH (upriver bright fall Chinook). The historical abundance fall Chinook in the Wind River has been estimated as 2,500 to 3,500 adult fish per year, with a current annual abundance of 0 to 400 adult fish (Wind River Subbasin Plan 2004). The Lower Columbia TRT has estimated a 50% extinction risk over the next 100 years.
<i>Habitat</i>	<i>Low.</i> Natural spawning occurs in the lower Wind River, and possibly Little Wind River, downstream of Shipherd Falls. The pool behind Bonneville Dam inundated the primary spawning habitat for fall Chinook in the Wind River in the late 1930's. Smolt capacity is estimated to be approximately 185,000 (Appendix A) to 206,608 smolts (Wind River Subbasin Plan 2004).
<i>Harvest</i>	<i>Medium to High.</i> Natural-origin tule fall Chinook in the Wind River are presumed to be harvested at a rate similar to tule fall Chinook from Spring Creek NFH (Appendix A).

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Table 3. Upriver bright (URB) fall Chinook

Management Premises and Goals	
<i>ESA Status</i>	<i>Not Listed.</i> The presence and natural spawning of URB fall Chinook in the Columbia Gorge region is largely the result of straying from the Bonneville State Hatchery ²⁵ and Little White Salmon NFH. Those hatchery stocks are not native to the Columbia Gorge region and are not included with any Chinook salmon ESUs under the ESA.
<i>Biological Significance</i>	<i>Low.</i> URB fall Chinook are not native to the Wind River. URB fall Chinook in the Wind River was first discovered in 1988 by WDFW and presumably resulted from the initial straying of hatchery-origin fish from Bonneville Hatchery. This hatchery started propagating URB fall Chinook in 1977 from natural-origin adults trapped at Bonneville Dam. Adult strays from Bonneville Hatchery and Little White Salmon NFH continue to occur in the Wind River (Wind River Subbasin Plan 2004).
<i>Population Viability</i>	<i>Low.</i> Natural spawning is influenced heavily by hatchery strays from Bonneville Hatchery and Little White Salmon NFH. Adult spawning escapement in the Wind River averaged 397 (range = 25-1,101) fish per year, 1988-2001. A self-sustaining population may have become established in the Wind River (Wind River Subbasin Plan 2004).
<i>Habitat</i>	<i>Low.</i> The primary spawning habitat for fall Chinook was inundated by the pool behind Bonneville Dam.
<i>Harvest</i>	<i>Medium to High.</i> Assumed to be harvested at rates similar for URB fall Chinook from Bonneville Hatchery and Little White Salmon NFH.

Table 4. Wind River coho

Management Premises and Goals	
<i>ESA Status</i>	<i>Threatened.</i> Included with the <i>Lower Columbia River coho salmon ESU</i> .
<i>Biological Significance</i>	<i>Low.</i> Hatchery-origin coho are presumed to have significantly influenced the naturally spawning population in the Wind River.
<i>Population Viability</i>	<i>Low.</i> Current abundance is approximately 200-300 adults with a historic abundance/capacity of approximately 1,200-10,000 adults per year (Wind River Subbasin Plan 2004) . The Lower Columbia TRT has estimated a 70% extinction risk over the next 100 years.
<i>Habitat</i>	<i>Low.</i> Historically restricted to area downstream of Shipherd Falls.
<i>Harvest</i>	<i>Medium.</i>

²⁵ Oregon Department of Fish and Wildlife (ODFW)

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Table 5. Wind River chum

Management Premises and Goals	
<i>ESA Status</i>	<i>Threatened.</i> Included with the <i>Columbia River Chum Salmon ESU</i> .
<i>Biological Significance</i>	<i>High.</i> Before the construction of Bonneville Dam, the Wind River supported an estimated spawning abundance of 25,000-30,000 adult chum salmon (Wind River Subbasin Plan 2004). NOAA Fisheries considers Wind River chum are part of the Upper Gorge Population that includes all tributaries to the Bonneville Pool up to and excluding the Klickitat River.
<i>Population Viability</i>	<i>Very Low.</i> Current spawning abundance is less than 100 adults per year, with Bonneville Dam counts typically less than 100 adults (Wind River Subbasin Plan 2004). The Lower Columbia TRT has estimated a 70% extinction risk over the next 100 years.
<i>Habitat</i>	<i>Low.</i> Bonneville Dam inundated the primary spawning habitat for chum salmon in the Wind River. Chum were historically restricted to the area downstream of Shipherd Falls.
<i>Harvest</i>	Low.

Table 6. Wind River summer steelhead

Management Premises and Goals	
<i>ESA Status</i>	<i>Threatened.</i> Included with the <i>Lower Columbia River Steelhead DPS</i> (Distinct Population Segment).
<i>Biological Significance</i>	<i>High.</i> Summer steelhead native to the Wind River historically ascended Shipherd Falls to reach spawning grounds. No other species of anadromous salmonid was capable of ascending the Wind River past the falls. Historic abundance estimated between 2,000 and 5,000 adults. Releases of hatchery steelhead into the Wind River (Skamania stock) were discontinued in 1994.
<i>Population Viability</i>	<i>Medium.</i> In recent years (2000-2006), population abundance has been highly variable, ranging from 200 to over 1,000 adults per year (Rawding and Cochran 2007; Appendix B). The population is currently self-sustaining. The Lower Columbia TRT has estimated a 10% extinction risk over the next 100 years.
<i>Habitat</i>	<i>Medium.</i> Historic logging and splash dam practices impacted spawning and rearing habitat in the upper Wind River and tributaries. Bonneville Dam inundated potential rearing habitat in the lower Wind River. Smolt density model estimates current production at 62,273 smolts (Wind River Subbasin Plan 2004).
<i>Harvest</i>	<i>Low.</i> Catch and release recreational fisheries have been allowed recently in years of high abundance (Dan Rawding, WDFW, pers. comm.).

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Table 7. Wind River winter steelhead

Management Premises and Goals	
<i>ESA Status</i>	<i>Threatened</i> . Included with the <i>Lower Columbia River Steelhead DPS</i> (Distinct Population Segment).
<i>Biological Significance</i>	<i>High</i> . The Wind River is near the eastern range for winter steelhead for the Washington side of the Columbia River. Historical abundance estimated between 300 and 2,700 adults (Wind River Subbasin Plan 2004).
<i>Population Viability</i>	<i>Low</i> . Current abundance has ranged from 20 to 53 adults for years 2000-2006 (Rawding and Cochran 2007). The Lower Columbia TRT has estimated a 70% extinction risk over the next 100 years.
<i>Habitat</i>	<i>Low</i> . Historically restricted to area downstream of Shipherd Falls. Bonneville Dam inundated habitat in the lower Wind River.
<i>Harvest</i>	<i>Low</i> .

Other Species of Concern

Table 8. Additional native fish species present in the Wind River²⁶

Common name	Scientific Name
Salmonid	
Cutthroat trout	<i>Oncorhynchus clarki clarki</i>
Mountain whitefish	<i>Prosopium williamsoni</i>
Non-Salmonid	
White Sturgeon	<i>Acipenser transmontanus</i>
Pacific lamprey	<i>Lampetra tridentata</i>
Longnose dace	<i>Rhinichthys cataractae</i>
Speckled dace	<i>Rhinichthys osculus</i>
Redside shiner	<i>Richardsonius balteatus</i>
Sculpins	<i>Cottus</i> sp.
Three-spine stickleback	<i>Gasterosteus aculeatus</i>

²⁶ From: Lower Columbia River Province Plan, Volume II, Chapter J, Wind River Subbasin Plan, December 15, 2004. Prepared for the Northwest Power and Conservation Council by the Lower Columbia Fish Recovery Board, Longview, Washington (Available at: <http://www.nwccouncil.org/fw/subbasinplanning/lowerColumbia/plan/>).

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Salmon and Steelhead Hatcheries in the Watershed

Carson National Fish Hatchery (U.S. Fish and Wildlife Service)

Carson National Fish Hatchery (NFH) is located at river mile RM 14 on the Wind River, Skamania County, Washington within the Columbia River basin. Carson NFH was authorized by Special Act 50 Stat. 220, May 28, 1937, and placed into operation in December 1937 to mitigate for the effects of federal water projects, primarily Bonneville Dam, in the Columbia River basin. The hatchery was reauthorized by the Mitchell Act (16 USC 755-757; 52 Stat. 345) May 11, 1938 as amended on August 8, 1946, (60 Stat. 932) to assist with the conservation of the fish and fishery resources in the Columbia River Basin, as specified in the Act. The hatchery was remodeled in 1956 to establish a hatchery stock of spring Chinook in the Wind River. The hatchery has five buildings involved in fish production, four residences, and a large covered pond. The hatchery is used currently for adult broodstock collection, egg incubation, rearing, and release of yearling spring Chinook. The hatchery also provides eyed eggs and fish for reintroducing spring Chinook to other watersheds where they have been extirpated.

The hatchery is funded by NOAA-Fisheries and the Service's Hatchery Cyclical Maintenance fund. The operational budget for FY2006 was \$588,792. Costs for monitoring and evaluation (M&E) in FY2006 were approximately \$108,377, including \$83,377 for tagging. Capital Improvements to the Carson NFH have totaled \$1,757,085 during the period 2000- 2006.

Funding Source: FY2006	Amount
NOAA-Fisheries(Mitchell Act)	\$538,124
USFWS –Hatchery Cyclical Maintenance	\$50,668
Total	\$588,792

Carson NFH Spring Chinook

Operator: U.S. Fish and Wildlife Service

Summary of Current Program

Goals

- **Harvest goal:** Support commercial, tribal, and recreational fisheries in the lower Columbia and Wind rivers. Based on a desired 0.5% smolt-to-adult return rate (harvest plus escapement back to the hatchery), the program goal would be to achieve a mean harvest of 5,700 adult spring Chinook per year based on the current size of the program, although a specific harvest goal has not been established.
- **Broodstock escapement goal:** Provide an escapement back to the hatchery of at least 1,400 hatchery-origin adult spring Chinook for a segregated broodstock program. Achieve a 0.1% survival from smolt release to adult recovery at the hatchery to maintain brood stock.
- **Conservation goal:** The hatchery program has no direct conservation goals within the Wind River drainage. Carson NFH spring Chinook are excluded from the Lower Columbia River Chinook ESU (currently listed as *threatened* under the ESA) and are not included in recovery planning for the ESU. However, the Carson NFH has been a principal stock for reintroducing spring Chinook elsewhere in the Columbia River Basin where natural populations have been extirpated.
- **Escapement goal for natural-origin adults:** No specific escapement goal exists for natural origin spring Chinook in the Wind River. Field data indicate that a naturalized population has not been established, although natural spawning by hatchery-origin fish does occur.
- **Research, education, and outreach goals:** Provide visitation opportunities daily, seven days a week, and develop education programs to promote public understanding of the Carson NFH and the biology of Pacific salmon. Current long-range outreach goals include lecture series, facility renovations, and improved visitor facilities. Long term monitoring and evaluation goals need to be developed.

Objectives

- Trap 1,400 adult spring Chinook for broodstock to obtain a minimum of 1,000 adult spring Chinook (minimum of 500 females) for broodstock.
- Spawn a minimum of 500 females to yield 2.2 million (M) fertilized eggs.
- Release 1.17 M yearling spring Chinook smolts annually from the hatchery directly into the Wind River. Through 1996, Carson NFH released approximately 2.0 M smolts per year, but rearing

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densities and release numbers were reduced in response to studies that showed rearing fewer spring Chinook at lower densities resulted in greater numbers of returning adults.²⁷

- Provide 250,000 yearling smolts annually to the Umatilla Tribe for reintroduction of spring Chinook to the Walla Walla River. This component of the program was transferred temporarily to Little White Salmon NFH because of brook trout in the intake water source at Carson NFH and inadequate screening to preclude entrainment. As a result, transfer of spring Chinook juveniles from Carson NFH to watersheds with ESA listed bull trout was not permitted. A new screen that excludes brook trout from the water intake was installed during the summer of 2007. As determined from an internal ESA section 7 consultation, the Service now provides constraints and allowances for continuing the Walla Walla River reintroduction program at Carson NFH.

Program Description

Carson NFH operates as part of the Columbia River Fisheries Development Program under U.S. v. Oregon and is funded through the Mitchell Act. Propagation of spring Chinook at Carson NFH began in 1955 after a fish ladder was constructed at Shipherd Falls, two miles upstream from the mouth of the Wind River, to allow for upstream passage of adult salmon to the hatchery.²⁸ Approximately 500 spring Chinook salmon were trapped annually from 1955 through 1964 at Bonneville Dam (Washington side of Columbia River) to initiate the broodstock and establish the population at Carson National Fish Hatchery (Spring Chinook are not native to the Wind River). Genetic data suggest that the Carson NFH stock was derived from a mixture of upper Columbia and Snake River populations passing Bonneville Dam²⁹. Small numbers of spring Chinook were counted past the newly constructed Shipherd Falls fish ladder in 1956, 1957, and 1958, and presumably represented natural strays from other populations. The first returns spring Chinook back to Carson NFH occurred in 1959 when 107 fish entered the hatchery (99 jacks, 2 adult females and 6 adult males). Carson NFH has maintained this population of spring Chinook since that time. Annual adult returns to Carson NFH averaged 3,797 fish between 1980 and 2001, with over 10,000 spring Chinook returning each year in 1990, 2000 and 2001 (Table 1.12b, Carson NFH HGMP).

Spring Chinook eggs, fry, and fingerlings from the Carson NFH have been transferred to many localities including Alaska (over 2 million eggs in the early 1970's), Oregon (22.9 million eggs from 1957 to 1993), Idaho (15.9 million eggs from 1960 to 1980), and several hatcheries in Washington (29.7 million eggs from 1957 to 1991). The "Carson stock" was the primary source of spring Chinook currently propagated at Little White Salmon and Leavenworth NFHs and has been the source of reintroduced spring Chinook in the Umatilla (Oregon) and Walla Walla (Washington) rivers.

²⁷ Banks, J.L. 1994. Raceway density and water flow as factors affecting spring chinook salmon (*Oncorhynchus tshawytscha*) during rearing and after release. *Aquaculture* 119:201-217.

²⁸ Carson NFH was also expanded in 1956, in part to accommodate development of a spring Chinook program.

²⁹ Campton, D.E. 2000. Genetic Comparisons among Hatchery and Wild Populations of Spring Chinook Salmon in the Methow River Basin. Unpublished report, U.S. Fish and Wildlife Service, Abernathy Fish Technology Center, Longview, Washington.

Assessment of Current Program

Operational Considerations

Listed below are the principal operational components of the hatchery program that the Review Team considered as part of its review.

Broodstock Choice and Collection

- Spring Chinook are not native to the Wind River. Historically, steelhead were the principal anadromous salmonid species able to migrate upstream of Shiphord Falls prior to construction of the fishway ladder.
- Carson NFH stock was derived from upstream migrating spring Chinook adults trapped at Bonneville Dam, 1955-1964.
- Broodstock are derived each year from hatchery-origin adults returning to the hatchery (segregated broodstock program). Genetic data suggest that both Snake River and upper Columbia River stocks of spring Chinook contributed to the origin of the Carson NFH stock. Because of their mixed stock origin, NOAA Fisheries does not include Carson NFH spring Chinook with any recognized ESU of Chinook salmon.
- Very few hatchery-origin spring Chinook salmon from elsewhere stray into Carson NFH. For example, based on coded-wire tag recoveries, five to six fish are estimated to have strayed to Carson NFH each year in 2005, 2006, and 2007, all from Little White Salmon NFH which were derived from Carson stock (CRiS database).
- The broodstock has received no imports of “non-Carson” eggs or fish from other hatcheries or populations since inception of the program.
- Hatchery-origin spring Chinook are trapped at the Carson NFH from May to August. Adults voluntarily ascend the ladder and enter the adult holding pond. No weir exists on the Wind River.
- If brood stock numbers are insufficient to meet hatchery production objectives, the hatchery will rear fewer fish. However, under current Service policies, Carson stock from Little White Salmon NFH or Leavenworth NFH could be imported to Carson NFH, although this contingency is unlikely to occur in the foreseeable future.

Hatchery and Natural Spawning, Adult Returns

- Adults are randomly selected and spawned over a two to three week period (one to three spawn takes, one take per week) from mid- to late August.
- Jacks (3 year old males) are included in the broodstock in proportion to their occurrence up to 10% maximum of the spawned males. On average, approximately 6% of the males spawned have been jacks (1980-2001).

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- Males and females are spawned pairwise, 1:1 ratio.
- The adult escapement and trapping goal at the hatchery is set to account for 55%:45% female:male ratio among returning adults. This requires trapping more females for broodstock to obtain sufficient numbers of males for pairwise spawning.
- A mean of 840 females were spawned each year, 1990-2001. A mean of 3,651,400 eggs were taken each year, 1990-2001. These data indicate a mean fecundity of 4,350 eggs per female (Carson NFH HGMP 2004). Note: The broodstock goal was reduced from approximately 1,000 females to approximately 500 females beginning in 1994 in response to data on adult return rates resulting from density studies (Banks 1994).
- Coded wire tag recoveries in the Wind River and at Carson NFH through BY1998 accounted for 92.5% of the fish released on station. Another 7.2% of the tags fish were recovered from the Drano Lake fishery (Little White Salmon River) and at Little White Salmon NFH. Few CWTs have been recovered elsewhere: 0.15% from the Big White Salmon River; 0.07% from the Kalama River; 0.03%, from the Deschutes River; and 0.07%, from the John Day Pool behind John Day Dam.
- Very few spring Chinook salmon stray into Carson NFH. For example, based on coded-wire tag recoveries, an estimated six fish in 2005, six fish in 2006, and five fish in 2007 strayed from other hatcheries to Carson NFH, and all these strays came from Little White Salmon NFH.
- The geometric mean number of spring Chinook spawning naturally in the Wind River was 195 fish per year for BY 1990-1999 (2% of all recoveries). In 2004, WDFW identified 614 spring Chinook spawners in the Wind River, with 112 hatchery origin and three natural origin fish in the upper Wind River upstream of Beaver Campground. In 2005, 237 spawners were found in the Wind River, with 69 hatchery origin and no natural origin adults in the upper river (Dan Rawding, WDFW, pers. comm.). In August 2006 and 2007, 267 and 79 adult spring Chinook, respectively, were counted in the Wind River as potentially naturally spawning fish (Wind River snorkel survey results for 2006 and 2007, Charlie Cochran, WDFW).
- Escapement and natural spawning of Carson NFH spring Chinook in the Wind River raises some concerns regarding potential disease transmission to other fish. Through 1996, when the Wind River supply was regularly used to supplement Tyee Springs water, disease outbreaks (BKD, IHN and furunculosis) among juvenile spring Chinook in the hatchery occurred in varying magnitudes. By reducing rearing densities and total fish production from 2.0 to 1.42 million yearlings, along with limited or no use of water from the Wind River, disease problems among juvenile fish in the hatchery were essentially eliminated. To date, no disease symptoms or significant pathogen levels have been detected among wild steelhead and naturally-produced Chinook salmon juveniles residing in the Wind River, based on sampling from 1997 to 2007. However, the incidence of IHN virus among Carson NFH spring Chinook is up to 88%, and steelhead fry are very susceptible to this virus. Although no virus has been detected among wild steelhead fry, sampling has been minimal during the most susceptible life stage.
- Spring Chinook are harvested primarily in Columbia River commercial and recreational fisheries, including tribal and recreational fisheries in the Wind River, although harvest occurs also in marine fisheries. In 2001, almost 5,000 and 1,840 spring Chinook were harvested in recreational and tribal fisheries, respectively, in the Wind River, with an escapement of 12,075 adults back to

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the hatchery. The mean sport and tribal harvests for 1989-1998 were 2,615 and 868 adults, respectively. Mean percent recoveries for BY1990 through BY1999 releases were 47% at the hatchery, 51% in Columbia River harvests, 2% from spawning grounds in the Wind River, and 0.1% in the ocean fishery.

- The number of adult spring Chinook surplused to the tribes varies annually depending on the total number of fish that return to the hatchery. For example, the number surplused has ranged from no fish in 2005 (only 1,160 fish returned to the hatchery) to 10,546 fish in 2001 (12,075 fish returned to the hatchery). A mean of 2,575 adult spring Chinook were surplused from Carson NFH to tribes, 1989-1998.
- Erythromycin injections for spring Chinook salmon brood stock are used to control bacterial kidney disease (BKD) among spring Chinook adults held for broodstock prior to spawning. This treatment helps control mortality in adults and may reduce vertical transmission of *Renibacterium salmoninarum*, the causative agent of BKD, from parents to progeny via eggs. Brood adults are also treated with formalin three times/week to control external parasites.
- Female spawners are individually tested for *Renibacterium*, based on an enzyme-linked immunosorbent assay (ELISA). Fertilized eggs from high risk females are culled and buried. Since implementation of this procedure, along with reduced juvenile densities, and erythromycin injection of adults, the prevalence of BKD among spring Chinook reared on station has been reduced significantly (Lower Columbia River Fish Health Center reports).
- Smolt-to-adult returns (SARs) back to the hatchery averaged 0.34% for BY1990-99. Including fisheries and all coded-wire tag recoveries, total SARs averaged 0.67% over the same 10-year period (i.e. approximately 50% of all adult recoveries occur at the hatchery).
- For each brood year, spring Chinook returns to Carson NFH are composed of a lower proportion of age 3 fish (jacks) than is typical of other spring Chinook hatchery stocks (brood years 1979-2001, CRiS reports³⁰).
- NOAA Fisheries desires that the outplanting program into the Walla Walla River remain fairly modest (250,000 yearlings) with 100% adipose fin clips of released fish, 50,000 of which carry a coded-wire tag so that managers can track potential straying into the geographic range of the *Snake River Spring/Summer Chinook ESU*. Umatilla hatchery-origin spring Chinook (originally derived from Carson NFH stock) released into the Umatilla River as yearlings have, in the past, strayed as returning adults into the Tucannon River within Snake River drainage (Mike Delarm, NOAA Fisheries, pers. comm.). The Tucannon River supports a native stock of spring Chinook which is currently listed as *threatened* under the ESA as part of the *Snake River Spring/Summer Chinook Salmon ESU*. As a result, potential straying of returning Carson NFH spring Chinook outplanted into the Walla Walla River is a concern.

Incubation and Rearing

- Tyee Springs (44° F) and Tyee Creek are the source of water for incubation of eggs and alevins.

³⁰ Columbia River Information System. The Columbia River Fisheries Program Office in Vancouver, Washington, maintains a database on adult returns and harvests for salmon and steelhead released from federal hatcheries in the Columbia River basin.

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- Fertilized eggs from each female are initially incubated separately in isolation buckets until ELISA results for BKD risk are available. Moderate to high risk eggs are culled.
- 6,000 eyed eggs are loaded per incubator tray (Heath incubators) after high BKD risk eggs have been culled.
- Water flow rates are set at three gallons per minute (gpm) at the eyed egg stage, and increased to 5 gpm at the first hatch of sac fry.
- Fry are ponded directly from the incubator trays into 14-18 raceways at 108,000 fry per one-half raceway, which results in a 0.08 initial density index (D.I.). The “reduced” one-half raceway area improves ease of feeding and cleaning of the raceways during the early stage of growth. When D.I. approaches 0.25, the fish are switched from belt feeders to hand-feeding, and the center screens are removed from the raceways, thus reducing D.I.s by 50% to approximately 0.12.
- Feeding of antibiotics has not occurred at Carson NFH since 1998. Before 1998, erythromycin was routinely fed prophylactically to assist with reducing BKD risks.
- Single pass water from Tyee Creek, 44-46° F, is gravity-fed into the raceways at 380 gallons/minute/raceway from Tyee Creek.
- All released fish are 100% adipose fin clipped. Subyearling fish are marked and tagged in May. At that time, the tagging crew marks, inventories and disperses the fry from each raceway throughout three banks of raceways (a total of 46 raceways).
- **Application of coded wire tags. Upper Bank Raceways 1-12:** One uniquely coded group of 25,000 tags is spread out among three raceways of approximately 8,400 fish each. These are later split into vacated raceways 13-18, (vacated because fish had been moved to upper dirt pond), so that the tagged fish reside in 6 raceways. These fish are released from these raceways. **Middle Bank Raceways 31-36:** One uniquely coded group of 25,000 tags is divided between two raceways at about 12,500 each. All fish in raceways 31-36 are then moved to the adult pond for subsequent release. **Middle Bank Raceways 19-30, and Upper Bank Raceways 13-18:** One uniquely coded group of 25,000 tags is spread out amongst 3 raceways at about 6,250 each in middle bank (19-30) and 1 raceway at 6,250 in upper bank (13-18). The three tagged raceways in middle bank 19-30 are moved with other untagged raceways to the lower dirt pond for subsequent release. The remaining tagged raceway from upper bank 13-18 is moved with other untagged raceways to the upper dirt pond for subsequent release. [Note: Tagging protocols were recently changed to those described here after the initial draft of this report was provided to the USFWS].
- The flow in earthen ponds = 3,500 to 4,000 gallons/minute and the density indices are <0.1. (On April 9, 2006, the following density indices were obtained: lower earthen pond DI=0.06; upper earthen pond DI=0.09). The lower earthen dirt pond receives second use water from the upper earthen pond.
- In December before release, 5,000 fish per each of three raceways in the upper bank are crowded and PIT tagged. A total of 15,000 PIT tags are put in the non-CWT-fish from the raceways (#6, 8, and 10) least subject to predation. Mortalities in these three raceways are monitored for PIT tags to ascertain the actual number of tagged fish at release.

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- New intake screens on Tyee Creek allows the resumption of the annual 250,000 yearling smolt program to the Umatilla Tribe for reintroduction of spring Chinook to the Walla Walla River.

Release and Outmigration

- Up through 1998, Carson NFH released up to 2.0 million smolts per year. Beginning with BY1997, rearing densities and on-station release numbers were reduced to 1.42 million smolts in response to the study of Banks (1994). In 2007, the US v Oregon agreement specifies an on-station release of 1.17 million yearling smolts to accommodate transfer of 250,000 yearlings for reintroduction into the Walla Walla River. Release numbers into the Wind River from 1998 to 2007 ranged from 1.2 to 1.7 million smolts.
- Smolts are force-released directly into the Wind River during the third week of April to coincide with natural spring migrations and spill at Bonneville Dam.
- The actual number of smolts released from the earthen ponds is unknown. The last inventory occurs in November during their transfer from the raceways.
- Mortalities collected from the earthen pond screens and raceways are tracked, but losses from predators are unknown.
- In 1999, the average travel time from release at Carson NFH to Bonneville Dam was 10.2 days, with a range from less than 24 hours to 94 days. Most PIT tagged fish released from Carson NFH are undetected at Bonneville Dam because releases from the hatchery coincide with scheduled spills, and most fish use the spillway.
- Mean size of released smolts is 16 to 18 fish per pound.
- Predation on native Wind River steelhead juveniles by released spring Chinook smolts is assumed to be negligible based on time and rapidity of outmigration. Fully-smolted hatchery fish outmigrate rapidly from the Wind River into the Columbia River, and available information indicates that hatchery-origin juveniles do not residualize. In addition, the primary spawning and rearing areas for steelhead are upstream of the hatchery in the mainstem Wind River and tributaries. Steelhead fry emerge from gravel after spring Chinook smolts have emigrated from the Wind River.

Facilities and Operations

- Brook trout are present in Tyee Creek, the main water source for the hatchery. New screens installed in 2007 preclude brook trout juveniles from hatchery inflow and an evaluation of the screens will occur from the 2007 through 2009 brood years.
- Two earthen ponds are present at Carson NFH. The lower earthen pond receives second pass water from the upper earthen pond.
- The lower half of the 46 raceways are covered, the upper half are not covered.
- The hatchery has a 40 cfs water right for Wind River water. Regular use of this water supply was discontinued when fish production was reduced from 2 million to 1.42 million. This essentially eliminated disease outbreaks in the juveniles, a result of pathogen transmission from the adult

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spring Chinook in the river. Through 1997 to 1999, use of the Wind River water was limited to supplementing the upper earthen pond during the summer months. To avoid the issues with NOAA Fisheries screening criteria, the fish loading and splitting protocols were changed in 2000, allowing the earthen ponds to remain fallow from mid-April through late October/early November and negating the need for Wind River water except under emergency conditions. The last considered use of this water supply was in 2001 when dry winter conditions reduced Tyee Springs to 20% below normal. To maintain the hatchery's water right for emergency purposes, a screened pump has been installed (although it still does not meet NOAA Fisheries criteria), and water withdrawals are made twice a year for maintenance.

- Bacteria additives (A.B.A., International Company, TN) are used in the earthen ponds to assist with the digestion of fish waste products. After release of fish, the ponds are hosed clean of debris, emptied, and left to dry over the summer. One or more of these actions reduced visual signs of tail rot (flag tail) which formerly occurred in a small proportion of the fish in the upper earthen pond.
- Carson NFH does not have a back-up generator for the mechanical screen intake and pumps.
- Water temperature averages 44-47° F.
- Otter predation is significant, particularly in the lower bank of raceways (ponds 37-46) and earthen ponds, and creates errors in the station fish inventory. Despite extensive fencing and electrical wiring, no immediate solutions are apparent other than hiring a trapper to remove live otters for relocation. Some modification to the fences, such as flashing at the top, might be useful.
- Most of the juvenile rearing units are not fenced and/or covered and are susceptible to bird predation (e.g. herons).
- The pollution abatement pond receives all raceway cleaning effluent water. Normal outflow is discharged into the Wind River. Cleaning effluent and total discharge (normal operation) effluent are monitored weekly for suspended and settled solids. The facility has been in compliance with NPDES standards since the early 1980's.
- Raceway alarms are needed on each raceway to detect high water levels from clogged screens. Low water alarms are present and functional.
- Security alarms to discourage poaching are not present on the adult holding ponds. Fences keep vehicles out, but will not exclude people.
- Domestic drinking water is irradiated with ultra-violet light (UV) prior to pumping to a storage tank that holds 10,000 gallons with a turnover rate of approximately 2-3 days (summer use is greater). Monthly coliform testing is ongoing, but positive tests have occurred in the past. Modifications are needed to UV-disinfect the water on the feed line from the storage tank to the on-station residences.
- Tanks in the nursery building have lead paint. Some lead paint is also present in the residences and on the adult fish crowder.
- Radon is high in the nursery building, and a circulation fan is needed.

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- Mitchell Act funding does not cover facility renovations or maintenance. Program improvements may not occur because reimbursable funding to cover those costs is lacking. This issue occurs at other Mitchell Act-funded facilities.

Research, Education, and Outreach

- Research on effects of rearing density and flow on survival was conducted by Abernathy Fish Technology Center and published in Banks (1994). Production was reduced from over 2 million to approximately 1.4 million based on results from the study. Density index is now maintained at <0.25 throughout the rearing cycle and at approximately 0.1 at release. Flow index is also < 1 throughout rearing cycle.
- Coded-wire tagging is conducted to assess survival and contribution to fisheries (Pastor 2007).
- PIT tagging is conducted as part of an on-going Comparative Survival Study to assess survival and mortality through mainstem dams on the Columbia and Snake rivers (USFWS 2007)³¹.
- The hatchery manager would like to construct an education/outreach visitor center at the entrance to the hatchery.
- In coordination with Abernathy Fish Technology Center, Carson NFH has advanced the use of electro-anesthesiology for anesthetizing adult salmon during hatchery spawning.
- In cooperation with the USGS Columbia River Research Lab, a multi-year study on steelhead and Chinook salmon juvenile interactions shows that highly variable numbers (0 to 99 fish/100 meters) of spring Chinook fry are produced each year by hatchery-origin spring Chinook spawning in the upper Wind River and its tributaries (between river kilometer 24.6 to 42.5). The abundance and distribution of natural-origin spring Chinook juveniles in the Wind River seems to depend on river flows which variably affect either the adult and/or the juvenile life stages, depending on the river reach. Low base flows appear to restrict access to the upper reaches of the Wind River during the late-summer period when adult Chinook salmon spawn. Some Chinook redds may have been dewatered after the spawning period, influencing reproductive success. In the river reach adjacent to the hatchery, the redds and/or fry appear to be susceptible to high winter flows. Seven out of 538 natural-origin spring Chinook smolts with USGS-applied PIT tags were detected at Bonneville Dam, 2004-2006. The relatively low numbers of smolt outmigrants coupled with a general lack of returning adults suggest that a self-sustaining naturalized population of spring Chinook has not been established in the Wind River. Although the potential existed for negative ecological interactions with wild juvenile steelhead, data collected to date do not indicate that those interactions are significant or of a detectably large effect (Appendix B; Jezoreck et al., 2007).³²
- Carson NFH is participating in the Mitchell Act funding outreach team.

³¹ *Comparative Survival Study (CSS) of PIT-Tagged Spring/Summer Chinook and Steelhead in the Columbia River Basin: Ten-year Retrospective Summary Report by the Comparative Survival Study Oversight Committee and Fish Passage Center, August 2007. Available at: <http://www.fws.gov/columbiariver>.*

³² Jezoreck, I.G., P.J. Connolly, C. Munz, and J. Charrier. 2007. *Ecological Interactions between hatchery spring Chinook salmon and wild steelhead in the Wind River, WA. Draft report for activities 2004 to 2006. USGS Columbia River Fisheries Research Center, Cook, WA*

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- Carson NFH hosts a volunteer program from April to end of September. The hatchery usually has two retired couples who “meet and greet” on weekends, and do gardening and landscaping. The hatchery is equipped with two RV pads, including a guest service area between the two RV pads with laundry facilities, showers, baths, etc.
- The hatchery receives approximately 2,000 visitors/year. Offsite outreach contacts over 10,000 additional people. The hatchery has an open house, a kids’ fishing day, and a disabled-handicapped persons fishing day, with ≈500-600 kids (2004 and 2005) participating each year in Kid’s Fishing Day
- The hatchery has a cooperative agreement with Mt. Hood Community College for student volunteers enrolled in the Fish Technology Program. Students conduct studies, feed fish, and take water quality samples, etc., on weekends as partial fulfillment of their fish technology curriculum.
- Carson NFH is starting a lecture series during the summer in Stevenson as a public outreach activity and currently participates in other community events.

Benefit and Risk Assessment

BENEFITS CONFERRED TO THE PROPAGATED STOCK AND LOCAL COMMUNITY

In the context of all possible harvest, conservation, and other benefits that a hatchery program can confer to the propagated stock and local community,³³ the Review Team identified the following benefits of this hatchery program:

Harvest Benefits

- Program confers significant sport and tribal harvest benefits. 10-year average for coded-wire tag recoveries from BY1990-1999 averaged 5,473 in Columbia River harvest (range = 92-12,802). Specifically in the Wind River, the state of Washington estimate in 2001 was 11,516 sport catch and 1,840 tribal catch, and escapement of 12,075 back to the hatchery. Mean sport and tribal catch in CY 1989-1998 in the Wind River was 2,615 and 868 adults, respectively.
- Carson NFH spring Chinook provided over 32,000 angler-days in 2001.
- Mass marking of Carson NFH spring Chinook allows for selective fisheries in mainstem Columbia River while managing risks to ESA-listed natural-origin spring Chinook, as specified in NOAA Fisheries biological opinions.
- Excess adults trapped at the hatchery are provided to the Yakama Nation (mean = 2,575/year) for subsistence and ceremonial purposes and to food banks.

Conservation Benefits

- Spring Chinook are not native to the Wind River, and a naturalized population has not been established. Consequently, the hatchery program confers no direct conservation benefit in the Wind River.

³³ See the “Components of This Report” section for a summary description of potential benefits and risks considered by the Review Team.

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Research, Education, Outreach and Cultural Benefits

- Tribal harvest and surplus adults trapped at hatchery provide a cultural benefit to Columbia River tribes.
- Carson NFH has been involved directly in BKD transmission and survival studies in light of new technologies and methods.³⁴
- Location of Carson NFH upstream from only one mainstem dam facilitates survival studies on spring Chinook for multiple tag groups.
- Carson NFH has provided many opportunities for research on spring Chinook: interaction studies between steelhead and spring Chinook, starter feed studies on spring Chinook.
- Geographic location of hatchery is on scenic byway access to Mt. St. Helens National Monument from the Columbia River Gorge.
- Fish are used to assess hydro impacts and fish passage.
- Hatchery staff are providing increasing outreach activities in the local community.
- Carson NFH supports educational activities of Hood River Community College.

BENEFITS CONFERRED TO OTHER STOCKS, SPECIES, AND COMMUNITIES

In the context of all possible harvest, conservation, and other benefits that a hatchery program can confer to other species and stocks,³⁵ the Review Team identified the following benefits of this program:

Harvest Benefits

- Harvest benefits are minimal outside the Columbia River Basin. Less than 1% of total harvest occurs in ocean fisheries.
- Carson NFH spring Chinook were the principal source of the current broodstock at Leavenworth and Little White Salmon NFH, and previously at Winthrop and Entiat NFHs.

Conservation Benefits

- Carson NFH spring Chinook have been an important source of fish for reintroduction programs in the Umatilla and Walla Walla rivers. One long-term goal of these reintroduction programs is to provide harvest benefits to the Umatilla Tribe.

³⁴ For example: Hard et al. 2006. Genetic effects of ELISA-based segregation for control of bacterial kidney disease in Chinook salmon (*Oncorhynchus tshawytscha*). *Canadian Journal of Fisheries and Aquatic Sciences* 63: 2793-2808 (and references therein).

³⁵ See the "Components of This Report" section for a summary description of potential benefits and risks considered by the Review Team.

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Research, Education, Outreach and Cultural Benefits

- Hatchery staff provides educational opportunities offsite to other communities, including the Wenatchee Salmon Festival at Leavenworth NFH.

RISKS POSED TO THE PROPAGATED STOCK AND LOCAL COMMUNITY

In the context of all possible genetic, demographic, ecological and other risks that a hatchery program can pose to the propagated stock,³⁶ the Review Team identified the following risks of the hatchery program:

Genetic Risks

- No genetic risks identified.

Demographic Risks

- Potential failure of the water screen mechanism and lack of a back-up generator poses a demographic risk to fish on station.
- Predation losses pose a demographic risk to fish in uncovered and unprotected ponds and raceways.
- Lack of shade covers over some of the raceways concentrates fish in shaded areas along raceway walls during summer months, increasing densities, potential stress, and disease risks.

Ecological Risks

- Low ecological risk from antibiotic resistance in bacterial flora from erythromycin injections of adults held for broodstock.
- Brook trout population in Tyee Creek could pose a disease risk that needs to be monitored and controlled. Brook trout are monitored for disease on an annual basis. BKD has been identified but not at levels high enough to be of concern.
- Natural spawning of spring Chinook in the Wind River poses a disease risk to fish on station if Wind River water is used for culture at the time fish or carcasses are in the river.

Research, Education, Outreach and Cultural Risks

- None identified.

RISKS POSED TO OTHER STOCKS, SPECIES, AND COMMUNITIES

In the context of all possible genetic, demographic, ecological, and other risks that a hatchery program can pose to other stocks and species in a watershed,³⁷ the Review Team identified the following risks from the hatchery program:

³⁶ *Ibid.*

³⁷ *Ibid.*

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Genetic Risks

- Straying of fish from Carson NFH has not been identified as significant nor a risk, but deliberate transfers of Carson NFH spring Chinook (e.g., to Walla Walla River) poses some genetic risk to populations in non-target watersheds (e.g. Tucannon River) due to straying. Additionally, transferring and releasing fish outside the Wind River to upriver locations in the Columbia and Snake rivers increases the potential for straying, although past transfers from Carson and Little White NFHs to the Umatilla River has achieved high homing fidelity and negligible straying. However, Umatilla hatchery-origin spring Chinook (Carson NFH stock derivative) released into the Umatilla River have, in the past, strayed as returning adults into the Tucannon River.

Demographic Risks

- Since construction of the hatchery, Tyee Creek has been blocked from access by migratory fish within the Wind River Basin.
- Potential use of Wind River water would pose demographic risks to other fish species via entrainment and lack of screening that complies with NOAA Fisheries requirements.
- Fisheries targeting spring Chinook in the Wind River incidentally encounter ESA-listed steelhead, but the incidental mortality and harvest rate on listed steelhead is unknown, thus posing unquantified demographic risks.

Ecological Risks

- Straying of spring Chinook from Carson NFH has not been identified as significant or a risk, but deliberate transfers of Carson NFH spring Chinook to other watersheds (e.g. Walla Walla River) poses some ecological risk to native fish populations in those recipient watersheds.
- Introduced spring Chinook poses ecological risks to native steelhead in the Wind River. Current size distribution data indicates that direct competition between spring Chinook and summer steelhead may be restricted to late summer months. In late summer, after steelhead have emerged and grown, significant size range overlap occurs between young-of-the year steelhead and age 0+ Chinook representing the progeny of hatchery-origin spring Chinook that successfully spawn in the wild.
- The hatchery poses disease risks to native species in the Wind River, although results to date from the National Wild Fish Disease Survey (1997-present) have detected no evidence of disease transfer from the Carson NFH to wild fish in the immediate vicinity of the hatchery.
- Natural spawning of spring Chinook in the Wind River poses a disease risk to native fishes in the Wind River, particularly steelhead, which are susceptible to IHN virus. Up to 88% of all hatchery-origin spring Chinook adults returning to the Wind River carry IHN virus.

Research, Education, Outreach and Cultural Risks

- Attraction of large numbers of anglers to the Wind River and limited access leads to refuse in habitat and social conflicts.

Recommendations for Current Program

The Review Team considered all the benefits and risks outlined in the preceding section. The Team concluded that some of the risks outlined in the preceding section were either minor or their probability of occurrence was small and, thus, did not warrant a proposed change or recommendation for the current program. The recommendations outlined below, in addition to potentially increasing benefits towards achieving program goals, address the identified risks or potential problems considered by the Review Team to warrant a potential modification to the current program. Preceding each numbered recommendation is a brief summary of the issue.

Program goals and objectives

Issue CA1: *Present program goals for spring Chinook are not expressed in terms of numeric outcomes that quantify intended benefits or goals. Harvest contributions vary widely in response to post-release survivals, marine conditions, and harvest regimes in the Columbia River. Like most other Mitchell Act funded programs, this hatchery program lacks specific numeric goals for contribution to harvest or other benefits.*

Recommendation CA1: Restate program goals to identify the number of harvestable adult spring Chinook desired from this program in the ocean, lower Columbia River, and Wind River. For example, the current program size and desired post-release survivals lead to a mean harvest goal of 5,700 adult spring Chinook per year. A stated harvest goal of 5,000 spring Chinook per year in the Wind River would be consistent with the size of the current program and expected smolt-to-adult return rates.

Issue CA2: *Excess spring Chinook adults return to the Carson NFH in most years with very large surpluses (>10,000 fish) in some years. Opportunities may exist for increased sport and tribal harvests in high return years. Federal lands along the Wind River may provide the potential for increased access by fishers for harvest. Carson NFH is currently working with the Wind River Watershed Council to improve fishing access (John Hitron, Manager, Carson NFH).*

Recommendation CA2a: The Service, WDFW, and the Wind River Watershed Council should investigate additional or improved fishing access sites to the Wind River.

Recommendation CA2b: Investigate potential for increased tribal terminal fisheries downstream of Carson NFH.

Broodstock Choice and Collection

Issue CA3: *The escapement goal is currently cited as the broodstock retention goal and is not consistent between planning documents (e.g. 1,400, 1,200, 1,000 have been noted) and may exceed the number of adults required for the current program (yield 1.17 million smolts for onsite release and transfer of 250,000 yearlings to the Walla Walla River for reintroduction).*

Recommendation CA3: Clarify the broodstock collection/retention goal so that a single specific number of adult fish is established as the annual broodstock goal for the program.

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Issue CA4: *Adult fish returning to the facility are not automatically enumerated. The adult fish are visually estimated as they enter the facility. The first accurate count occurs when fish are given their first injection of erythromycin. An accurate count of adult fish at the time of entry to the facility would help with ladder operations, broodstock collection, and providing surplus fish to tribes and food banks.*

Recommendation CA4: Install an electronic fish counter between the ladder and the adult holding pond.

Hatchery and Natural Spawning, Adult Returns

Issue CA5: *In the past, the ladder into the facility was closed in some years during adult returns to encourage natural spawning and establishment of a naturalized population of spring Chinook in the Wind River. The deliberate exclusion of returning adults from entering the hatchery increases ecological risks to native fish species in the Wind River. This is a particular concern to native steelhead. Spring Chinook are not native to the Wind River and establishment of naturalized population would pose some ecological risks to other species with few potential benefits that are not already conferred by the existing segregated hatchery program.*

Recommendation CA5a: Leave the ladder open during the entire adult return season (May-August) in all years, and surplus excess adults to tribes and food banks. Adult spring Chinook returning to the Carson NFH should not be excluded from entering the hatchery ladder regardless of their numbers (see also Recommendation CA2).

Recommendation CA5b: Install a one-way weir or trap within the ladder to make sure fish cannot exit. PIT tag data from the 2007 return year indicate that some fish enter the ladder but may not be recovered in the brood ponds.

Recommendation CA5c: Investigate the feasibility and benefit of a temporary weir in the Wind River immediately upstream of the hatchery or hand-seining of adult fish from the river. The benefits and risks (e.g. to steelhead) of a temporary weir would need to be assessed. For example, some type of sorting facility may be required in the ladder to exclude steelhead from entering the adult holding pond. Seining spring Chinook from the Wind River in the vicinity of the hatchery could be established as a multi-day terminal fisheries program with the tribes (See Recommendation CA2b).

Recommendation CA5d: Maintain PIT tag antennas in the hatchery ladder to detect PIT tag returns to the facility as well as updating in-season forecasting of hatchery escapement.

Issue CA6: *Fisheries targeting spring Chinook in the Wind River incidentally encounter ESA-listed steelhead, thus imposing unknown mortality and take on a listed species. WDFW has estimated that the total incidental harvest or exploitation rates on summer and winter steelhead due to recreational fisheries in the Wind River are 3% and 6%, respectively. However, comparable estimates are not immediately available for tribal fisheries in the Wind River.*

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Recommendation CA6: The Service should work with the Yakama Nation to estimate incidental harvest rates and mortality of steelhead in fisheries targeting spring Chinook in the Wind River.

Incubation and Rearing

Issue CA7: *Lack of shade covers for many of the raceways increases crowding of fish, particularly during the summer months, potentially increasing stress and disease risks to spring Chinook juveniles.*

Recommendation CA7: Construct covers over raceways that are currently uncovered.

Issue CA8: *Fencing around raceways and ponds is inadequate for controlling predation from birds (e.g., herons) and small mammals (e.g., otters).*

Recommendation CA8: Install improved fencing and other exclusion methods to reduce predation by birds and mammals.

Issue CA9: *Lack of high water alarms poses flooding and risk of fish loss. Blockage of water flow from the upper to the lower earthen pond can cause flooding and fish loss.*

Recommendation CA9: Install a high water alarm on the upper earthen pond to detect blockage of screening between the two earthen ponds that could cause fish loss in the lower pond with insufficient water flow and flooding in the upper pond.

Release and Outmigration

Issue CA10: *Fish released from earthen ponds are not enumerated prior to release. The last inventory occurs when fish are transferred to earthen ponds from raceways, five to six months prior to release. Actual release numbers are unknown. Losses due to predation in earthen ponds could be significant but are not currently quantified.*

Recommendation CA10: Install a fish counting device at the outlet of the lower earthen pond to quantify total release numbers and the number of fish lost to predation.

Facilities/Operations

Issue CA11: *Carson NFH is under funded for operations, maintenance, and M&E, and has insufficient funding for major maintenance and infrastructure improvements. This is caused by lack of Mitchell Act funding to cover all program and facility costs, thus resulting in increasing gaps between facility needs and fund availability. These gaps are related to both inflation and increased aging of hatchery facilities. Fishery comanagers and partners have developed a Mitchell Act outreach team to address Mitchell Act facility and funding needs.*

Recommendation CA11: The Service should adopt or advocate the funding levels developed by the outreach team, including the development of a major maintenance budget and funding of the infrastructure improvements identified here in this report.

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Issue CA12: *The mechanical cleaning mechanism for the intake water screen is antiquated, requiring frequent maintenance by personnel, particularly during periods of rain and run-off. In addition, mechanical portions of the mechanism are exposed, posing a potential human health and safety risk to hatchery staff working in the area to service the mechanism. Although security fencing and safety rails have been installed, additional modifications may be desired.*

Recommendation CA12: The Service should have appropriate safety and engineering personnel inspect the water intake mechanism to determine if (a) an improved mechanism requiring less human maintenance can be installed and (b) whether a safety problem exists.

Issue CA13: *Carson NFH does not have a back-up generator for the mechanical screen intake and pumps.*

Recommendation CA13: Provide a back-up generator for critical electrical needs and, possibly, residences.

Issue CA14: *Facility and on-site living currently use a UV treatment system for their domestic water supply. The domestic water supply is currently treated prior to entering a storage tank. Stored water can become contaminated based on occasional positive testing for coliform bacteria. Additionally, if a loss of power occurs and the storage water is depleted, no treated water is available.*

Recommendation CA14: The water treatment system for the domestic water supply should be evaluated, and upgrades or alternatives considered.

Issue CA15: *Radon is a potential problem in the hatchery incubation room, and lead paint is present in various rearing areas within the facility. A 1994 radon testing report identified two locations with readings of radon in indoor air in excess of recommended levels (4.0 picoCuries per Liter): (1) residence quarters #1 and the break room in the nursery building recorded 5.3 and 26.7 picoCuries, respectively. Follow up testing in 1996 recorded 7.8 and 14.5 picoCuries, respectively. Correction measures have already been implemented in residence quarters #1, but not in the nursery building.*

Recommendation CA15: Retest radon levels in the nursery building and take corrective action as warranted. Contact the Regional Environmental Coordinator and develop a lead paint survey and corrective action plan to address lead paint issues at the facility.

Issue CA16: *Carson NFH has a water right granted in 1950 for 40 cfs from the Wind River. However, the facility has relied predominantly on Tyee Creek and has rarely used water from the Wind River in recent years. The Wind River is currently considered a secondary or emergency back-up water supply. The intake screen from the Wind River does not comply with NOAA Fisheries ESA criteria.*

Recommendation CA16: Develop a contingency operational plan for using Wind River water and ensure that the intake fish screen complies with NOAA Fisheries' ESA criteria. If Wind River water is no longer needed for fish culture or domestic use at Carson NFH, the Service should pursue options for reserving that water for maintaining instream flows. The Review

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Team considers the water right as a way to preserve instream flows and water quality in the Wind River and recommends that the right be reserved for maintaining instream flows when not needed at Carson NFH. One approach would be for the Service to work with the Washington River Conservancy to craft an agreement that reserves the water right for instream flows and continues the water right for the hatchery when needed intermittently.

Research, Monitoring, and Accountability

Issue CA17: Coded wire tagged fish need to accurately represent all progeny groups released from Carson NFH. *Because populations of fish in different rearing vessels can differ (e.g., mean age and size) and pond environments differ also (e.g., flow and flow pattern), tagging practices need to be reviewed and updated annually based on the populations of fish of each brood year in different raceways and rearing vessels. In most NFH programs, salmon are spawned throughout the adult return to ensure that most segments of the run are represented in the resulting progeny. This procedure usually results in many different spawn “takes” and progeny groups. Accurate estimation of fishery contributions and stray rates requires that fish carrying CWTs represent the entire brood year statistically (e.g., stratified sampling and tagging of fish from each spawn group).*

Recommendation CA17: Consult with the Columbia River Fisheries Program Office annually after spawning is complete and prior to tagging to discuss tagging strategies that accurately represent the entire brood year of progeny from all spawn groups. The progeny of all spawn groups should be represented proportionately among tag groups and raceways.

Issue CA18: There is no in-basin monitoring of PIT tag returns to the Wind River. *Adult returns are monitored at Bonneville Dam and at the hatchery, but no in-stream monitoring occurs. In-stream monitoring would help with in-season harvest management on the Wind River.*

Recommendation CA18: Install a PIT tag detector in the fishway at Shipherd Falls to detect returning spring Chinook adults and wild steelhead carrying PIT tags associated with ongoing research studies.

Issue CA19: The Service currently electrofishes and removes brook trout in Tyee Creek on an annual basis to minimize the size of the introduced population. *In the past, reducing the abundance of brook trout was considered a way to control disease risks and reduce the potential for brook trout entering Carson NFH via the water intake. However, fish health believes the disease risk is minimal, and an upgraded screen was installed in 2007 that prevents brook trout from entering the facility.*

Recommendation CA19: Develop an annual monitoring and removal plan for brook trout, including collection of samples for fish health that accounts for the current level of concern regarding the disease risk from the brook trout population and the physical risk they may pose after installation of an upgraded intake screen. [Note: This recommendation is now being implemented as part of the recently completed internal ESA Section 7 consultation assessing spring Chinook transfers and effects on bull trout in the Walla Walla River.]

Issue CA20: Current studies by USGS to understand ecological interactions between introduced spring Chinook and native steelhead in the Wind River have been ongoing for only a short

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period of time (less than one salmon generation). Additional years of data are needed to fully understand those ecological interactions.

Recommendation CA20: The Service should support continued interaction studies to assess the effects of Carson NFH spring Chinook on natural populations of steelhead in the Wind River.

Issue CA21: *The “visioned” function, purpose, and membership of Hatchery Evaluation Teams (HET) - as originally described during the “Fisheries: A Future Legacy”(USFWS, 1991) planning process - have been inconsistently applied regarding hatchery evaluations and fish production modifications. Meetings and communications between Service offices regarding Carson NFH fish programs and evaluations are infrequent. The Review Team believes that regular and recurring meetings and communications should occur with both internal and internal/external partner meetings. The Review Team recommendations below are based on the 1993 USFWS “Hatchery Evaluation Action Plan” with modifications by the Review Team.*

Recommendation CA21: Establish an internal hatchery evaluation team (HET) consisting of staff from the hatchery, the Lower Columbia River Fish Health Center (Willard, WA), the Columbia River Fisheries Program Office (Vancouver, WA), and the Abernathy Fish Technology Center (Longview, WA). This internal HET should meet twice annually to coordinate planning and activities (a) after smolts are released in the spring and (b) after adults return in the fall. These internal HET meetings should discuss results of on-going evaluations, tagging/marketing protocols and plans, adult and juvenile sampling for data collection, data management and reporting, fish program modifications, fish ponding densities and protocols, number of adult fish to be spawned, number of juvenile fish to be raised and released, disposition of excess juvenile fish on station, fish health and related issues (e.g., nutrition, physiology, genetics), and implementation of Hatchery Review Team recommendations. The HET can meet more often as necessary to discuss specific fish program or evaluation issues. The HET should record meeting minutes and distribute them to the HET and the appropriate line manager in the Regional Office. In addition, the HET should meet annually with comanaging partners and interested parties to share the results of ongoing evaluations and receive comments and suggestions regarding proposed future activities.

Education and Outreach

Issue CA22: *The facility has limited infrastructure to accommodate the public and the number of people that visit the facility. Given its location along a scenic byway, improved outreach facilities could be very beneficial for public education and conveying the mission of the Carson NFH and fisheries program.*

Recommendation CA22: The Team recommends that facilities be improved to expand visitation and education/outreach opportunities.

Alternatives to Current Program

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The Review Team considered the benefits and risks of the existing spring Chinook program at the Carson NFH and developed seven possible alternatives designed to reduce risks and/or increase benefits. The first alternative is the current program with all previously-described recommendations adopted. The last alternative is the “no hatchery” option. Following these descriptions of alternatives, the Review Team has identified a recommended alternative (or alternatives).

Alternative 1: Current program with recommendations

Pros

- Provides significant sport and tribal harvest benefits within the Columbia and Wind rivers. Spring Chinook are a highly valuable recreational and commercial species, particularly among sport fishers.
- Surplus adult fish contribute to tribal subsistence and ceremonial purposes.
- Composite genetic stock successfully used for reintroductions in the mid-Columbia region. Broodstock source for reintroductions in the Umatilla and Walla Walla rivers.
- Successfully used to establish segregated hatchery programs in support of valuable fisheries in the mid-Columbia region (e.g., Leavenworth NFH).
- Carson NFH spring Chinook have a high homing fidelity back to the Wind River from on-station releases
- Results of ecological interaction studies with steelhead suggest little negative impact to natural populations of steelhead in the Wind River. Although some spring Chinook spawn in the Wind River, no naturalized population has been established.

Cons

- Spring Chinook are not native to the Wind River above Shipherd Falls.
- Risk of disease transfer from spring Chinook to the natural steelhead population and other species in the Wind River basin.
- Transfers of Carson NFH spring Chinook to other watersheds poses some genetic and ecological risks to natural populations due to potential straying to non-target watersheds.
- Presence of brook trout in Tyee Creek water poses some ecological risk to fish stocks in other watersheds when Carson NFH spring Chinook are transferred to other facilities. However, with the screen replacement on the water intake in 2007, this risk has been reduced substantially. A biological opinion examining the effects of transfers from Carson NFH to bull trout in other watersheds was completed in the summer of 2007.

Alternative 2: Expand the facility or reduce the size of the current spring Chinook program and develop an integrated harvest summer steelhead program

Expand the facility or reduce the existing spring Chinook program and develop an integrated harvest summer steelhead program (proposed size to be determined by comanagers) derived from ESA-listed, natural-origin summer steelhead trapped at Shipherd Falls or upstream of the falls. The sport fishery would be expected to occur primarily in the area above Shipherd Falls.

Pros

- Provides additional sport fishing opportunity for steelhead on the Wind River.
- Serves as a genetic repository for the ESA-listed Wind River summer steelhead population.

Cons

- May reduce a high-valued sport and tribal fishery for spring Chinook in the Wind River.
- Fewer surplus spring Chinook adults may be available for tribal subsistence and ceremonial purposes.
- The presence of a steelhead hatchery program in the Wind River would be expected to reduce the individual productivity of natural-origin steelhead in the Wind River due to competition and potential natural spawning of hatchery-origin fish, although the total population abundance of steelhead (hatchery + wild) would be expected to increase.
- A hatchery program for steelhead in the Wind River would be inconsistent with WDFW's current management strategy for the Wind River.
- Inclusion of wild steelhead in a genetically integrated broodstock would reduce the number of natural-origin steelhead spawning naturally in the Wind River (broodstock mining risk).
- Increased disease risk to the hatchery populations if Wind River water is used for rearing steelhead.
- If Wind River water is used, it may reduce homing fidelity of hatchery-origin fish back into the facility, thus increasing straying risks to natural populations.
- Attempts to control or exclude hatchery-origin steelhead upstream of Shipherd Falls would reduce the number of hatchery-origin steelhead available for harvest in the Wind River.

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Alternative 3: Expand the facility or reduce the size of the current spring Chinook program and develop an integrated conservation winter steelhead program

Expand the facility or reduce the existing spring Chinook program and implement an integrated conservation winter steelhead program (proposed size to be determined by comanagers) derived from ESA-listed, natural-origin winter steelhead trapped at Shipherd Falls.

Pros

- Increases a listed winter steelhead spawning population in the Wind River.
- Serves as a genetic repository for the ESA-listed upper Columbia River Gorge winter steelhead population.

Cons

- Same as the cons for Alternative 2 except the broodstock mining risk would be to the natural winter steelhead population in the Wind River.
- Low abundance of winter steelhead may require a captive broodstock program to begin a hatchery program.
- Rearing winter steelhead at Carson NFH above Shipherd Falls may change the distribution of winter steelhead, which was historically restricted to downstream of Shipherd Falls.

Alternative 4: Expand the facility or reduce the current spring Chinook program and implement the F2 component of the White River (Wenatchee) spring Chinook program

The Service has recently accepted responsibility for rearing F2 hatchery-produced progeny from F1 captively-reared spring Chinook parents obtained as eyed eggs from the endangered White River population, Wenatchee River drainage. That F2 rearing program is currently conducted at Little White Salmon National Fish Hatchery. This alternative would rear 150,000 F2 White River Spring Chinook received as eyed eggs from the F1 captive broodstock and is coupled to alternatives at Little White and Willard NFHs. The Service is also considering responsibility for the F1 captive rearing and breeding portion of the program at LWS/Willard Complex.

Pros

- Supports recovery of an ESA-listed, “endangered” population. This population has been identified with distinct biological attributes (e.g., the population spawns in a tributary to a lake).
- Considered a biologically significant stock in the mid-Columbia river region.
- White River spring Chinook program has strong co-manager support.

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- Reduces the risk of catastrophic loss by separating captively-bred F1 broodstock and their F2 generation progeny.

Cons

- May reduce a high valued sport and tribal fishery for spring Chinook in the Wind River.
- Fewer surplus spring Chinook adults may be available for tribal subsistence and ceremonial purposes.
- Increases disease risk and the potential for increased drug use at Carson NFH if medicated feeds are necessary to prevent bacterial kidney disease outbreaks among White River spring Chinook.
- Requires extensive rearing space for the relatively small size of the program.
- Does not provide direct mitigation for Bonneville Dam as prescribed in the Mitchell Act.
- Presence of brook trout in Tyee Creek may increase risks to White River spring Chinook and other fish stocks, both at Carson NFH and after transfer to other watersheds. However, recent installation of a new water intake screen at Carson NFH during the summer of 2007 has reduced these risks significantly.
- Requires significant infrastructural changes to Carson NFH (e.g. effluent treatment).

Alternative 5: Hatchery production for restoration of naturally spawning populations in the Big White Salmon River (emphasis on spring Chinook), depending on availability of space (could be combined with other alternatives)

Adjust the size of the current spring Chinook program and use a portion of the Carson NFH to rear fish for reintroduction of native species into the Big White Salmon River after removal of Condit Dam. This could include spring Chinook, tule fall Chinook, coho salmon, chum salmon, bull trout and steelhead, although spring Chinook is the only species demonstrated to be successful at Carson NFH. This would include potential rehabilitation of the Big White Ponds on the White Salmon River and reconstruction of a conservation weir for broodstock collection and management of naturally spawning populations in the Big White Salmon River (see Spring Creek NFH tule fall Chinook current program recommendations).

Carson NFH may be especially suited for rearing spring Chinook for reintroduction into the Big White Salmon River³⁸. Due to its close geographic proximity, spring Chinook from the Klickitat River have been chosen by WDFW as the stock of choice for reintroduction of spring Chinook into the Big White Salmon River, contingent upon infrastructure improvements for trapping and rearing spring Chinook for the Yakama Nation's Klickitat Hatchery program. The reintroduction program for the Big White Salmon River would likely be a small program (< 250,000 fish release).

³⁸ Little White Salmon NFH is another facility that could rear spring Chinook for reintroduction into the Big White Salmon River (see Alternatives under Little White Salmon NFH spring Chinook). Facility and regional priorities will largely determine the specific facility (or facilities) where fish will be raised for reintroduction into the Big White Salmon River.

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Pros

- Documented success of raising Spring Chinook salmon at Carson NFH.
- Would have a minimal effect on facility rearing space and could be combined with other alternatives.
- The number of facilities with a diverse array of rearing environments in relative close proximity to the Big White Salmon River makes Carson NFH, Little White Salmon NFH, Willard NFH and Spring Creek NFH attractive sites for rearing fish for reintroduction.
- The removal of Condit Dam offers a unique opportunity in the Columbia River Basin to test a large-scale reintroduction project of an entire river system.
- Offers the opportunity to initiate populations in the Big White Salmon River that were depleted by the construction of Condit Dam and, later, Bonneville Dam.
- Reduces the risk of straying to the Big White Salmon River that the currently reared out-of-basin populations have.

Cons

- Reduces the amount of rearing space available for the current production of fish for Columbia River and Wind River harvest, including valuable sport and tribal fisheries.
- May increase the risk of disease transfer within the hatchery.

Alternative 6: Terminate the existing program and decommission the facility

Pros

- Removes an out-of-basin species, not native to the Wind River above Shipherd Falls.
- Eliminates the risk of disease transfer from spring Chinook to natural steelhead populations and other species within the Wind River basin.
- Potentially opens up Tyee Creek for steelhead rearing habitat.

Cons

- Eliminates a high valued sport and tribal fishery for spring Chinook in the Wind River.
- Surplus spring Chinook adults would not be available for tribal subsistence and ceremonial purposes.
- Terminates an important hatchery population that has been used successfully for reintroduction of spring Chinook into the Umatilla River and Walla Walla River, and used also to establish valuable hatchery-supported harvest programs in the mid-Columbia region (e.g., Leavenworth NFH).

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- Reduces the Service's outreach capabilities for the Gorge region.
- Brook trout in Tyee Creek would have access to the Wind River.

Recommended Alternatives

Short-term Goal (up to 15 years): Implement Alternative 1 but at reduced release levels to allow the implementation of Alternative 5 as desired by comanagers. Implementation of Alternative 5 would be contingent on similar decisions at Little White Salmon NFH and the potential use of this latter facility to assist with reintroduction of spring Chinook in the Big White Salmon River (Service and comanager decisions). If Alternative 5 is implemented, then the current spring Chinook program at Carson NFH would be retained, with implementation of all recommendations (Alternative 1), but with a reduction of on-station rearing of up to 250,000 fish to accommodate the rearing of another stock of spring Chinook (e.g., Klickitat River spring Chinook) for restoration of a naturally spawning population in the Big White Salmon River. This reintroduction program would most likely be limited to three salmon generations (i.e., up to 15 years). In addition, the Review Team supports the spring Chinook reintroduction program in the Walla Walla River and assumes that Carson NFH will resume this latter responsibility of rearing and delivery of approximately 250,000 yearlings for that program. Implementation of both reintroduction programs (Walla Walla and Big White Salmon rivers) at full capacity (250,000 juveniles each) would result in a temporary reduction of on-station releases to approximately 900,000 smolts to retain current rearing densities and a maximum of 1.4 million smolts or pre-smolts reared on-station, as dictated by the results of fish density studies and corresponding adult returns.

Long-term Goal (15+ years): Resume current program (Alternative 1) of a 1.17 million smolt release into the Wind River, to a potential maximum of 1.4 million, contingent upon the successes of the spring Chinook reintroduction efforts in the Big White Salmon River (potentially the Klickitat stock), reintroduction efforts elsewhere (e.g., Walla Walla River), and potential program changes at Little White Salmon, Willard, and Spring Creek NFHs (see following sections for review of those programs).

V. Big White Salmon River Watershed

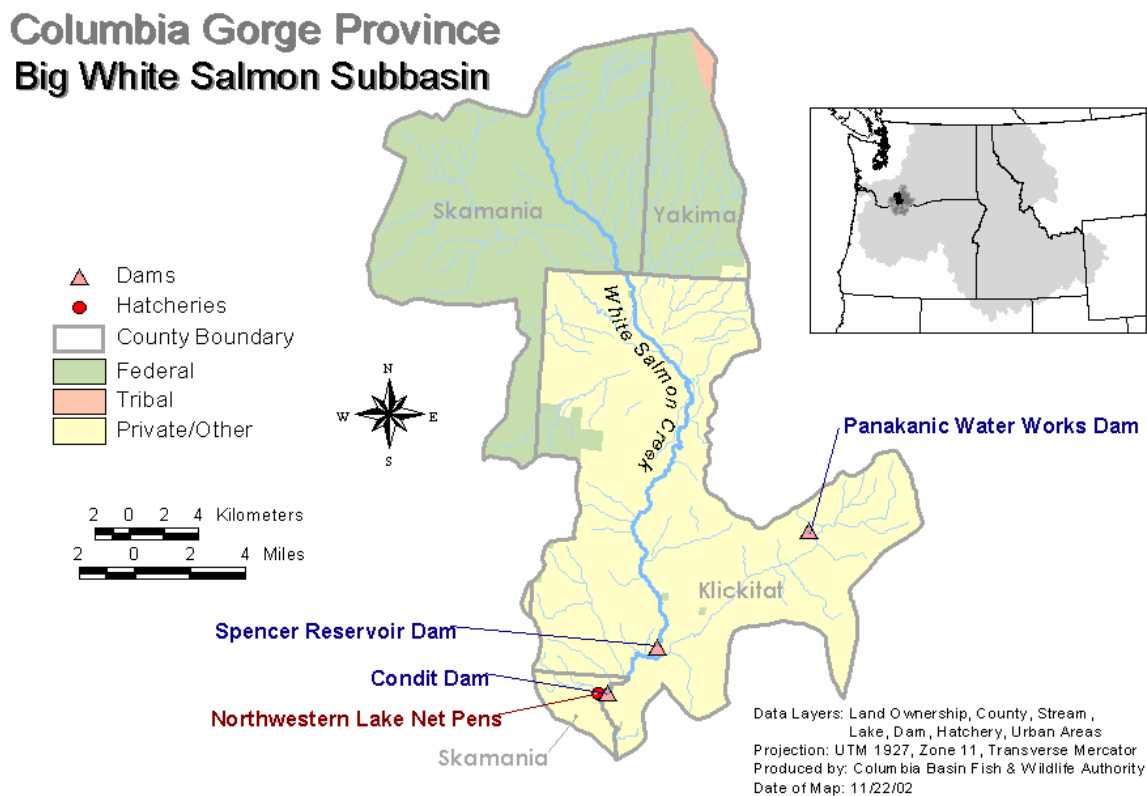


Figure 4. Big White Salmon River Watershed³⁹

³⁹ APRE Columbia Gorge Province Report - <http://www.nwcouncil.org/fw/apre/provincereports/Columbia%20Gorge%20Province%20Report.doc>

Big White Salmon River Overview⁴⁰

Watershed Description

The Big White Salmon River (aka White Salmon River) originates in the Gifford Pinchot National Forest in south central Washington along the south slope of Mount Adams in Skamania and Yakima counties. It flows south for 45 miles before entering the Bonneville Pool in Underwood, Washington at Columbia River Mile (RM) 167. The Big White Salmon River drains approximately 386 square miles (250,459 acres) of Skamania, Yakima, and Klickitat counties. Principal tributaries include Trout Lake, Buck, Mill, Dry, Gilmer, and Rattlesnake Creeks. Basin elevations range from 80 to 7,500 feet above sea level. Topography varies within the watershed from rugged mountains to rolling hills to river valleys. Consolidated sediments are overlain with basaltic lava flows. Subsequent erosion, mud flows, and glaciation have resulted in precipitous cliffs, deeply incised canyons, and relatively flat valley floors.

The mainstem of the Big White Salmon River has an average gradient of 3.2% over its length of 45 miles. Anadromous fish passage is currently blocked at RM 3.1 by Condit Dam, construction of which was completed in 1913. A 20-foot falls (Big and Little Brother Falls) at RM 16 was likely a barrier historically to upstream migration by most anadromous fish; however, some historical evidence also exists of anadromous fish reaching the Trout Lake Valley upstream of the falls. Stream flows fluctuate from low flows in summer to peak flows in winter. Some streams only flow during high flow events and are dry the remainder of the year (ephemeral streams). Mean flows in the mainstem river increase from an average minimum flow of 644 cubic feet per second (cfs) in the early fall to 1,538 cfs in the spring. The largest stream flows typically occur in response to rain-on-snow events, when heavy rains combine with high air temperatures and high winds to cause widespread snowmelt. Low flows are maintained on the mainstem by late season snowmelt and areas of water retention or recharge.

Fisheries

Fisheries on salmon and steelhead are restricted to the lower three miles of the Big White Salmon River downstream from Condit Dam. Sizes of historical spawning populations of salmon and steelhead prior to the construction of Condit Dam are not well documented.

The lower mile of the Big White Salmon River supports a significant steelhead fishery. Skamania stock summer steelhead and winter steelhead have been released into the Big White Salmon River watershed to mitigate for the losses of anadromous fish caused by Condit Dam and to provide local recreational and tribal fishing opportunities. All hatchery steelhead are adipose fin clipped, and the river has been managed under catch-and-release sport fishing regulations for wild steelhead since 1986. In addition, as summer steelhead migrate up the Columbia River, they seek refuge in the cooler waters of the lower Big White Salmon River before continuing their upstream migration. Terminal fisheries on summer steelhead in the Big White Salmon River can also impact other stocks further upstream within the Columbia River basin.

⁴⁰ From: *White Salmon Subbasin Plan*, May 28, 2004. Prepared for The Northwest Power and Conservation Council. Available at: <http://www.nwcouncil.org/fw/subbasinplanning/bigwhitesalmon/plan/>.

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Conservation

Natural populations of salmon and steelhead in the Big White Salmon River have been severely impacted by hydropower development. The closure of Condit Dam in 1913 at RM 3.4 blocked all upstream migration of salmon and steelhead, resulting in extirpation of all anadromous populations upstream of the dam. Resident populations of rainbow trout and cutthroat trout persisted upstream of the dam and are present currently as self-sustaining natural populations. Construction of Bonneville Dam in 1938 flooded natural spawning habitat for fall Chinook and chum salmon in the lower reaches of the Big White Salmon River at its confluence with the Columbia River.

ESA listed bull trout are found seasonally downstream of Condit Dam but may be extinct upstream of the dam. The last two observations of bull trout upstream of the dam were in 1986 and 1989. During recent surveys in 2000 and 2007, no bull trout were found upstream of the dam. River miles 0 to 16 have been designated as *critical habitat* for bull trout, and restoring the White Salmon River population has been considered essential to recovery of the species in the Gorge region.

The owner and operator of Condit Dam, PacifiCorp, is scheduled to begin removing Condit Dam in October, 2008 in lieu of maintaining the dam and providing fish passage. Removal of Condit Dam will potentially provide access to fall Chinook of approximately 8 river miles to Husum Falls, as well as open 13 miles for spring Chinook, 21 miles for coho, and 33 miles for steelhead natural reproduction and juvenile rearing.

Habitat

The Big White Salmon River supports only 1.2 miles of anadromous spawning and rearing habitat downstream from the Condit Dam powerhouse and another 1.8 miles between the powerhouse and the dam. This distance compares to approximately 40 miles of potential anadromous fish habitat upstream of the dam.

In 1992-93, the U.S. Forest Service (USFS) and Underwood Conservation District (UCD) jointly surveyed fish habitat and associated riparian vegetation along 86 miles of private and state managed stream corridor within the Big White Salmon River. The survey covered the main branches of the lower and upper Big White Salmon River, Trout Lake Creek, Gilmer Creek, Rattlesnake Creek, Buck Creek, Indian Creek, Mill Creek and Spring Creek. The surveys mapped and described various features related to water quality, vegetation, streambed structure, bank stability, water withdrawals, erosion, grazing, culverts, and other land-use and natural features.

The USFS manages 50% of the land within the Big White Salmon River subbasin. The President's Forest Plan (ROD) categorizes the basin as a Tier 2 Key Watershed.

Federal land management decisions in the watershed will significantly influence the quality of habitat in the Big White Salmon River subbasin. Currently, national forest habitat is considered fair to excellent depending on the location. Habitat in the lower mainstem and tributaries (state and private ownership) is judged to be poor to excellent. Most habitat in the subbasin is degraded compared to historic conditions. Habitat problems noted by the USFS (and others) are mainly related to timber harvesting practices, roads, agriculture, water withdrawals, and rural development. This is evidenced by increased peak water flows, increased sedimentation, lack of large woody debris, increased width-to-depth stream ratios, lack of riparian vegetation, and increased water temperature (Champion Pacific

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Timberlands 1997, USFS 1995, 1997, and 1998⁴¹). Habitat improvements for salmon and steelhead upstream of Condit Dam will need to restore riparian conifer vegetation, reduce sediment delivery to streams, slow runoff rates, increase water storage capacity of the watershed, reduce stream energies during high flows, eliminate barriers, enhance channel complexity, and ensure adequate recruitment of large woody debris into the system to provide additional rearing habitat for juvenile salmon.

Current Status of Salmonid Stocks

The co-managers have identified 14 principal salmonid stocks in the Big White Salmon River watershed, one of which (spring Chinook salmon) is considered extirpated, two additional stocks may also be extirpated (coho salmon and bull trout), and another two stocks are severely depressed (steelhead and chum salmon).

- Spring Creek NFH tule fall Chinook salmon (segregated hatchery)
- Tule fall Chinook salmon (natural)
- Upriver bright fall Chinook (non-native hatchery strays)
- Spring Chinook salmon (natural, extirpated)
- Chum salmon (natural, extirpated)
- Coho salmon (natural, extirpated)
- Summer steelhead (natural, extirpated)
- Skamania strain hatchery summer steelhead (segregated hatchery)⁴²
- Winter steelhead (natural, extirpated?)
- Chambers Creek/Beaver Creek strain hatchery winter steelhead (segregated hatchery)⁴³
- Rainbow trout (natural, upstream of Condit Dam)
- Cutthroat trout (natural, upstream of Condit Dam)
- Bull trout (extirpated?)
- Brook trout (non-native; naturalized population upstream of Condit Dam)

The following tables summarize the current status and management premises of those stocks, as identified by the co-managers. Habitat assessments were obtained from: *Northwest Power and Conservation Council. 2004. White Salmon River Subbasin Plan* (available at: www.nwcouncil.org/fw/subbasinplanning). Population viability assessments were obtained from: *Lower Columbia Technical Recovery Team, July 2004 report. Status evaluation of salmon and steelhead populations in the Willamette and Lower Columbia River Basins* (available at: www.nwr.noaa.gov/salmon-recovery-planning).

⁴¹ For cited references, see: <http://www.nwcouncil.org/fw/subbasinplanning/bigwhitesalmon/plan/>.

⁴² These fish represent smolt outplants (n=20,000 annually) from the Washougal Hatchery (WDFW) and returning hatchery-origin adults. No fish are recaptured for broodstock in the Big White Salmon River.

⁴³ *Ibid.*

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Table 9. Columbia River Gorge hatchery tule fall Chinook (Spring Creek NFH)

Management Premises and Goals	
<i>ESA Status</i>	<i>Threatened.</i> NOAA Fisheries includes the Spring Creek NFH population of fall Chinook with the <i>Lower Columbia River Chinook Salmon ESU</i> .
<i>Biological Significance</i>	<i>Medium to High.</i> Tule fall Chinook propagated at Spring Creek NFH were ancestrally derived from Chinook salmon native to the Big White Salmon River, a population largely extirpated by the flooding of spawning habitat by the Bonneville Dam pool and the construction of Condit Dam. Spring Creek NFH fall Chinook have been included in diversity evaluations as the potential source for re-establishing a self-sustaining natural population in the Big White Salmon River after removal of Condit Dam.
<i>Population Viability</i>	<i>High.</i> This hatchery propagated stock has achieved a 10-year average of eight recruits per spawner (R/S) for brood years 1990-99.
<i>Habitat</i>	<i>Low.</i> Spawning habitat for fall Chinook in the Columbia River Gorge region is very limited because of the flooding of that habitat by the pool behind Bonneville Dam.
<i>Harvest</i>	<i>High.</i> Averages of 18,994 and 18,098 fish were harvested in the Columbia River and ocean, respectively, for brood years 1990-99 (10-year average). On average, approximately two fish are harvested for every fish returning to the hatchery.
Hatchery Program	
<i>Facilities</i>	Spring Creek NFH.
<i>Type</i>	Segregated.
<i>Authorization and Funding</i>	Mitchell Act and John Day Dam Mitigation.
<i>Primary Purpose</i>	Harvest.
<i>Secondary Purposes</i>	Conservation. The Spring Creek NFH population represents the genetic legacy of native fall Chinook in the Bonneville pool region and is a potential source for re-establishing native runs.
<i>Broodstock Origin(s)</i>	Wild fish from Big White Salmon River.

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Table 10. Big White Salmon River tule fall Chinook

Management Premises and Goals	
<i>ESA Status</i>	<i>Threatened.</i> Included with the <i>Lower Columbia River Chinook Salmon ESU.</i>
<i>Biological Significance</i>	<i>Medium.</i> The Big White Salmon River population of fall Chinook is included in the Gorge Tributaries Fall Run strata, which also includes the lower and upper Columbia River Gorge and Hood River populations (TRT 2006). Few wholly intact spawning areas remain for Columbia River Gorge populations of fall Chinook, which increases the biological significance of a natural population in the Big White Salmon River. However, this population is also heavily influenced by spawning of stray hatchery fish from Spring Creek NFH (tule fall Chinook), Bonneville Hatchery (“upriver bright” fall Chinook) and Little White Salmon NFH (upriver bright fall Chinook). Upriver bright (URB) fall Chinook salmon represent an introduced stock native to regions of the Columbia River upstream of The Dalles Dam and, to a greater extent, McNary Dam. However, recent genetic data indicate that little direct interbreeding between native tule fall Chinook and non-native URB fall Chinook is occurring in the Big White Salmon River based on DNA profiles of outmigrating smolts; these smolts constitute two distinct groups similar genetically to lower (tules) and middle (URBs) Columbia River populations, respectively. Upriver bright fall Chinook salmon enter the Big White Salmon River and spawn after most tule fall Chinook have spawned.
<i>Population Viability</i>	<i>Low.</i> TRT viability scores ranged from 0.6 to 1.4, with a weighted average score of 0.86 (high risk of extinction). Completion of Bonneville Dam inundated the primary habitat in the lower river. Natural production is likely composed of hatchery strays. Abundance surveys since 1964 indicate a significant population decline. Estimated escapement of wild fish has averaged 319 for 1992-2003 (Big White Salmon River Subbasin Plan 2004).
<i>Habitat</i>	<i>Low.</i> TRT habitat score ranged from 0.2 to 1.2. Habitat impacted by Condit and Bonneville dams. The historic distribution of fall Chinook salmon is believed to have extended to Husum Falls, located at River Mile 8. The Big White Salmon River currently has an estimated capacity to support a maximum of 1,170 natural-origin fall Chinook adult recruits with a mean abundance of 982 adults per year. The estimated capacity and mean abundance of fall Chinook are estimated to increase to 1,210 and 995 adults per year following removal of Condit Dam and restoration of <i>properly functioning conditions</i> (PFC).
<i>Harvest</i>	<i>Moderately High.</i> Harvested at similar rate as tule fall Chinook salmon from Spring Creek NFH.

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Table 11. Big White Salmon River spring Chinook

Management Premises and Goals	
<i>ESA Status</i>	<i>Extirpated.</i> Construction of Condit Dam in the early 1900's blocked all upstream migration of native spring Chinook from their natural spawning areas after failure of the Condit Dam fish ladder.
<i>Biological Significance</i>	<i>Not applicable.</i> The TRT consensus was that extirpation of this population eliminated all its genetic resources (TRT 2004). Klickitat spring Chinook salmon are being considered as potential source for restoring a spring Chinook population after Condit Dam is removed.
<i>Population Viability</i>	<i>Extirpated.</i>
<i>Habitat</i>	<i>Medium to High.</i> The TRT currently assigns a habitat score of 0 for spring Chinook in the Big White Salmon River because habitat access is blocked by Condit Dam. However, the estimated maxima for productivity and capacity of the Big White Salmon River for spring Chinook are 5.1 recruits per spawner (R/S) and 1,013 adult recruits, respectively, with an estimated mean abundance of 814 adults per year, parameters than can be restored after the planned removal of Condit Dam (Big White Salmon River Subbasin Plan 2004).
<i>Harvest</i>	<i>Not applicable.</i>

Table 12. Big White Salmon River coho

Management Premises and Goals	
<i>ESA Status</i>	<i>Threatened.</i> Included with the <i>Lower Columbia River Coho Salmon ESU</i> .
<i>Biological Significance</i>	<i>Low.</i> Hatchery introductions, the near absence of accessible spawning habitat below Condit Dam, and the low probability of successful natural reproduction suggest that much of the genetic diversity native to the Big White Salmon River is extirpated (TRT 2004). Removal of Condit Dam provides an opportunity for re-colonization into historic habitat.
<i>Population Viability</i>	<i>Functionally extirpated.</i> Big White Salmon River population may be extirpated because of the blockage caused by Condit Dam (TRT 2004). A small spawning population of coho persists in the Big White Salmon River below Condit Dam. However, hatchery-origin coho are, most likely, the primary source of natural reproduction.
<i>Habitat</i>	<i>Very Low.</i> Much of the habitat for coho salmon was blocked (or eliminated) by Condit Dam (RM 3.4). The historical distribution of coho extended to RM 14 and included Buck, Spring, Indian, and Rattlesnake creeks, a total of 21.1 stream miles). Current habitat below the dam has an estimated capacity to support a maximum of 643 adult recruits with a mean abundance of 470 adults per year. After the planned removal of Condit Dam, the habitat will have an estimated capacity to support a maximum of 1,828 adult recruits with a mean abundance of 1,227 adults per year (Big White Salmon River Subbasin Plan 2004).
<i>Harvest</i>	<i>Medium</i> (High historically). Adult fish resulting from natural reproduction are, most likely, intercepted in marine and lower Columbia River fisheries at rates comparable to other lower Columbia River coho stocks.

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Table 13. Big White Salmon River chum

Management Premises and Goals	
<i>ESA Status</i>	<i>Threatened.</i> Included with the <i>Columbia River Chum Salmon ESU</i> .
<i>Biological Significance</i>	<i>Not applicable.</i> . There are no known natural spawning aggregations of chum salmon upstream of Bonneville Dam (TRT 2004). The pool behind Bonneville Dam eliminated most of the spawning habitat for chum salmon in the Big White Salmon River.
<i>Population Viability</i>	<i>Very low or extirpated.</i> . The TRT provided a weighted average viability score of 0.18 (very high risk of extinction or functionally extinct) for upper Columbia Gorge populations of chum salmon in Washington. However, no self-sustaining natural populations of chum salmon are present upstream of Bonneville Dam.
<i>Habitat</i>	<i>Very Low.</i> The principal spawning habitat historically for chum salmon in the Big White Salmon River is currently flooded by the pool behind Bonneville Dam.
<i>Harvest</i>	<i>Not applicable.</i>

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Table 14. Big White Salmon River steelhead (winter and summer combined)

Management Premises and Goals	
<i>ESA Status</i>	<i>Threatened.</i> Natural-origin steelhead in the Big White Salmon River are included in the <i>Middle Columbia River Steelhead DPS</i> . Hatchery-origin steelhead, representing outplants and strays, are excluded.
<i>Biological Significance</i>	<i>Very Low.</i> Natural populations of summer steelhead native to Big White Salmon River would have been extirpated in the early 1900's by the upstream blockage caused by Condit Dam (but see resident rainbow trout discussion in following table). Populations of steelhead in the lower 3.4 miles of the Big White Salmon River are heavily influenced by hatchery-origin fish representing both summer-run (Skamania stock) and winter-run (Chambers Creek stock origin) outplants from the Washougal Hatchery (WDFW).
<i>Population Viability</i>	<i>Low.</i> Natural spawning of winter and summer steelhead is currently limited to the lower 3.4 miles of the river below Condit Dam. Some natural-origin smolts may be the progeny of resident rainbow trout upstream of Condit Dam ((Big White Salmon River Subbasin Plan 2004).
<i>Habitat</i>	<i>Low.</i> The historical distribution of steelhead was up to RM 16 which, including tributaries, provided 32.9 miles of habitat for steelhead (Big White Salmon River Subbasin Plan 2004). The current habitat downstream from Condit Dam has an overall estimated capacity to support a maximum of 26 adult recruits with a mean abundance of 20 natural-origin adults per year. After removal of Condit Dam, the Big White Salmon River has an estimated capacity to support a maximum of 633 adult recruits with a mean abundance of 544 natural-origin adults per year, although the historic capacity of the watershed was approximately 1,200 adult recruits (Big White Salmon River Subbasin Plan 2004). Removal of Condit Dam may also restore anadromy to the existing resident rainbow trout population of <i>O. mykiss</i> upstream of Condit Dam (see following table).
<i>Harvest</i>	<i>Low.</i>

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Table 15. Big White Salmon River rainbow trout

Management Premises and Goals	
<i>ESA Status</i>	<i>Not listed.</i>
<i>Biological Significance</i>	<i>Medium.</i> Resident rainbow trout are native to the Big White Salmon River drainage and inhabit the Big White Salmon River up to RM 42.5 where the stream becomes a barrier due to steep gradient and low flow. Rainbow trout in the Big White Salmon River are listed as one of the outstanding resources in the wild and scenic portion of the river. This designation affords a high level of protection for these fish. Stocking of rainbow trout in the Big White Salmon River is documented to have occurred as early as 1934, although undocumented stocking may have occurred earlier. Stocking was terminated in the 1990's except for 10-40,000 fingerling rainbow trout that are stocked annually in Northwestern Lake for recreational fishing. Genetic studies conducted by WDFW indicated that wild rainbow trout populations in the Big White Salmon River are genetically distinct from Washington State hatchery rainbow trout strains (Phelps 1990) The study concluded that hatchery releases of rainbow trout in the drainage had not caused a loss of distinct wild populations. Consequently, local populations of <i>O. mykiss</i> upstream of Condit Dam may retain the genetic structure inherent in historic steelhead populations prior to the construction of Condit Dam (Big White Salmon River Subbasin Plan 2004).
<i>Population Viability</i>	<i>Unknown.</i> However, a viable, self-sustaining natural population is presumed to exist upstream of Condit Dam.
<i>Habitat</i>	<i>Low to High.</i> Factors limiting resident fish include past riparian timber harvests, past removal of log jams, road building, grazing, agriculture, and regeneration harvest within the rain on snow zone. Implementation of current federal forest management plans and protection of riparian reserves is anticipated to restore high quality salmonid habitat over time, but there is little anticipation of significant recruitment of large woody debris (LWD) for possibly 75-120 years. Few of the surface water diversions or pumps are screened to prevent entrainment of juvenile salmonids. It is also unclear whether the screened diversions are utilizing the most current screening design criteria adopted by WDFW. The salmonid mortality associated with irrigation diversions has not been assessed, but is believed to be significant (Summary obtained from Big White Salmon River Subbasin Plan 2004).
<i>Harvest</i>	<i>Medium to High.</i> Rainbow trout upstream of Condit Dam support a popular recreational fishery.

Other Species of Concern

Table 16. Additional native fish species present in the Big White Salmon River

Common name	Scientific Name
Salmonid	
Cutthroat trout	<i>Oncorhynchus clarki clarki</i>
Bull trout (extirpated?) ⁴⁴	<i>Salvelinus confluentus</i>
Mountain whitefish	<i>Prosopium williamsoni</i>
Non-Salmonid	
Pacific lamprey	<i>Lampetra tridentata</i>
White Sturgeon	<i>Acipenser transmontanus</i>
Speckled dace	<i>Rhinichthys osculus</i>
Longnose dace	<i>Rhinichthys cataractae</i>
Redside shiner	<i>Richardsonius balteatus</i>
Sculpins	<i>Cottus</i> sp.
Three-spine stickleback	<i>Gasterosteus aculeatus</i>

Fish assemblages in the Big White Salmon River are divided into the areas upstream and downstream of Condit Dam. Species found downstream from the dam include Chinook salmon, coho salmon, steelhead, large-scale and bridgelip suckers, pacific and brook lamprey, threespine stickleback, sculpins, white sturgeon, redbside shiners, peamouth, northern pikeminnow, rainbow trout, and bull trout. Sea-run cutthroat trout, pink salmon, and chum salmon most likely used this area historically but are now considered extirpated. Species found upstream of Condit Dam include cutthroat trout, rainbow trout, sculpins, and introduced (non-native) population of brook trout. Pacific lamprey represent an important species culturally to the Yakama Indian Nation, both historically and currently, but their status in the Big White Salmon River is unknown. Brood trout were established via historical releases from hatcheries, but such releases have been discontinued, and the current viability of brook trout in the Big White Salmon River is unknown.

Nonanadromous (resident) coastal cutthroat trout occur in the watershed, but their historic distribution and abundance are unknown. Releases of hatchery-origin cutthroat trout occurred as early as the 1930s but were discontinued by the 1970's. The current status of coastal cutthroat trout in the Big White Salmon River is largely unknown; however, their distribution in the upper watershed relative to rainbow trout appears to be limited, and the sea-run form may be extirpated.

Similarly, the status of bull trout in the Big White Salmon River is unknown. Bull trout have been observed in the mainstem river below Condit Dam, and fishery biologists believe these fish are part of an adfluvial population which uses the Bonneville pool for rearing. In 1993, no bull trout were found in the watershed during a cooperative survey project between the U.S. Forest Service (USFS) and WDFW. WDFW and USFWS have initiated a bull trout-sampling project in the Columbia Gorge

⁴⁴ Currently listed as a threatened species rangewide under the ESA.

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Province to more accurately determine the distribution of bull trout in the Big White Salmon River and other Washington tributaries. In the Big White Salmon River, surveys will focus on cold water habitats that can support bull trout. A presence/absence survey conducted in summer/fall of 2007 by USFWS found no bull trout upstream of Condit Dam.

Salmon and Steelhead Hatcheries in the Watershed

Spring Creek National Fish Hatchery (U.S. Fish and Wildlife Service)⁴⁵

Spring Creek NFH is located 20 miles upstream from Bonneville Dam on the Columbia River, at river mile 167, on 60.21 acres. The hatchery is on the north side of the Columbia River near Highway 14 in Skamania County, Washington (Figure 1). The hatchery is bounded by the Columbia River on the south and by the highway and 500-ft high basalt cliffs to the north.

Spring Creek National Fish Hatchery (NFH) was authorized by Special Act 24 Stat. 523, March 03, 1887 and Special Act 30 Stat. 612, July 01, 1898 and placed into operation in September 1901 to support the commercial fishing industry in the Columbia River. The hatchery was reauthorized by the Mitchell Act (16 USC 755-757; 52 Stat. 345) May 11, 1938 and amended on August 8, 1946, (60 Stat. 932) for mitigation of Bonneville Dam and conservation of fishery resources in the Columbia River Basin. The hatchery was remodeled in 1948 to prevent inundation by the pool behind Bonneville Dam. The hatchery was again remodeled in 1970 to expand operations to meet commitments under the John Day Dam Mitigation Act. The hatchery is currently propagating tule fall Chinook salmon and includes adult broodstock collection, egg incubation, rearing, and on-station release of 15.1M subyearling smolts. The tule fall Chinook stock was developed from wild fish native to the White Salmon River. The hatchery has reared this stock since 1901.

Spring Creek NFH also operates a sub-station on the Big White Salmon River. Known as the *Big White Salmon Ponds*, this facility is located on 42 acres approximately 1-1/4 miles upstream from the mouth of the White Salmon River. The two ponds have been used to rear spring Chinook, but the facility has not been used recently.

The majority of funding in FY 2006 for Spring Creek National Fish Hatchery was reimbursable provided by the Army Corps of Engineers (John Day Dam Mitigation), NOAA Fisheries, (Mitchell Act) and the Service's Maintenance Management funds for a total of \$943,871. M&E costs for FY2006 were approximately \$1,196,178 primarily includes the cost for personnel and equipment for tagging, marking, sampling, data management, and reporting. Capital improvements to the Spring Creek NFH have total \$1,114,396 for the period 1998 – 2006

Funding Source: FY2006	Amount
Corps of Engineers	\$559,141
NOAA-Fisheries(Mitchell Act)	\$353,007
USFWS – Hatchery Cyclical Maintenance	\$31,723
Total	\$943,871

⁴⁵ Spring Creek National Fish Hatchery is located on the mainstem Columbia River, approximately two miles downstream from the mouth of the Big White Salmon River. Due to its close proximity to Big White Salmon River, the Review Team assessed the hatchery as if it were within the Big White Salmon River watershed.

Spring Creek NFH Tule Fall Chinook

Operator: U.S. Fish and Wildlife Service

Summary of Current Program

Goals

- **Harvest goal:** Support commercial, tribal, and recreational fisheries in the ocean, lower Columbia River, and Bonneville pool. Although not specifically stated as a program goal, the desired harvest goal is to achieve a mean overall harvest of 37,000 adult Chinook per year based on the current size of the program and a 10-year average smolt-to-adult survival of 0.379% (harvest plus escapement back to the hatchery). John Day Dam mitigation has an escapement goal of 30,000 adults to the project area, 15,000 of which are to come from Spring Creek NFH. Mitigation for salmon lost as a result from construction and operation of The Dalles Dam is also being discussed between co-managers. Production at Spring Creek NFH is for John Day and The Dalles dam mitigation and Mitchell Act. Current discussions are underway regarding the extent tule fall Chinook mitigate for fish losses associated with John Day and The Dalles dams (see discussion of *upriver bright* fall Chinook at Little White Salmon NFH).
- **Broodstock escapement goal:** Provide an escapement back to the hatchery of at least 10,000 hatchery-origin adult Chinook for a segregated broodstock program to support lower Columbia River fisheries. Achieve a 0.07 survival from smolt release to adult recovery at the hatchery to maintain brood stock.
- **Conservation goal:** Spring Creek NFH Tule NFH fall Chinook are included within the Lower Columbia River Chinook ESU which is currently listed as *threatened* under the ESA. The conservation goal is to maintain a genetic repository for tule fall Chinook native to the lower Columbia River. The draft White Salmon Recovery Plan (p. 44) states, “When Condit Dam is removed, fall Chinook salmon from the program [Spring Creek NFH] will be used to reintroduce fall Chinook into the basin.” A comprehensive lower Columbia River ESA recovery plan is under development.⁴⁶
- **Escapement goal for natural-origin adults:** None. The hatchery does not intercept natural-origin tule fall Chinook. With the implementation of mass marking starting with the 2005 juvenile fish, recovery of unmarked, non-tagged tule fall Chinook salmon will assist with determining natural production in the Big White Salmon River. Mark quality and tag retention will also need to be taken into account.
- **Research, education, and outreach goals:** Provide visitation opportunities at the Spring Creek NFH, but no specific long-range goals currently exist.

⁴⁶ See <http://www.nwr.noaa.gov/Salmon-Recovery-Planning/ESA-Recovery-Plans/Index.cfm>.

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Objectives

- Trap 10,000 adults and spawn 8,000 adults (min. 4,000 females) tule fall Chinook to yield a minimum of 20 million green eggs (4,675 = approx. avg. fecundity, 1986-2005).
- Release 15.1 M subyearling smolts directly from the hatchery into the Columbia River (Bonneville Pool) (U.S. v. Oregon agreement): 8.55M for John Day mitigation, 6.55M funded by Mitchell Act.

Program Description

The Spring Creek tule fall Chinook brood stock originated from the White Salmon River, a mile from the location of the hatchery, and is the stock of choice for reintroduction in the White Salmon River pending Condit Dam removal scheduled in 2008. The tule fall Chinook stock is indigenous to the White Salmon River and the hatchery has reared this stock since 1901.

Spring Creek NFH is a single species facility rearing only tule fall Chinook salmon. Brood stock collection at the hatchery is managed to maintain the genetic integrity of the stock. The Service ensures that adult brood stock is randomly collected across the spawning run in proportion to the rate at which they return. The hatchery escapement goal is 10,000 adults of which 4,000 need to be females, but all fish returning are allowed to enter the hatchery.

Adult tule fall Chinook return to the hatchery from late August through September with 70% of the return entering the hatchery between September 4th and September 20th. Traditionally, the hatchery starts the spawning process around the 15th of September and is generally finished by the 5th of October. Spawning takes place daily with an average daily egg take of 1.75 million although it's possible to have daily takes of over 5 million eggs. Fish exceeding hatchery needs are distributed to the Yakama Nation for Ceremonial and Subsistence (C&S) and other tribes as requested. Additional fish are transferred to the State Food Bank Program.

Production goals are to release 15.1M tule fall Chinook smolts. The Spring Creek facility is operated under a strategy that releases smolts (fingerlings) during three time periods: March, April, and May. This release strategy maximizes production from available rearing space.

Spring Creek NFH also operates a sub-station on the White Salmon River. Known as the Big White Salmon Ponds this facility was used to collect adult tule fall Chinook up until the late 1960's once the number of the Chinook returning directly to the hatchery were able to fulfill broodstock needs.

Assessment of Current Program

Operational Considerations

Listed below are the principal operational components of the hatchery program that the Review Team considered as part of its review.

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Broodstock Choice and Collection

- Derived from Big White Salmon river, propagated for over 100 years with little influence from other stocks.
- Stock represents the ancestral population native to the Big White Salmon River and the population that spawned in areas now flooded by the Bonneville pool.
- Included within the Lower Columbia Chinook ESU; hatchery fish are included with the current *threatened* listing under the ESA.
- Adults return to the facility from the last week of August through first week of October.
- Fish enter the hatchery daily, via a fish ladder directly from the Columbia River, are visually counted and sexed, and guided to one of 17 Burrows ponds. One Burrows pond is filled at a time before another pond is opened, with each pond receiving between 400 and 1,000 fish, depending on the size of the run.

Hatchery and Natural Spawning, Adult Returns

- Fish spawning occurs between September 15 and October 1
- 13-16 egg takes, every day except for weekends during spawn season.
- The egg take goal is 20 million fertilized eggs.
- In most years, surplus fish are available and given to a food bank;
- Some natural spawning of tule fall Chinook from Spring Creek NFH occurs in the Big White Salmon River. For BY 1990-1999 average 1,156 Spring Creek tule fall Chinook returned to spawning grounds (primarily to the Big White Salmon River). Very few adults stray from the vicinity of Spring Creek NFH (Pastor 2004⁴⁷). However, the ladder pulsing strategy used during 2003-2005 resulted in increased numbers of fish straying into the Big White Salmon River (Engle et al. 2006).
- During broodstock collection and surplus sampling at Spring Creek NFH, very few Chinook salmon other than Spring Creek origin fish are recovered (i.e. very few strays from other hatcheries). For example, based on coded-wire tag recoveries, an average of 23 fish out of an average return of 40,100 strayed from other hatcheries into Spring Creek NFH during 2000-2006 (CRiS database).
- Jacks (2-year old males) compose 2-3% of the total number of spawners, 1987-2001, with 4% of the spawned males composed of jacks.
- Spawning is generally pairwise. Three females and three males are first pair-spawned in three separate color-coded pans. Saline water is added to each pan the eggs allowed to fertilize for 30

⁴⁷ Pastor 2004. *An evaluation of freshwater recoveries of fish released from National Fish Hatcheries in the Columbia River basin, and observations of straying*, pages 87-98. In: M.J. Nickum, P.M Mazik, J.G. Nickum, and D.D. MacKinlay (editors), *Propagated Fish in Resource Management*, American Fisheries Society Symposium 44, Bethesda, Maryland.

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seconds to one minute. The egg-milt mixtures from each pairwise spawning are then combined into a single bucket for transport to the hatchery and loading into the incubation trays (see below).

- Spring Creek NFH fall Chinook are taken in fisheries in US, Canada and Southeast Alaska as part of the negotiated U.S.-Canada Treaty harvest allocation.
- Fall Chinook are harvested in ocean commercial and recreational fisheries from Oregon to Alaska, in addition to Columbia River commercial gill net and sport fisheries.
- Columbia River commercial harvest occurs in August and September, but flesh quality is low once tule Chinook move from salt water; the price is low compared to higher quality bright stock Chinook.
- Fall Chinook destined for areas upstream of Bonneville Dam are harvested in August and September Treaty Indian commercial and subsistence fisheries.
- Fall Chinook originating upstream of Bonneville Dam are subject to Federal Court Agreements regarding Indian and non-Indian harvest sharing.
- Coded-wire tag recoveries since 1980 from Spring Creek NFH indicates that the majority of tule fall Chinook stock harvest occurs in British Columbia, Washington, and Oregon ocean fisheries and Columbia River gillnet fisheries.
- Bonneville Pool tule stock fall Chinook are important contributors to the Columbia River estuary (Buoy 10) sport fishery; in 1991, Bonneville Pool Hatchery fish comprised 25% of the Buoy 10 Chinook catch.
- Average recoveries of Spring Creek NFH Chinook for broodyears 1990-1999 were 34% (19,295) at the hatchery, 33% in Columbia River harvests (18,994), 31% in ocean harvests (18,098), and 2% to spawning grounds in the Big White Salmon River (1,156).
- SARs back to the hatchery have averaged 0.138% (BY1980-BY2001).
- SARs that include all recoveries (hatchery + harvest + spawning ground) based on coded-wire tagging averaged 0.41% (BY1990-99).
- Recent survival rates (harvest + escapement) have been over 1% (BY1998-2000)

Incubation and Rearing

- Incubation takes place in Heath trays, two trays are initially loaded with the eggs from three females (7,500/tray).
- At the eyed stage, eggs are shocked and reloaded at 5,000 eggs/tray.
- Excess eggs are buried on site

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- Fry button up in trays, and are then ponded in 44 outdoor Burrows Ponds after approximately 1,600 Temperature Units (TUs). During the first few weeks of December, 350,000 swim up fry are placed in each of the ponds
- Water source is 50% well, 50% spring water to achieve an incubation temperature of 50-52 degrees F. (warmer well water mixed with spring water-brings temperature up to desired incubation temperature).
- At present time, there is not a soft-shell problem, Soft-shell has not existed since the new well came on line in 1992. Hydrogen sulfide in the well water may have helped. Additional changes may have also reduced soft-shell (e.g. changing to an iodine flow-through treatment 3 times/week, and improved handling techniques of adult fish).
- Fungus is not a problem, therefore, formalin treatments are not necessary.
- Hatchery water source is 46 degree F spring water, 2,500-3,000 gpm. The hatchery operates a 90% biological reuse water system for the outdoor ponds.
- Green egg to eye-up survival is 93.7%
- Fry to Smolt survival is 97.5%.
- Average density index for the last 10 years has been 0.28 and flow index has been 1.44
- Enteric Redmouth and bacterial gill disease are the two primary fish health concerns.
- Hatchery production records are maintained in the CRIS database program.
- Predation and possible disease transmittance within the facility is a possibility caused by Great Blue Herons (*Ardea herodias*) and to a lesser extent otters (*Lontra canadensis*).

Release and Outmigration

- Since 2005 fish are 100% mass-marked by an adipose fin clip prior to release. 450,000 fish receive a coded-wire tag (cwt) and an equal number, 450,000 receive a cwt but no adipose fin clip (Double Index Tag group).
- Proposed Spring Creek reprogramming would reduce on station releases to 10.5 M smolts from the current release goal of 15.1M smolts.
- Smolts are forced released in three release groups (March 7.6M, April 4.2M, May 3.3 M)
- Carrying capacity of rearing ponds is approximately 100,000 pounds, requiring an early March release of 7.6M to achieve a total release of 15.1 M.
- On average, May release groups have the highest mean smolt-to-adult survival (0.27%), followed by April (0.23 %), and then March (0.17%), based on data for brood years 1990-2002 and return years 1992-2006 recovered at hatchery. However, when brood year 2001 is not included in the analysis, April has the highest mean smolt-to-adult survival, followed by May, and then March.

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- May release groups have the highest variability in mean smolt-to-adult survivals, and March release groups have the lowest variability.
- Because of variable smolt-to-adult survival among brood years and the large release in March (7.6 million fish), the March release groups have the highest adult yield in some years.
- Historically, brood stock needs are met most years utilizing the combined March, April and May release strategy to meet a 15.1 million release.
- Mean survival from ponded fry to smolt is 97.5%.
- Fish out-migrate to Bonneville within 24-48 hours of release with full passage within 96 hours. The release of hatchery smolts that are physiologically ready to migrate is expected to minimize competitive interactions as they should quickly migrate from the release site.
- Spring Creek NFH fish are released directly into the mainstem Columbia River migration corridor rather than into tributary spawning or rearing areas.
- Predation by hatchery-origin fish is, most likely, not a major source of mortality to naturally reproducing populations, at least in freshwater environments of the Columbia River basin.

Facilities and Operations

- Biological filter utilizes oyster shells as the media source. Operation of a biological reuse system is a risk factor for disease since there are limited options for treatment of fish pathogens without harming the beneficial bacteria in the reuse system.
- Bacterial consortiums are added to the reuse system for breaking down solids and maintaining desired levels of nitrosomonas and nitrobacter bacteria.
- A weir has been used previously on the Big White Salmon River at Big White Salmon Ponds for adult collection is no longer functional. The weir was last used in 1987. Only 595 adults returned to the Spring Creek National Fish Hatchery that year. Trapping at the Big White Ponds produced 186 adults, the North Shore trap at Bonneville Dam provided 1,487 fish, and 1,473 fish were excess to the needs of the Bonneville State Hatchery so were transported to Spring Creek. In that same year 303 adults also came from Abernathy NFH. The total egg take in 1987 was 11.6 million, approximately 7 million short from meeting its mitigation commitment.
- The Big White Ponds is a facility which could potentially play a roll in restoration and recovery of native stocks in the White Salmon River after Condit Dam is removed, but is currently inoperable since the water intake screens are not compliant with NOAA Fisheries screening criteria and is susceptible to flooding.
- Spring water collection facility access and security is a potential problem. Increased security would be desired.
- Need to upgrade flow alarms. Incubation building doesn't have alarms. Need continuous meters on reuse system to monitor water chemistry for oxygen, ammonia, nitrates, nitrites, and pH.

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- Limited security for the broodstock ponds. Currently, hatchery staff checks the adult holding ponds during broodstock season once per night and it is monitored during normal working hours.
- Individual flow meters are needed on each pond. At present time, flows are estimated by percent that valves are opened.
- All production water used in the outdoor ponds is discharged through the settling pond. The hatchery operates on a 90% recirculated water system. Cleaning of the biological reuse system involves back flushing the oyster shell media filter beds which is discharged into the settling pond. Settling pond outflow is sampled weekly; outflow is sampled 2-3 hours after back flushing the filter beds. All effluent water is discharged into the settling pond prior to discharge from the facility into the Columbia River. Settled solids were removed approximately six years ago. Both petroleum compounds and PCBs were identified and material were disposed of at the Waster Management Landfill in Arlington, OR.
- Aquamats used in Burrows ponds (n=44 ponds); precludes need to brush ponds. Aquamats work especially well in Burrows ponds because of circular nature (as compared to rectangular raceways).
- Fish were reared in the settling pond in one year with qualitative conclusions that the fish did well.
- No ability to automatically count adult fish as they enter the facility. An automatic counter would facilitate operations.
- Do not have a major bird predation problem, Great Blue Herons and mallard ducks are occasionally seen on the hatchery
- The hatchery is located within the Columbia Gorge Scenic Area. Any new construction needs to be coordinated with the Columbia Gorge Scenic Area Commission.
- The hatchery is considering electro-anesthesia so that carcasses and surplus adults could be used for consumptive purposes. Initial findings suggest major facility modifications would be necessary to convert to an electro-anesthesia system.
- Mitchell Act does not pay for facility renovations or maintenance. Program improvements may not occur because of lack of reimbursable funding to cover those costs.

Research, Education, and Outreach

- Joint project with USGS evaluating out-migrants from the Big White Salmon River. The following questions are being addressed: Is there natural production of tule fall Chinook in the river? If so, are they genetically distinct from the Spring Creek NFH stock?
- Condit Dam is scheduled to be breached (removed) in October 2008.
- A full parental genotyping feasibility study is currently underway for the hatchery program.
- A fry release study (January/February release) was conducted for brood years 1999, 2001 and 2002. Through otolith marking and recovery, juvenile to adult survival rates of the fry releases

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were very low (only 1% to 4% of the survival observed from the standard March through May production release).

- ERM (Enteric Red Mouth) has been a serious issue for Spring Creek NFH in the past and remains a constant concern. An ERM disease study is currently being conducted by the lower Columbia River Fish Health Center.
- Spring Creek NFH houses the lower Columbia River Information and Education Office. This office also serves Carson NFH and the Lower Columbia Fish Health Center.
- Differential coded-wire tag groups are used to assess the March, April, and May releases
- The March release has been marked in a manner to perform an evaluation of different dam operations (spill and turbine, corner collector operation and turbine, turbine only)

Benefit and Risk Assessment

BENEFITS CONFERRED TO THE PROPAGATED STOCK AND LOCAL COMMUNITY

In the context of all possible harvest, conservation, and other benefits that a hatchery program can confer to the propagated stock and local community,⁴⁸ the Review Team identified the following benefits of this hatchery program:

Harvest Benefits

- The program confers significant sport, tribal and commercial harvest benefits. The 10-year average (broodyear 1990-1999 which includes all return years for each broodyear): Columbia River harvest is 18,994, or 33% of the returning population, and ocean harvest is 18,098, or 31% of the returning population, including the continental US (Washington and Oregon coastlines), British Columbia and Southeast Alaska.
- Mass marking began at Spring Creek NFH in 2005; therefore, selective fisheries will be an option in the near future.
- Excess adults trapped at the hatchery are currently provided to food banks and are used for tribal subsistence and ceremonial purposes. For example, over a recent three year period 3,192, 28,815, and 59,843 were donated to the Federal Prison System in the years 2000, 2001 and 2002 respectively (Streamnet data query).

Conservation Benefits

- Mass marking began at Spring Creek NFH in 2005 and will allow for quantifying the number and proportion of hatchery fish on the spawning grounds.
- Hatchery program reduces extinction risks to tule fall Chinook in the lower Columbia River ESU.

⁴⁸ See the "Components of This Report" section for a summary description of the potential benefits and risks considered by the Review Team.

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- Spring Creek NFH tule fall Chinook are considered the genetic repository for restoring fall Chinook to the Big White Salmon River after removal of Condit Dam.
- Confers planned recovery benefits for Big White Salmon River restoration.

Research, Education, Outreach and Cultural Benefits

- The hatchery is home to the Lower Columbia Information and Outreach Office and provides support from this office to fisheries offices within the region.
- The visitor facilities adequately support the number of visitors (5,000 per year) that pass through the hatchery.
- Spring Creek NFH provides significant outreach activities, including an open house, salmon-in-the-classroom programs and fishing derby support.
- The land which the facility is on provides recreational access (e.g. sturgeon fishing and windsurfing) to the waters of the Columbia River mainstem.
- Tribal harvest and surplus adults trapped at the hatchery provide a cultural benefit to Columbia River tribes.
- Participating in a Mitchell Act funding outreach team.

BENEFITS CONFERRED TO OTHER STOCKS, SPECIES, AND COMMUNITIES

In the context of all possible harvest, conservation, and other benefits that a hatchery program can confer to other species and stocks,⁴⁹ the Review Team identified the following benefits of this program:

Harvest Benefits

- Substantial harvest of Spring Creek NFH tule fall Chinook occurs along the coast of Oregon and Washington, and into British Columbia and southeast Alaska (ocean harvest is 18,098, or 31% of the returning population), thus conferring a significant harvest and economic benefit to commercial fishers and citizens of Alaska and British Columbia.

Conservation Benefits

- None identified at the present time, but this stock could be used to help restore naturally spawning populations in other watersheds of the lower Columbia River.

Research, Education, Outreach and Cultural Benefits

- Spring Creek NFH tule fall Chinook are a Pacific Salmon Treaty indicator stock.
- Hatchery staff provide educational opportunities offsite to other communities and the education program addresses other stocks in the region.

⁴⁹ *Ibid.*

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- Double index tagging provides harvest exploitation rates on wild stocks in the Columbia River. This may be useful for evaluating selective fisheries.

RISKS POSED TO THE PROPAGATED STOCK AND LOCAL COMMUNITY

In the context of all possible genetic, demographic, ecological and other risks that a hatchery program can pose to the propagated stock,⁵⁰ the Review Team identified the following risks of the hatchery program:

Genetic Risks

- There is a domestication risk for Spring Creek NFH tule fall Chinook due to their intended conservation role as a genetic resource for reintroductions in the lower Columbia River and their sustained propagation as a *segregated* hatchery stock propagated with hatchery-origin adults.
- A significant proportion of the tule fall Chinook in the Big White Salmon River are Spring Creek NFH origin. This precludes the establishment of a viable self-sustaining natural population as long as the number of natural spawners is dominated by hatchery-origin fish. The long-term goal is to reverse this situation after the removal of Condit Dam. Removing the dam will provide a total of ~8 miles of fall Chinook habitat in the Big White Salmon River.

Demographic Risks

- The use of 90% reuse water poses a demographic risk to the stock because of difficulties to control fish pathogens.
- The biological filter (oyster beds) for the reuse system is a risk factor for disease.
- The large numbers of hatchery strays from Spring Creek NFH into Big White Salmon River may pose a demographic risk (e.g. competition for spawning habitat) to the establishment of a viable self-sustaining population.
- Spring water collection facility access and security is a potential problem because it is adjacent to a major state highway.
- Inadequate alarms at the hatchery pose demographic risks to fish on station. Incubation building doesn't have alarms. The facility does not have continuous electronic meters to monitor oxygen, ammonia, nitrates, nitrites, pH, or other water chemistry parameters of the reuse system .
- Limited security for the broodstock ponds.
- Bonneville Dam provides a significant risk to the survival of Spring Creek NFH tule fall Chinook, especially the March release groups. The March release is prior to the present spill window during operation of Bonneville Dam. Each year a specific spill request must be made to Bonneville Power Administration.

⁵⁰ *Ibid.*

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Ecological Risks

- Concentration of northern pike minnow at the outflow of the hatchery ladder may pose a significant risk at time of release.

Research, Education, Outreach and Cultural Risks

- Raceways at Spring Creek NFH are not fenced, posing a public safety risk.

RISKS POSED TO OTHER STOCKS, SPECIES, AND COMMUNITIES

In the context of all possible genetic, demographic, ecological, and other risks that a hatchery program can pose to other stocks and species in a watershed,⁵¹ the Review Team identified the following risks from the hatchery program:

Genetic Risks

- None identified.

Demographic Risks

- None identified.

Ecological Risks

- Risk to chum redds through nitrogen gas supersaturation and potential predation in the lower Columbia mainstem during the March spill at Bonneville Dam that accommodates the release of Spring Creek NFH tule fall Chinook.

Research, Education, Outreach and Cultural Risks

- None identified.

Recommendations for Current Program

The Review Team considered all the benefits and risks outlined in the preceding section. The Team concluded that some of the risks outlined in the preceding section were either minor or their probability of occurrence was small and, thus, did not warrant a proposed change or recommendation for the current program. The recommendations outlined below, in addition to potentially increasing benefits towards achieving program goals, address the identified risks or potential problems considered by the Review Team to warrant a potential modification to the current program. Preceding each numbered recommendation is a brief summary of the issue.

⁵¹ *Ibid.*

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Program goals and objectives

Issue SC1: Present program goals for Spring Creek NFH tule fall Chinook are not fully expressed in terms of numeric outcomes that quantify intended benefits or goals. Harvest contributions vary widely in response to post-release survivals, marine conditions, and harvest regimes in the Columbia River. Like most other Mitchell Act funded programs, this hatchery program lacks specific goals for numeric accountability with respect to harvest, conservation, or other benefits. John Day Dam mitigation harvest numbers for tule fall Chinook from Spring Creek NFH are identified (15,000 adults). However, there are tribal concerns regarding the appropriate stock and point of release for John Day Dam mitigation.

Recommendation SC1: Restate program goals to identify the number of harvestable adult tule fall Chinook desired from the Mitchell Act proportion of this program in the ocean and lower Columbia River. For example, the current program size and desired post-release survivals lead to a mean harvest goal of 19,000 fish per year for Columbia River harvest and 18,000 fish per year for ocean harvest.

Broodstock Choice and Collection

Issue SC2: Spring Creek NFH tule fall Chinook does not represent the same stock composition as the one impacted by John Day Dam. John Day Dam mitigation funds are received by Spring Creek NFH for the tule fall Chinook program, although the stock does not represent an in-place, in-kind contribution to mitigation for the dam. However, hatchery mitigation for The Dalles Dam may be combined with mitigation for John Day Dam, as per recent comanager discussions. The Dalles and John Day dams and pools collectively had the biggest impacts to upriver-bright fall Chinook, whereas Bonneville Dam and pool had the biggest impact to tule fall Chinook production.

Recommendation SC2: Continue to work through the U.S. v. Oregon process to resolve broodstock composition and point of release issues regarding John Day, The Dalles, and Bonneville dam mitigations (see also discussion and recommendations for upriver bright fall Chinook at Little White Salmon NFH).

Issue SC3: Adult fish returning to the facility are not automatically enumerated. The adult fish are visually estimated as they enter the facility, one pond is hand counted, and the total number of fish at the facility is extrapolated to the other ponds. The size of the return (tens of thousands of adult fish in some years) makes this process extremely labor intensive and reduces the accuracy of this method.

Recommendation SC3: Install a fish counter at the entrance to each pond where broodstock are held.

Hatchery and Natural Spawning, Adult Returns

Issue SC4: In some years, large numbers of Spring Creek NFH tule fall Chinook spawn in the Big White Salmon River. Removal of Condit Dam will provide the opportunity to restore fall Chinook salmon in the Big White Salmon River. Restoration of fall Chinook in the upper Big

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White Salmon River may require control of hatchery fish escapement to allow colonization and natural population adaptations.

Recommendation SC4a: The Service should continue to collect adult and juvenile tissue samples and conduct genetic analyses to determine stock composition of naturally spawning adults and contribution to juvenile production. This would require continuing the estimation of adult spawning and juvenile production abundance.

Recommendation SC4b: Investigate the opportunity for installing a conservation weir in the Big White Salmon River to control the number of hatchery-origin fish passed upstream and for brood stock collection as part of the restoration process. As the number of natural-origin fall Chinook increases over time, the number of hatchery-origin fish allowed to spawn naturally would need to be reduced to allow a self-sustaining natural population to develop. A weir would also allow monitoring of the recolonization success and future opportunity to collect broodstock for a potential integrated hatchery program, if desired in the future.

Recommendation SC4c: Continuously operate the hatchery ladder throughout the tule fall Chinook return. Do not “pulse” the ladder for broodstock collection unless the intended purpose is to increase stray rates and “seed” the Big White Salmon River with hatchery fish.

Issue SC5: *MS-222 is currently used to anesthetize adults during spawning. This precludes the use of carcasses for nutrient enhancement of streams and other beneficial uses for potential human use. At the present time, the hatchery must render the carcasses at a cost of approximately \$10,000/year. MS-222 is also a human health hazard.*

Recommendation SC5: Develop an alternative method of anesthetizing broodstock at the time of spawning. Use of electro-anesthesia is currently being investigated. Carbon dioxide could also be used.

Incubation and Rearing

Issue SC6: *Iodine treatment of fertilized eggs overlaps with the time that adults are held for broodstock. As a result, treated water from the hatchery building is discharged directly into the Columbia River to avoid recirculating iodine through the water re-use system and into the adult holding ponds .*

Recommendation SC6: Re-plumb the hatchery building so that water can be discharged directly into the settling pond rather than the re-use system or river.

Release and Outmigration

Issue SC7: *The current program size of 15.1 M smolts pushes the capacity of the hatchery to rear all fish within recommended density guidelines for fall Chinook. In addition, the water re-use system for the hatchery increases disease and water quality risks to fish on station.*

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Recommendation SC7: Reduce program size to 10.5M subyearling smolts to maintain density indexes below 0.3 (Banks and LaMotte 2002⁵²). Reducing the size of the program and on-station releases would not jeopardize the ability to collect the minimum broodstock needed to maintain the program⁵³. This does not necessarily preclude the release of fish in March (See also Issue 8a and 8b). A March release component is currently critical for maintaining a fish rearing density index below 0.3. The Service should continue to coordinate production changes through U.S. v Oregon and U.S.-Canada Treaty forum, including the need to meet John Day, The Dalles, and Bonneville dam mitigation re-programming.

Issue SC8a: *Operation of Bonneville Dam strictly for power generation in March inhibits downstream passage and survival of Spring Creek NFH Chinook subyearlings.*

Recommendation SC8a: Continue to work with the COE and BPA to establish a March spill to facilitate downstream passage through Bonneville Dam of fall Chinook subyearlings from Spring Creek NFH and other populations (e.g. trapping in the Big White Salmon River indicates that naturally produced fall Chinook begin outmigration in March). If a March spill cannot be negotiated or is determined to be detrimental to chum salmon redds downstream of Bonneville Dam, then continue to investigate survival of Spring Creek NFH subyearlings through the corner collector at Bonneville Dam's Second Powerhouse.

Issue SC8b: *Variable survival rates from the March, April and May releases provide uncertainty in instituting a reduction of the hatchery production from 15.1 million to 10.5 million.*

Recommendation SC8b: Analyze the historical March, April and May releases and model future production and release scenarios that involve the 10.5 million on-station release. This includes an assessment of the effect of spills at Bonneville Dam. For example, if March spills were discontinued, what would be the effect on total smolt-to-adult survivals over multiple years and over variable inter-annual flow conditions in the Columbia River?

Facilities/Operations

Issue SC9: *Water source for the hatchery is an unsecured spring collection point adjacent to a state highway. There is a risk to the hatchery's water supply from highway accidents and vandalism.*

Recommendation SC9: The Service's Fisheries Program should work with engineering personnel to design a cover and physical barrier that would protect the water supply from highway spills, vehicle intrusions, and potential vandalism.

Issue SC10: *The water re-use system is not equipped with alarms that respond to water chemistry parameters for oxygen, ammonia, nitrates, nitrites, and pH levels. Current system is over 20 years old and only measures water levels.*

⁵² Banks and LaMotte. 2002. Effects of four rearing density levels on tule fall Chinook salmon during hatchery rearing and after release. *North American Journal of Aquaculture* 64:24-33.

⁵³ See survival and modeling results in Spring Creek NFH Tule Fall Chinook section of Appendix B.

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Recommendation SC10: Upgrade the water monitoring system to include electronic metering of critical water quality parameters with alarms to notify hatchery staff when levels exceed fish safety guidelines.

Issue SC11: *Water flows into individual ponds cannot be currently measured.*

Recommendation SC11: Install water flow meters on each pond. These new flow meters could be integrated into the upgraded monitoring system for the water re-use system.

Issue SC12: *Adult broodstock ponds are not fenced or equipped with intruder alarms.*

Recommendation SC12: Install a security fence around the broodstock ponds, including intruder security alarms.

Research, Monitoring, and Accountability

Issue SC13: *Spring Creek NFH is under funded for operations, maintenance, and M&E, and has insufficient funding for major maintenance and infrastructure improvements. There is currently a maintenance backlog of \$1,259,470. The figure does not include rehabilitation of the Big White Ponds in the Big White Salmon River with an estimated cost of \$328,500.⁵⁴ Spring Creek NFH is funded by 43% Mitchell Act and 57% John Day Dam mitigation (ACOE funding). This maintenance backlog issue is caused primarily by a lack of Mitchell Act funding to cover program and facility costs, thus resulting in increasing gaps between funding needs and availability related to both inflation and increased aging of hatchery facilities. Fishery comanagers and partners have developed a Mitchell Act outreach team to address Mitchell Act facility and funding needs. John Day Dam mitigation funding levels are currently adequate for operations and maintenance; however, John Day Dam mitigation funds are insufficient to cover M&E (monitoring and evaluation) activities.*

Recommendation SC13: Adopt the funding levels developed by the outreach team including the development of a major maintenance budget that includes funding of the infrastructure improvements identified here in this report.

Issue SC14: *Currently, at the Spring Creek NFH, 150,000 fish in a few raceways for each of the raceway series representing the three release groups of Chinook are tagged (e.g., three or four of 20 raceways). Since the populations between raceways can be different (age and size) and the pond environments can differ slightly (flow and flow pattern), the current tagging protocols may not represent the entire population. Production monitoring using coded-wire tags requires that the tags represent the entire population.*

Recommendation SC14: Consult with Columbia River Fisheries Program Office to develop a consistent tagging strategy that accurately represents the entire population of progeny from all spawn groups. For example, one approach could be to apply tags to 15,000 fish each in 10 of the 20 raceways. [Review Team Note: consultations recommended here have been initiated].

⁵⁴ Data from the Service's SAMMS database.

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Issue SC15: *At Spring Creek NFH, “double-index tag” (DIT) groups, where some fish receive CWTs but no adipose fin clip while other fish receive the adipose fin clips but no CWTs, are not always applied to the same raceways. Therefore, it is highly unlikely that the fish in the two groups represent the same progeny groups or rearing environments as required for the underlying statistical assumptions. DIT groups need to be paired coded-wire tagged groups that are reared and released in a similar manner and are identical with the exception that one of the groups in the pair is adipose clipped (marked) and the second is not clipped (unmarked)” (Joint Coho DIT Analysis Workgroup). DIT is used as a method to analyze the effects of selective fisheries. Different tag groups in different raceways violates the statistical assumptions.*

Recommendation SC15: Consult with Columbia River Fisheries Program Office to develop a new DIT application strategy that ensures that the paired groups are identical fish (other than the fin clip). The paired groups should come from and reside in the same raceway(s). [Note: these consultations are underway].

Issue SC16: *Peaks and troughs in numbers of returning adults during the return season make it difficult for Spring Creek NFH to collect broodstock representative of the entire returning population. The current practice is to collect enough fish to fill a minimum of one pond per day (one of 17 ponds) after the fish begin returning.*

Recommendation SC16: Implement a PIT tag program to determine travel time of adults from Bonneville Dam to Spring Creek NFH. PIT tags could also provide information regarding the survival of outmigrating juveniles through the corner collector, juvenile bypass facilities, or turbines.

Issue SC17: *The facility has no clearly defined M&E program.*

Recommendation SC17: Develop a consistent and clearly defined M&E program and review on an annual basis (prior to ponding and coded-wire tagging of a broodyear).

Issue SC18: *The “visioned” function, purpose, and membership of Hatchery Evaluation Teams (HET) - as originally described during the “Fisheries: A Future Legacy”(USFWS, 1991) planning process - have been inconsistently applied regarding hatchery evaluations and fish production modifications. Meetings and communications between Service offices regarding Spring Creek NFH fish programs and evaluations are infrequent. The Review Team believes that regular and recurring meetings and communications should occur with both internal and internal/external partner meetings. The Review Team recommendations below are based on the 1993 USFWS “Hatchery Evaluation Action Plan” with modifications by the Review Team.*

Recommendation SC18: Establish an internal hatchery evaluation team (HET) consisting of staff from the hatchery, the Lower Columbia River Fish Health Center (Willard, WA), the Columbia River Fisheries Program Office (Vancouver, WA), and the Abernathy Fish Technology Center (Longview, WA). This internal HET should meet twice annually to coordinate planning and activities (a) after smolts are released in the spring and (b) after adults return in the fall. These internal HET meetings should discuss results of on-going evaluations, tagging/marking protocols and plans, adult and juvenile sampling for data collection, data management and reporting, fish program modifications, fish ponding densities and protocols,

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number of adult fish to be spawned, number of juvenile fish to be raised and released, disposition of excess juvenile fish on station, fish health and related issues (e.g., nutrition, physiology, genetics), and implementation of Hatchery Review Team recommendations. The HET can meet more often as necessary to discuss specific fish program or evaluation issues. The HET should record meeting minutes and distribute them to the HET and the appropriate line manager in the Regional Office. In addition, the HET should meet annually with comanaging partners and interested parties to share the results of ongoing evaluations and receive comments and suggestions regarding proposed future activities.

Education and Outreach

Issue SC19: The demands of the education and outreach program for the Lower Columbia

Interpretative and Education (I&E) office located at Spring Creek NFH have increased.

This includes: a proposed visitors facility at Warm Springs NFH, new support needs for Eagle Creek NFH, continuing support for the Columbia Gorge NFHs and the Lower Columbia Fish Health Center, and additional regional outreach responsibilities.

Recommendation SC19: Evaluate the future needs of the program in terms of both infrastructure support and personnel.

Alternatives to Current Program

The Review Team considered the benefits and risks of the existing tule fall Chinook program at Spring Creek NFH and developed four alternatives designed to reduce risks and/or increase benefits. The first alternative is the current program with all previously-described recommendations adopted including reduction of the annual release size to 10.5 million. The last alternative is the “no hatchery” option. Following these descriptions of alternatives, the Review Team has identified a recommended alternative (or alternatives).

Alternative 1: Current program with recommendations, including reduction of program to 10.5 million smolts

Continue production with on-station releases. This alternative does not necessarily include other aspects of the “Spring Creek reprogramming” proposal currently under discussion by comanagers (i.e. elimination of March release and production changes at other hatcheries).

Pros

- Maintaining a March release component would reduce fish rearing density index below 0.3.
- Current program contributes significantly to sport, tribal and commercial fisheries in the Columbia River and ocean harvest, including continental US (Washington and Oregon coastlines), British Columbia and Southeast Alaska.

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- Indicator stock for the US/Canada Treaty and is a significant contributor to fisheries in Canadian waters.
- Program has relatively high productivity with a recruit per spawner rate of 8 recruits per spawner (BY 1990-1999).
- Reduction of smolt production from 15.1 to 10.5 million will improve smolt quality, fish health, and expected smolt-to-adult survivals.
- Despite re-use water and current rearing densities, the propagated stock is largely disease-free.
- Provides surplus adults for food banks and tribal subsistence and ceremonial purposes.
- Use of local broodstock reduces demographic extinction risks to ESA-listed tule fall Chinook in the lower Columbia River Chinook ESU.
- Spring Creek NFH is the identified broodstock source for reestablishing tule fall Chinook populations in upper Gorge tributaries and the Big White Salmon River.
- If reduction in program size eliminates the early release in March, coordination with the COE and BPA to spill water at Bonneville Dam to facilitate juvenile downstream passage will no longer be needed. Elimination of the March spill would reduce risks to chum salmon redds downstream of Bonneville through reduced nitrogen gas supersaturation.

Cons

- The current program results in incidental take on other listed species in the intensive ocean and lower Columbia fisheries that target the Spring Creek NFH tule fall Chinook and other hatchery fall Chinook stocks.
- The large number of hatchery fish from Spring Creek NFH spawning in the Big White Salmon River, and possible strays into other production areas in the Bonneville Pool, poses genetic and demographics risks to natural populations.
- Does not fully meet in-kind mitigation for John Day Dam.
- A reduction from 15.1 to 10.5 million smolts will decrease contributions to fisheries, unless the 4.6 million shortfall is made up elsewhere (for example, at ODFW's Bonneville Hatchery).
- Elimination of the March release may decrease mean smolt-to-adult survival benefits of the three-stage release at Spring Creek NFH over multiple years because survival rates vary between releases, and the rankings vary annually. In some years, each survival rate (March, April, May release) has been shown to be better than the other two releases.

Alternative 2: Replace Spring Creek NFH tule fall Chinook program with an upriver bright fall Chinook harvest program

Terminate the existing Spring Creek NFH tule fall Chinook program and implement an upriver bright fall Chinook program (10.5 M subyearling smolts).

Pros

- Better meets in-kind mitigation for John Day Dam.
- Contributes to sport and tribal fisheries in Columbia River and ocean harvest. Upriver bright fall Chinook are sought after for harvest, particularly by tribal fishers, because they return to freshwater at a time and physical condition that increases their human consumption value relative to tule fall Chinook.
- Contributes more harvest to southeast Alaska compared to tule fall Chinook.
- The current URB fall Chinook program at Little White Salmon NFH has a relatively high recruit per spawner (7.6 adult recruits per spawner, BY 1990-1999).

Cons

- Upriver bright fall Chinook pose a greater disease risk than tule fall Chinook at Spring Creek NFH, particularly because of reuse water.
- Eliminates the only remaining tule fall Chinook (ESA-listed) hatchery stock above Bonneville Dam.
- Increased risk of straying of out-of-basin stock into listed lower Columbia populations.
- URB fall Chinook contribute less to ocean fisheries off the Washington and Oregon coasts, and more to fisheries in Alaska and British Columbia, compared to Spring Creek NFH tule fall Chinook.
- Tag recovery efforts for URB fall Chinook are not as comprehensive as those for tule fall Chinook due to lack of cooperation by Alaska and Canada compared to recovery efforts along the Washington and Oregon coast.

Alternative 3: Continue tule fall Chinook production as described in Alternative 1 and accommodate hatchery production for restoration of naturally spawning populations in the Big White Salmon River (emphasis on tule fall Chinook reintroduction)

Use the facility to rear fish for reintroduction of native species in the Big White Salmon River after the removal of Condit Dam. This could include spring Chinook, tule fall Chinook, coho, chum, bull trout and steelhead, although tule fall Chinook would most likely be the species of choice based on culture history at Spring Creek NFH. This would also include the recommendations for rehabilitation of Big White Ponds and the reconstruction of a conservation weir for broodstock collection and management

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of the naturally spawning population on the Big White Salmon River (see Spring Creek NFH tule fall Chinook current program recommendations).

Spring Creek NFH has egg incubation and early rearing capabilities, and offsite incubation/rearing capabilities at Big White Ponds. Given the current water reuse system at Spring Creek NFH, only tule fall Chinook should be considered for full-term rearing on station.

The size of the reintroduction program would be up to 350,000 subyearlings with the goal of returning 1,000 adults based on a mean survival rate of 0.3%

Pros

- The number of facilities with a diverse array of rearing environments in relative close proximity to the Big White Salmon River makes Carson NFH, Spring Creek NFH, Big White Ponds, Little White Salmon NFH and Willard NFH attractive sites for rearing fish for reintroduction.
- The removal of Condit Dam offers a unique opportunity in the Columbia River Basin to test a large-scale reintroduction project of an entire river system.
- Offers the opportunity to jump-start populations in the Big White Salmon River that were depleted or extirpated by the construction of Condit Dam and, later, Bonneville Dam.
- Provides a broodstock collection and acclimation site at Big White Ponds on the Big White Salmon River and allows for the control of hatchery influence on the natural populations in the Big White Salmon River.
- Spring Creek NFH hatchery tule fall Chinook have been identified by the Lower Columbia TRT as a potential broodstock source for reintroduction of tule fall Chinook in the Big White Salmon River.

Cons

- Spring Creek NFH is limited as not all species are suitable for rearing on a water reuse system, and water reuse systems are less desirable for rearing multiple species at once.
- May reduce the amount of rearing space available for the current production of fish for ocean treaty harvest and Columbia River harvest.
- The cost of the construction, operation and maintenance of a conservation weir, the rehabilitation of Big White Ponds and other facility improvements is high.
- May increase the risk of disease transfer within the hatchery if multiple species/stocks are maintained, particularly at a facility that depends on re-use water.

Alternative 4: Terminate the program and decommission the facility

Pros

- Reduces incidental take on other listed species in the intensive ocean and lower Columbia River fisheries that target Spring Creek NFH tule fall Chinook.
- Eliminates hatchery strays from Spring Creek NFH into Big White Salmon River and possible strays into other production areas in the Bonneville Pool.
- Eliminates the need for coordination with COE and BPA to have spills and favorable juvenile passage conditions through Bonneville Dam in March.
- Eliminates the March spill that poses a potential risk to chum salmon redds through nitrogen gas supersaturation downstream from Bonneville Dam.

Cons

- Significantly reduces contribution of fall Chinook to sport, tribal and commercial fisheries in the Columbia River and ocean harvest, including continental US (Washington and Oregon coastlines), British Columbia and Southeast Alaska.
- Surplus tule fall Chinook adults would not be available for food banks and tribal subsistence and ceremonial purposes.
- Eliminates a mitigation hatchery program with high productivity.
- Increases the demographic extinction risks to ESA-listed tule fall Chinook in the Lower Columbia River Chinook ESU by eliminating the demographic buffer and genetic reserve provided by the broodstock.
- Eliminates an important broodstock source for reestablishing upper Gorge and Big White Salmon tule fall Chinook populations.
- Reduces the Service's outreach capabilities for the Gorge region via closure of Spring Creek NFH.

Recommended Alternatives

Short-term goal (up to 15 years): Continue tule fall Chinook production as described in Alternative 1, and accommodate hatchery production for restoration of naturally spawning fall Chinook in the Big White Salmon River as described in Alternative 3.

This alternative would include a mitigation program reduction to 10.5 million fall Chinook smolts for on-station release. This would be compatible with the current Spring Creek reprogramming proposal and recent comanager discussions to modify current mitigation strategies for John Day Dam. Those strategies call for increased releases of URB-fall Chinook upstream of John Day Dam (for example, (e.g., in the Yakima River and from Ringold Springs on the mainstem Columbia River) and reduced releases of URB fall Chinook in the Bonneville pool region.

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The conservation element of this proposal is linked to restoration strategies for the Big White Salmon watershed following the planned removal of Condit Dam. Design of this program would be based on ongoing genetic studies to determine level of potential divergence between Spring Creek NFH broodstock and natural origin tule fall Chinook in the Big White Salmon River. The initial stage of implementation could incorporate a rescue program, taking naturally spawning adults from the Big White Salmon prior to Condit Dam removal. The broodstock would be collected on the Big White Salmon River, and offspring would be differentially marked and released back into the Big White Salmon after the period of high sediment load immediately following dam removal. Alternately, tule fall Chinook returns to Spring Creek NFH could be used as initial broodstock for outplanting in the Big White Salmon. Over time, a conservation weir on Big White Salmon would then be used to collect broodstock as well as exclude hatchery strays from the natural production area.

The fall Chinook conservation program would be of limited duration: It would likely last for approximately three generations (up to 12 years). Optimally, the outplanting program would decrease in size over time as the size of the naturally spawning population increases.

Alternative management operations of the ladder at Spring Creek NFH should be considered as a means of further reducing possible effects of fall Chinook hatchery strays on natural production areas within Bonneville Pool.

Big White Salmon ponds have the capability to assist with restoration of other species including spring Chinook, winter steelhead, coho, and chum salmon. Present steelhead and coho populations in the Big White Salmon River are expected to increase in numbers without use of hatchery supplementation because of the innate reproductive capabilities of coho and the potential role that resident rainbow trout upstream of Condit Dam will contribute to reestablishment of anadromous populations. Spring Chinook and chum salmon will most likely require reintroduction methods requiring the use of hatchery incubation, rearing, and acclimation capabilities. Continued discussion and coordination with co-managers will be required to determine possible conservation roles for Service facilities.

Long-term goal (15+ years): Continue recommended mitigation hatchery program (Alternative 1), including a revaluation of regional management priorities and continued implementation of methods for managing stray hatchery-origin fish in the Bonneville Pool consistent with conservation and recovery objectives of the region.

VI. Little White Salmon River Watershed

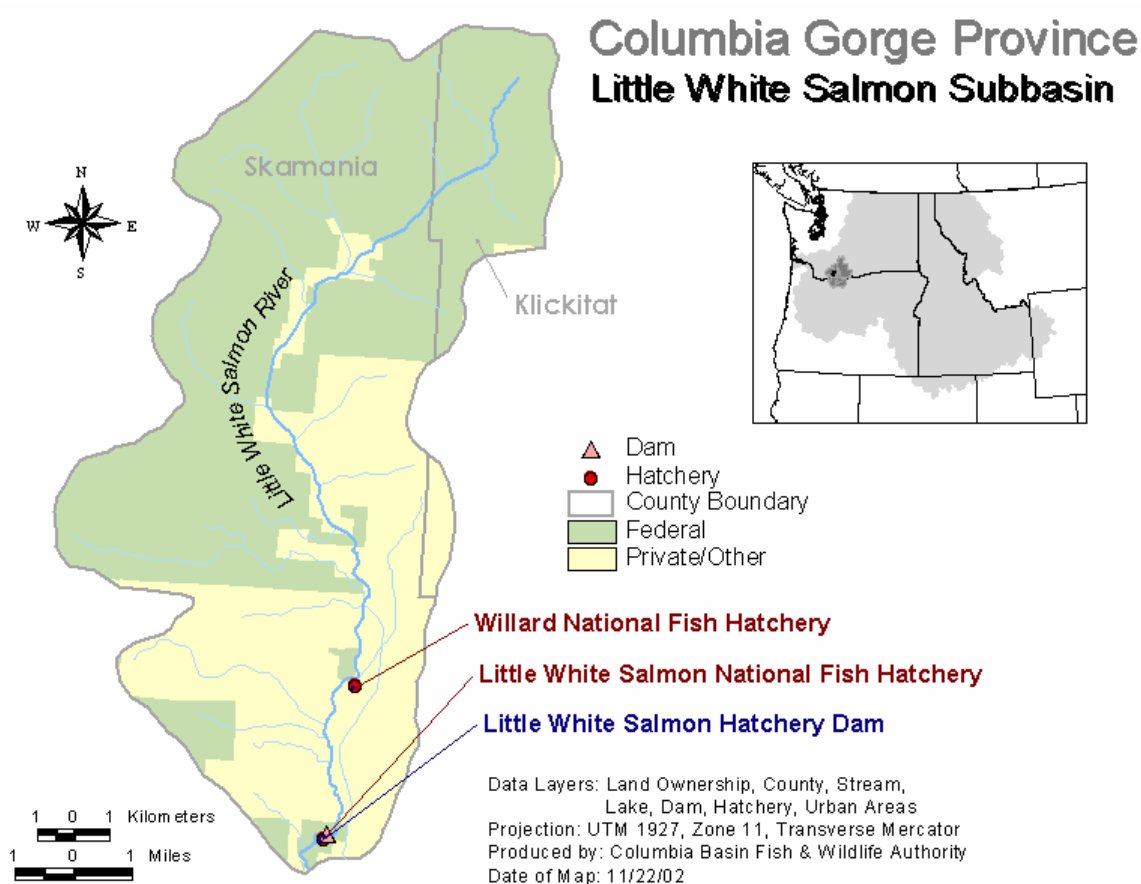


Figure 5. Little White Salmon River Watershed⁵⁵

⁵⁵ APRE Columbia Gorge Province Report -
<http://www.nwcouncil.org/fw/apre/provincereports/Columbia%20Gorge%20Province%20Report.doc>

Little White Salmon River Overview⁵⁶

Watershed Description

The headwaters of the Little White Salmon River originate along the eastern crest of the Cascade Mountains in south central Washington. The basin encompasses approximately 136 square miles and enters the Columbia River at RM 162. Anadromous fish use is limited in this basin, with only about 500 meters of available spawning habitat in the lower river because of a natural barrier falls immediately upstream of the Little White Salmon NFH at RM 2. Basin topography varies from gentle slopes formed by lava flows and volcanic cones to steep, rugged landforms (WDFW 1990). The basin drains the Indian Heaven Wilderness and Monte Cristo Range in the northwest and northeast portions of the basin, respectively. A major feature is the *Big Lava Bed*, which constitutes a large area in the western portion of the subbasin. The geology of this area, and the Indian Heaven Wilderness to the north, consists of relatively young quaternary basalt and andesite lava flows, of which the Big Lava Bed is a recent (8,000 years ago) example. In contrast, the area in and around the Monte Cristo Range is composed of older, tertiary deposits of volcanic tuff and pyroclastic flows. This latter area makes up much of the mainstem of the Little White Salmon and is susceptible to large, deep seated landslides due to decomposition of the older deposits into silts and clays. Deep soils of glacial origin are present in alluvial deposits in valley bottoms. These soils also tend to be susceptible to deep-seated landslides. Elevation in the basin ranges from 5,300 to 50 feet above sea level in the mountain peaks and at the mouth, respectively. Major tributaries to the Little White Salmon River are Rock Creek, Lava Creek, Moss Creek, Wilson Creek, Cabbage Creek, Berry Creek, Homes Creek, Lusk Creek, and Beetle Creek.

Fisheries

The Little White Salmon River supports terminal fisheries on hatchery-origin spring Chinook and *upriver bright* fall Chinook released from Little White Salmon NFH. These fisheries occur primarily in Drano Lake, a natural depression near the mouth of the Little White Salmon River inundated by the pool behind Bonneville Dam. The hatchery is located on the Little White Salmon River approximately two miles upstream from the Columbia River. Fishing opportunities for anadromous salmonid fishes in the Little White Salmon River are restricted because of a natural barrier falls immediately upstream from the hatchery.

Conservation

Fall Chinook (“tule” strain) and chum salmon are native to the Little White Salmon River. Spawning habitat for both species was significantly reduced in the early 1940s when the pool behind Bonneville Dam inundated the lower portion of the Little White Salmon River. Historical abundance of tule fall Chinook is estimated as 4,000 to 5,000 adult fish, but only 100 to 200 adult fish are estimated to currently spawn annually in the Little White Salmon River, and that natural spawning is heavily

⁵⁶ From: *Lower Columbia Salmon Recovery and Fish and Wildlife Subbasin Plans, Volume II-Subbasin Plan, Chapter K-Little White Salmon*, December 15, 2004. Lower Columbia Fish Recovery Board, Longview, Washington (Available at: <http://www.nwcouncil.org/fw/subbasinplanning/lowerColumbia/plan/>; see also Appendix B of this report).

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influenced by hatchery-origin fish. Chum salmon may be functionally extirpated from the Little White Salmon River. Both fall Chinook and chum in the Columbia River Gorge area are listed as *threatened* under the ESA. When considering biological objectives for recovery of natural populations, fall Chinook in the Little White Salmon River are combined with fall Chinook in the Wind River to form the *upper Gorge fall Chinook population*. Similarly, chum salmon in Gorge tributaries are combined to form the *upper Gorge chum population*. The abundances of fall Chinook and chum have declined to a fraction of their historical levels (see tables below).

A fluvial population of bull trout uses Drano Lake.⁵⁷ For example, a bull trout tagged in Hood River was recovered by WDFW personnel in Drano Lake and was observed to be preying on salmon smolts. Tribal pikeminnow gillnetters also observed a bull trout in Drano Lake. Bull trout are not found in the Little White Salmon River upstream of the natural barrier falls upstream from the hatchery.⁵⁸

Habitat

Very little habitat is available to anadromous fish in the Little White Salmon River. Historically, anadromous fish could ascend as far as RM 2, where a barrier falls (Spirit Falls) blocked upstream passage, and possibly up to RM 3 where larger falls exist. Approximately 1 mile of the most productive habitat was inundated in the early 1940s by the pool behind Bonneville Dam. A portion of that flooded habitat now forms Drano Lake. Most natural spawning of salmon occurs in a 400-500 meter stretch of free-flowing river immediately upstream of Drano Lake and below the barrier dam that diverts fish into the adult holding ponds at Little White Salmon NFH. High temperatures and other conditions in Drano Lake might affect passage. Another dam is located on Lost Creek (north) adjacent to a diversion intake. Resident fish species upstream of the Little White Salmon NFH are affected by past land use practices (logging, farming, road building, etc.) A survey of culverts in 1995 revealed that 15 of 26 culverts presented migratory or movement barriers to resident fish (USFS 1995).

Current Status of Salmonid Stocks

The co-managers have identified nine principal salmonid stocks in the Little White Salmon River and at the hatchery, one of which (tule fall Chinook salmon) considered severely depressed or extirpated and another considered extirpated (chum salmon).

- Tule fall Chinook salmon (natural, severely depressed or extirpated)
- *Upriver bright* fall Chinook (segregated hatchery)
- Spring Chinook salmon (segregated hatchery)
- Chum salmon (natural, extirpated)
- Coho salmon (segregated hatchery)⁵⁹

⁵⁷ *Columbia Gorge Mainstem Subbasin Plan, prepared for the Northwest Power and Conservation Council by Oregon Department of Fish and Wildlife, May 28, 2004 (Available at: <http://www.nwcouncil.org/fw/subbasinplanning/columbiagorge/plan/>)*

⁵⁸ *Little White Salmon River watershed analysis by the Mt. Adams Ranger District of Gifford Pinchot National Forest, September 1995*

⁵⁹ *Releases of hatchery-origin coho salmon into the Little White Salmon River were terminated in 2004. Smolt to adult survival rates for that discontinued program ranged from 0.1% to 1.1% (broodyears 1992-2001). Willard*

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- Cutthroat trout (natural, resident)
- Rainbow trout (natural, resident)

The following tables summarize the current status and management premises of those stocks, as identified by the co-managers. Habitat assessments were obtained from: *Northwest Power and Conservation Council. 2004. Lower Columbia River Subbasin Plan, Volume II, Chapter K: Little White Salmon River* (available at: <http://www.nwcouncil.org/fw/subbasinplanning>). Population viability assessments were obtained from: *Lower Columbia Technical Recovery Team, July 2004 report. Status evaluation of salmon and steelhead populations in the Willamette and Lower Columbia River* (available at: <http://www.nwr.noaa.gov/salmon-recovery-planning>).

Table 17. Little White Salmon River tule fall Chinook

Management Premises and Goals	
<i>ESA Status</i>	<i>Threatened.</i> Included with the <i>Lower Columbia River Chinook Salmon ESU.</i>
<i>Biological Significance</i>	<i>Very Low.</i> Natural spawning is heavily influenced by introduced, non-ESU hatchery-origin fish (<i>upriver bright</i> fall Chinook) from Bonneville Hatchery and Little White Salmon NFH. Some tule fall Chinook strays from Spring Creek NFH have also been recovered in the Little White Salmon River.
<i>Population Viability</i>	<i>Very Low.</i> Historical abundance of tule fall Chinook in the Little White Salmon River is estimated as 4,000 to 5,000 adult fish, but current estimates range from 100 to 200 adult fish, TRT score for the upper Gorge Fall-run (Washington) strata is 0.85, which implies a 50% risk of extinction over the next 100 years.
<i>Habitat</i>	<i>Very Low.</i> Bonneville Dam inundated the primary habitat for tule fall Chinook in the river (lower two miles). Spawning is now restricted to a one-fourth mile stretch of the river immediately upstream from Drano Lake and downstream of Little White Salmon NFH. Smolt capacity now estimated at 73,652 smolts (Little White Salmon River Subbasin Plan 2004) There are few intact spawning areas remaining for the Columbia River Gorge populations (TRT 2004).
<i>Harvest</i>	<i>Moderately High.</i> Harvested at rates similar to tule fall Chinook from Spring Creek NFH.

NFH currently assists with the reintroduction and propagation of coho salmon in the Wenatchee River (Washington), but no juvenile releases or adult recaptures occur presently in the Little White Salmon River.

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Table 18. Little White Salmon River hatchery upriver bright (URB) fall Chinook (Little White Salmon NFH)

Management Premises and Goals	
<i>ESA Status</i>	<i>Not Listed.</i> Excluded from the <i>Lower Columbia River Chinook Salmon ESU</i> .
<i>Biological Significance</i>	<i>Low.</i> This is an introduced hatchery stock. Upriver bright fall Chinook salmon are not native in the Little White Salmon River or the Columbia River Gorge region.
<i>Population Viability</i>	<i>High.</i> A 10-year average of approximately eight recruits per spawner (R/S) for broodyears 1990-99.
<i>Habitat</i>	<i>Very Low.</i> Natural spawning is restricted to a one-fourth mile stretch of the river immediately upstream of Drano Lake and downstream of Little White Salmon NFH.
<i>Harvest</i>	<i>High.</i> Based on coded-wire tag recoveries, an average 1,227 fish were harvested in the Columbia River and 1,973 were harvested in the ocean for broodyears 1990-99 (10-year average). Coded-wire tag recoveries may be under-reported for the Drano Lake fishery, where the average sport catch was estimated as 467 fish for return years 1994-2003 (Joe Hymer, WDFW, pers. comm.). A tribal fishery on URB fall Chinook salmon in Drano Lake was initiated recently with 3,571 and 3,866 fish harvested in 2004 and 2005, respectively (Roger Dick Jr., Yakama Nation, pers. comm.).
Hatchery Program	
<i>Facilities</i>	Little White Salmon NFH.
<i>Type</i>	Segregated.
<i>Authorization and Funding</i>	Mitchell Act and John Day Dam mitigation.
<i>Primary Purpose</i>	Harvest.
<i>Secondary Purposes</i>	Conservation and harvest via outplants of smolts into the Yakima River, Washington.
<i>Broodstock Origin(s)</i>	Wild fish trapped at Bonneville Dam beginning in 1977 and propagated subsequently at Bonneville Hatchery. The actual geographic origin of the fish trapped at Bonneville Dam is unknown. The stock was first transferred to Little White Salmon NFH from Bonneville Hatchery in 1988.

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Table 19. Little White Salmon River hatchery spring Chinook (Little White Salmon NFH)

Management Premises and Goals	
<i>ESA Status</i>	<i>Not Listed.</i> Excluded from the <i>Lower Columbia River Chinook Salmon ESU.</i>
<i>Biological Significance</i>	<i>Low.</i> This is an introduced hatchery stock. Spring Chinook are not native to the Little White Salmon River. This hatchery stock has been used for reintroducing spring Chinook salmon into watersheds where the native populations were extirpated, for example Umatilla and Walla Walla rivers in eastern Oregon.
<i>Population Viability</i>	<i>Medium.</i> A 10-year average of greater than three recruits per spawner (R/S) for brood years 1990-99.
<i>Habitat</i>	<i>None.</i> Virtually no natural spawning or rearing habitat exists for spring Chinook in the Little White Salmon River, although Drano Lake could provide some rearing habitat.
<i>Harvest</i>	<i>High.</i> Based on coded-wire tag recoveries, an average 1,289 fish were harvested, broodyear 1990-99 10-year average. It appears that coded-wire tag recoveries are under-reported for the Drano Lake fishery, where the average sport catch was estimated at 1,861 and the average tribal catch was estimated at 2,026 for return years 1994-2003 (Joe Hymer, WDFW, written communication). Over this same 10-year period, an average 1,276 were also surplus hatchery returns distributed to the Yakama Nation for ceremonial and subsistence purposes.
Hatchery Program	
<i>Facilities</i>	Little White Salmon NFH.
<i>Type</i>	Segregated.
<i>Authorization and Funding</i>	Mitchell Act.
<i>Primary Purpose</i>	Harvest.
<i>Secondary Purposes</i>	Conservation. Re-introduction of spring Chinook to areas upstream of Bonneville Dam.
<i>Broodstock Origin(s)</i>	Wild Spring Chinook salmon trapped at Bonneville Dam, 1955-64 (Carson stock origin).

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Table 20. Little White Salmon River Chum Salmon

Management Premises and Goals	
<i>ESA Status</i>	<i>Threatened.</i> Included with the <i>Columbia River Chum Salmon ESU.</i>
<i>Biological Significance</i>	<i>Not applicable.</i> There are no known natural spawning aggregations of chum salmon upstream of Bonneville Dam (TRT 2004). The pool behind Bonneville Dam eliminated most of the spawning habitat for chum salmon in the Big White Salmon River.
<i>Population Viability</i>	<i>Extirpated.</i> The historical abundance of chum salmon in the Little White Salmon River is unknown. The TRT provided a weighted average viability score of 0.18 (very high risk of extinction or functionally extinct) for upper Columbia Gorge populations of chum salmon in Washington. However, no self-sustaining natural populations of chum salmon are present upstream of Bonneville Dam
<i>Habitat</i>	<i>Very Low.</i> The principal spawning habitat historically for chum salmon in the Little White Salmon River is currently flooded by the pool behind Bonneville Dam.
<i>Harvest</i>	<i>Not applicable.</i>

Other Species of Concern

Table 21. Additional native fish species present in the Little White Salmon River⁶⁰

Common name	Scientific Name
Salmonid	
Cutthroat trout (resident)	<i>Oncorhynchus clarki</i>
Rainbow trout (resident)	<i>Oncorhynchus mykiss</i>
Mountain whitefish	<i>Prosopium williamsoni</i>
Non-Salmonid	
White Sturgeon	<i>Acipenser transmontanus</i>
Pacific lamprey	<i>Lampetra tridentata</i>
Longnose dace	<i>Rhinichthys cataractae</i>
Speckled dace	<i>Rhinichthys osculus</i>
Redside shiner	<i>Richardsonius balteatus</i>
Sculpins	<i>Cottus</i> sp.
Three-spine stickleback	<i>Gasterosteus aculeatus</i>

⁶⁰ Columbia Gorge Mainstem Subbasin Plan, prepared for the Northwest Power and Conservation Council by Oregon Department of Fish and Wildlife, May 28, 2004 (Available at: <http://www.nwcouncil.org/fw/subbasinplanning/columbiagorge/plan/>)

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Salmon and Steelhead Hatcheries in the Watershed

Little White Salmon and Willard National Fish Hatchery Complex (U.S. Fish and Wildlife Service)

Little White Salmon NFH is located in south-central Washington, one mile upstream of the mouth of the Little White Salmon River. The Little White Salmon River joins the Columbia River at river mile 162. Drano Lake, a natural impoundment at the mouth of the river, is a popular sport and tribal fishing area. The hatchery encompasses 433 acres of land including easements. A natural barrier falls immediately upstream of the hatchery precludes upstream migration of salmon and steelhead.

Little White Salmon NFH was established in 1898, although fish propagation began two years earlier in 1896 on an experimental basis. The hatchery was built to address the decline of tule fall Chinook, the native salmon stock that returned to the Little White Salmon River. This site was selected because it was considered one of the principal spawning areas of Chinook salmon. Assistant U.S. Fish Commissioner William Ravenel, describing the significance of the hatchery site noted in 1898: “During the season, the salmon appeared in such large numbers below the rack that the Indians often speared two and three at one cast of the spear.”

The Little White Salmon NFH was placed in operation following official Congressional authorization with the intent to supplement the commercial fishing industry. The hatchery’s role expanded during the 1930’s under the Mitchell Act to one of mitigation for the loss of habitat due to the completion of Bonneville Dam in 1938.

The Little White Salmon NFH currently propagates three stocks of Chinook: “*upriver bright*” (URB) fall Chinook *Carson-strain* spring Chinook for on-station releases to support harvest as partial mitigation for hydropower dams on the Columbia River, and White River spring Chinook to support conservation and recovery of this endangered population in the Wenatchee River basin (near Leavenworth, Washington). The latter program supports a captive breeding program and is not reviewed here because it was transferred to Little White Salmon NFH only recently in 2006.

Willard NFH is located on the Little White Salmon River approximately five miles upstream of the Little White Salmon NFH. A barrier falls immediately upstream of the Little White Salmon NFH precludes upstream migration of salmon and steelhead to Willard NFH. However, Willard NFH can release juvenile salmonids which migrate downstream over the falls to the Columbia River. In the past, adult broodstock were collected and spawned at Little White Salmon NFH, and the fertilized eggs were transported to Willard NFH for incubation, hatch, and rearing prior to release. The Columbia River Research Laboratory, a satellite research station of the Western Fisheries Research Center, U.S. Geological Survey (USGS), Seattle, WA, is co-located adjacent to Willard NFH (Cook, WA). Willard NFH was authorized by an amendment to the Mitchell Act to mitigate for fisheries lost due to the construction and operation of hydroelectric dams on the Columbia River. The earliest reports available indicate that Willard NFH was initially planned and constructed as a fall Chinook facility. However, the very cold water temperatures at Willard NFH inhibited the rearing of fall Chinook, but those temperatures were adequate for rearing coho salmon and spring Chinook.

For many years, 1.0 million yearling coho salmon were released on site annually from Willard NFH, with brood stock collection of returning adult fish at Little White Salmon NFH. Also 500,000 coho salmon had been released annually in the Yakima River as part of the Yakama Nation’s coho reintroduction program, but responsibility for that program was transferred to Eagle Creek NFH, OR in 2004 when the coho program at Willard NFH was discontinued due to shortfalls in Mitchell Act

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funding. Since 2004, no fish have been released into the Little White Salmon River from Willard NFH. However, the hatchery currently rears coho salmon, in support of the Yakama Nation's coho reintroduction program in the Wenatchee River.

In 1975, Little White Salmon NFH and Willard NFH were administratively combined to form the Little White Salmon/Willard NFH Complex (LWS/Willard Complex). Administration of the Complex occurs at the Little White Salmon facility. Complex facilities are managed, staffed, and budgeted as a single entity. The Complex has 12 full-time employees, three of which are stationed at Willard NFH. The staff includes the Complex Manager, Deputy Complex Manager, Hatchery Manager at Willard NFH, two Fishery Biologists, a Maintenance Worker, and five Animal Caretakers.

Operational budget for the complex in FY2006 was \$1,211,424. Monitoring and evaluation (M&E) costs for FY2006 were approximately \$422,227 and included \$274,966 and \$122,261 for tagging at Little White Salmon and Willard NFHs, respectively). Capital Improvements to the Little White Salmon NFH Complex have totaled \$7,055,475 during the period 2000- 2006.

Funding Source: FY2006	Amount
NOAA- Fisheries(Mitchell Act)	\$774,376
Bonneville Power Administration	\$207,389
Corps of Engineers	\$63,699
USFWS Quarters	\$90,213
USFWS Hatchery Cyclical Maintenance	\$75,747
Total	\$1,211,424

Little White Salmon NFH Upriver Bright (URB) Fall Chinook

Operator: U.S. Fish and Wildlife Service

Summary of Current Program

Goals

- **Harvest goal:** Support commercial, tribal, and recreational fisheries in marine waters, the lower Columbia River, Drano Lake, and the Yakima River. Achieve a 10-year average of 0.4% smolt-to-adult survival that includes harvest plus escapement back to the hatchery. Although not specifically stated as a program goal, the desired survival would lead to a mean harvest goal of approximately 3,200 adult URB fall Chinook annually based on the current size of the program.
- **Broodstock escapement goal:** Provide an escapement back to the hatchery of at least 930 hatchery-origin adult female fall Chinook (1,937 adults total). Achieve a 0.1% smolt-to-adult return rate back to the hatchery to provide sufficient numbers of adult fish for brood stock.
- **Conservation goal:** The hatchery program has no direct conservation goals within the Little White Salmon River. Upriver bright fall Chinook are not native to the Little White Salmon River and are not part of the lower Columbia River Chinook ESU. However, releases of URB fall Chinook in the Yakima River are intended to help restore a natural population via supplementation natural spawning.
- **Escapement goal for natural-origin adults:** Not applicable in the Little White Salmon River. A natural population of upriver bright fall Chinook salmon does not exist in the Little White Salmon River.
- **Research, education, and outreach goals:** No specific short or long term goals, plans, or programs currently exist.

Objectives

- Trap and spawn a minimum of 1,937 adult URB fall Chinook (minimum 930 spawned females) to yield a minimum of 4.46 million green eggs.
- Release 2.0 million subyearling smolts directly from the hatchery into the Little White Salmon River (U.S. v. Oregon agreement).
- Transfer 1.7 million subyearlings to the Yakama Nation's Prosser Hatchery acclimation ponds between February and the first week of April for release into the Yakima River.

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Program Description

Development of the “mid-Columbia” or Columbia Gorge URB fall Chinook brood stock was initiated in 1977 when adult URB fall Chinook migrating upstream were trapped from the Bonneville Dam fish ladder and spawned at Bonneville Hatchery. An upriver bright fall Chinook program was established at Little White Salmon/Willard complex in 1988. However, in 1998, eyed eggs were imported from Klickitat, Lyons Ferry, Bonneville, Priest Rapids, and Umatilla hatcheries to make up for eggs lost to mechanical failures. Returning adults are spawned in the fall, and their progeny are released (into the Little White Salmon River) or transferred (to the Yakima River) the following spring as subyearlings.

Assessment of Current Program

Operational Considerations

Listed below are the principal operational components of the hatchery program that the Review Team considered as part of its review.

Broodstock Choice and Collection

- A barrier dam/weir on the Little White Salmon River diverts adults into the ladder and adult holding pond. The ladder is pulsed until about October 20 so that excess adults to program needs are available to the terminal fishery in Drano Lake. After that time, the ladder is left open throughout the return to reduce straying to the Big White Salmon River and surrounding tributaries. This latter protocol began in 2006
- Stock is excluded from the Lower Columbia River Chinook Salmon ESU.

Hatchery and Natural Spawning, Adult Returns

- Avg. egg take = 5.5M/year (1990-2001) Avg. number of adults spawned 1990-2001 = 2,320 (avg. no. of females 1,204). Avg. No. of males = 1,116. 3.5% of the males are jacks (2-years old). (4,800 – 5,000 eggs/female). Approx. 48% females. From 1990 to 2001 an average of 5,429,289 eggs (range 4,192,595 – 6,675,395) have been taken from fish returning to the hatchery.
- Avg. SAR to the hatchery = 0.22%, BY1982-2001.
- *On-station release:* Harvest and returns from this release average (for broodyears 1990-1999): hatchery recoveries 38% (3,131), Columbia River harvest 15% (1,227), ocean harvest 24% (1,973), spawning ground 22% (1,827). Including all these recoveries, smolt to adult survival for the same 10-year period has averaged 0.37%.
- *For the Yakama Nation, Prosser Hatchery component:* Average for broodyears 1990-1999 (excluding BY 1991-1993): hatchery recoveries 0.1% (8), Columbia River harvest 32% (1,605), ocean harvest 33% (1,677), spawning ground 35% (1,750).
- Based on coded-wire tag recoveries, an average of 13% of the fall Chinook handled during spawning and surplus sampling at Little White Salmon NFH came from strays from other

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hatcheries during 2000-2005 (CRiS database). Most of these strays originated from Bonneville hatchery.

- Spawning occurs from mid-September to late October.
- Adults are randomly spawned pairwise (1:1); up to 5% of the males are jacks (2-year old males).
- Less than 40% of coded-wire tag recoveries occur at the hatchery, while 10% of the reported tag recoveries occurred upstream (Columbia River) of the hatchery. Nearly 80% of those upstream recoveries occurred in the Big White Salmon River.
- URB fall Chinook, which are not native to the Columbia River Gorge region, stray and spawn within the historic range of tule fall Chinook. This is of particular concern in the Big White Salmon River where comanagers have identified restoration of a self-sustaining natural population of tule fall Chinook as a post Condit dam removal goal. The genetic constitution of the existing naturally spawning population in the Big White Salmon river is unknown. Genetic studies are currently underway to address these uncertainties; however, M&E funding is limited.
- Fall Chinook provide important ocean fisheries, including contribution to U.S. Canada treaty numbers.
- Fall Chinook are harvested in ocean commercial and recreational fisheries from Oregon to Alaska, and in Columbia River commercial gill net and sport fisheries.
- URB fall Chinook migrate farther north in the ocean than lower Columbia Chinook, with most ocean harvest occurring in Alaska and Canada.
- URB fall Chinook are also an important sport fish in the mainstem Columbia from the mouth upstream to the Hanford Reach, and an important commercial fish from August into early October.
- URB fall Chinook destined for above Bonneville Dam are extremely important fish for Treaty Indian commercial and subsistence fisheries during August and September.
- CWT data analysis of the 1989-94 brood URB fall Chinook from Priest Rapids Hatchery indicates that the majority of the URB fall Chinook stock harvest occurred in Alaska (24%), British Columbia (23%), and Columbia River (42%) fisheries during the mid 1990s.
- Columbia River harvest of URB fall Chinook is limited to 31.29% (23.04% Indian/ 8.25% non-Indian) based on Snake River wild fall Chinook ESA limits.
- An estimated mean of 1,973 and 1,227 URB fall Chinook from Little White Salmon NFH were harvested annually (brood years 1990-1999) in marine and lower Columbia River fisheries, respectively. A mean of 3,131 URB fall Chinook for brood years 1990-1999 returned annually to Little White Salmon NFH.
- Fall Chinook originating upstream of Bonneville Dam are subject to Federal Court Agreements regarding Indian and non-Indian harvest sharing.

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- For BY2007, Yakama Nation requested 4.0 million eyed eggs for incubation and rearing at Klickitat Hatchery for release into the Klickitat River. The long-term goal is to maintain a self-sustaining broodstock in the Klickitat subbasin at the proposed Wahkiacus Hatchery. From 1986 to 2006, the 4.0 million eyed eggs had been provided to Klickitat Hatchery from Priest Rapids Hatchery (WDFW; funded by Grant County PUD). Grant County PUD is no longer funding the collection and transfer of eggs from Priest Rapids Hatchery to Klickitat Hatchery.
- Eggs and fry, totaling 1.7 million, are transferred to the Yakama Nation's Prosser Hatchery as part of the US. v. Oregon mandates.

Incubation and Rearing

- Excess eggs are buried on station.
- Trays are initially loaded at 1 female per tray (average of 4,800 eggs per tray). Then after shocking and enumeration, 5000 eggs are loaded per tray.
- Eggs are incubated with single pass spring and well water and then supplemented with river water as needed to control temperature. Incubation temperature is 42-48 °F. Flows are 3 gpm initially and 5 gpm after first hatch.
- After hatch and yolk-sac absorption, fry are transferred directly to outdoor ponds (1,750 TUs required).
- Transfers of eggs and fish to the Yakama Nation occurs before the end of February.
- Predation and disease transmittance within the facility is a possibility from otters (*Lontra canadensis*) and to a lesser extent mink (*Mustela vison*) and American Water Dipper (*Cinclus mexicanus*).

Release and Outmigration

- 400k of the 2.0 M Chinook released on station are CWT (200k AD + CWT, 200k CWT only). The remainder are ad-fin clipped only. 100% Ad-fin clipping began in 2005.
- Release size objective = 90 fish/lb. This release size objective is based on other Chinook programs and has not been evaluated specific to little White Salmon NFH.
- The screens are pulled 24 hours before the fish are force released.

Facilities and Operations

- There are twenty-two 110' x 10' wide raceways with baffles that have catwalks several feet above the raceways which are approximately three feet deep with water. OSHA has approved the raceways as they are currently operated.
- Pollution abatement vault is currently insufficient for larger volumes of water and restricts cleaning procedures; however, effluent water has always complied with NPDES standards.

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- Reliance on reimbursable funding, funding shortfalls have resulted in program reductions (i.e. Willard coho harvest program). Mitchell Act does not pay for facility renovations or maintenance. Program improvements may not occur because of lack of reimbursable funding to cover those costs.
- Spawning area would need to be increased if reprogramming of Spring Creek NFH occurs and increased production of URB fall Chinook at Little White Salmon NFH occurs. Reprogramming would require the handling of twice as many adults currently processed. Also, returning mass marked adults will require electronic sampling devices that will not fit into the current spawning area.
- Electro-anesthesia proposed for increased program size of URB due to Spring Creek reprogramming.
- Inline flow meters would allow spring water use to be monitored.
- Washington Department of Fish and Wildlife plants trout upstream of the anadromous barrier. The screen on the water intake for LWS is inadequate for avoiding entrainment of juvenile fish and may be a source of disease transmission to the hatchery. Lamprey have been observed occasionally in the hatchery water supply or settling basin. No other entrained fish have been reported.
- USGS research facility (Cook Lab) located just downstream of the Willard NFH and upstream of LWS NFH brings in foreign fish for research, but effluent water goes through an ozonator and/or is chlorinated before the water enters the Little White Salmon River.
- Fish brought into the Willard NFH pose a potential disease risk to fish at the downriver facilities.
- A remote incubation facility (Carson Depot Springs) is on leased property with no security fence. Intruders have broken into the building in the past, but the facility now has an intruder alarm with a new radio base station and pager system tied to door alarms. However, given its location away from Little White Salmon NFH, security is a concern. Upgrades to plumbing, wiring and the interior were performed in 2005 and 2006, and a water level alarm probe on the water supply line was installed. The water outflow from the building is not treated.

Research, Education, and Outreach

- M&E support from reimbursable sources is inadequate. For example, funds for conducting control: treatment hatchery evaluations and in-river survival studies (PIT tags) are not available and need to match the program needs.
- The visitors area is helpful but it could use enhancements. Also, on-station outreach programs/plans are a low priority relative to proposed program changes.
- Little White Salmon NFH is participating in a Mitchell Act funding outreach team.
- Mitchell Act does not fund M&E activities. M&E needed for understanding genetic risks of releasing URB fall Chinook in Bonneville pool areas.

Benefit and Risk Assessment

BENEFITS CONFERRED TO THE PROPAGATED STOCK AND LOCAL COMMUNITY

In the context of all possible harvest, conservation, and other benefits that a hatchery program can confer to the propagated stock and local community,⁶¹ the Review Team identified the following benefits of this hatchery program:

Harvest Benefits

- URB fall Chinook are sought after for harvest, particularly by tribal fishers, because they return at a time and condition that makes the salmon very valuable.
- A tribal fishery on URB fall Chinook in Drano Lake was initiated recently, with 3,571 fish harvested in 2004 and 3,866 fish harvested in 2005.
- The sport harvest on URB fall Chinook in Drano Lake averaged 467 fish annually, 1994-2003.
- Little White Salmon NFH provides harvest benefits of: Columbia River harvest 15% (1,227), ocean harvest 24% (1,973) (data from BY 1990-1999). Ocean harvest predominantly occurs in Alaska and British Columbia.

Conservation Benefits

- None identified.

Research, Education, Outreach and Cultural Benefits

- Tribal harvest and surplus adults trapped at the hatchery provide a cultural benefit to Columbia River tribes. Excess adults provided to tribes for ceremonial and subsistence purposes.
- Approximately 5,000 people visit the hatchery annually.
- Little White Salmon NFH staff make presentations about the facility to local clubs and organizations.

BENEFITS CONFERRED TO OTHER STOCKS, SPECIES, AND COMMUNITIES

In the context of all possible harvest, conservation, and other benefits that a hatchery program can confer to other species and stocks,⁶² the Review Team identified the following benefits of this program:

Harvest Benefits

- Ocean harvest predominantly occurs in Alaska and British Columbia.

⁶¹ See the "Components of This Report" section for a summary description of the potential benefits and risks considered by the Review Team.

⁶² Ibid.

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- *For Yakama Nation Prosser Hatchery component:* Average for broodyears 1990-1999 (excluding BY 1991-1993): hatchery recoveries 0.1% (8), Columbia River harvest 32% (1,605), ocean harvest 33% (1,677), spawning ground 35% (1,750).

Conservation Benefits

- For Yakama Nation Prosser Hatchery component: Approximately 35% of all recoveries are found on spawning grounds (if properly integrated broodstock, see also genetic risk below).

Research, Education, Outreach and Cultural Benefits

- Double index tagging provides harvest exploitation rates on wild stocks in the Columbia River. This may be useful for evaluating selective fisheries.
- Little White Salmon River and Drano Lake are considered a wildlife viewing area. Wildlife is attracted to the area to take advantage of adult carcasses.
- Tribal harvest of fish released at Prosser provide a cultural benefit to Columbia River tribes.

RISKS POSED TO THE PROPAGATED STOCK AND LOCAL COMMUNITY

In the context of all possible genetic, demographic, ecological and other risks that a hatchery program can pose to the propagated stock,⁶³ the Review Team identified the following risks of the hatchery program:

Genetic Risks

- Adults are not randomly collected throughout the entire run.

Demographic Risks

- None identified.

Ecological Risks

- None identified.

Research, Education, Outreach and Cultural Risks

- Constant import of fish to the USGS Columbia River Research Laboratory (located adjacent to the Willard NFH) for on-station research poses fish health risks to fish reared on station at Little White Salmon NFH.

RISKS POSED TO OTHER STOCKS, SPECIES, AND COMMUNITIES

In the context of all possible genetic, demographic, ecological, and other risks that a hatchery program can pose to other stocks and species in a watershed,⁶⁴ the Review Team identified the following risks from the hatchery program:

⁶³ *Ibid.*

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Genetic Risks

- Straying risk to the lower Columbia fall Chinook ESU (i.e. natural populations of tule fall Chinook). Significant levels of straying into the Big White Salmon River have been documented.
- URB fall Chinook from Little White Salmon NFH have been recorded upstream of The Dalles Dam, based on recovery of coded wire tags (approximately 2% of all recoveries), thus posing a straying risk to natural populations upstream of the Dalles Dam.
- The URB fall Chinook program at the Yakama Nation's Prosser Hatchery is classified as integrated with some broodstock obtained from returning adults trapped at Prosser Dam; however, the continued importation of fish from Little White Salmon NFH poses a genetic risk to the establishment of a natural population and a properly integrated hatchery program in the Yakima River. At the present time, URB fall Chinook from the Little White Salmon NFH represent a segregated hatchery stock that pose a genetic risk to natural populations upstream of the pool behind McNary Dam.

Demographic Risks

- Carrying out mainstem fisheries to harvest upriver bright fall Chinook is resulting in high incidental catch of several listed salmonid species, including Snake River B-run steelhead.
- Incidental capture of listed tule fall Chinook (or steelhead rarely) occasionally occurs during adult collection. If collected, they are returned to the river live.

Ecological Risks

- Upriver bright fall Chinook spawning in the Big White Salmon River pose an ecological risk to naturally spawning populations (i.e. superimposition of redds, competition for prey, etc.). Stocks of particular concern are naturally spawning tule fall Chinook and coho, both of which are listed.

Research, Education, Outreach and Cultural Risks

- None identified.

Recommendations for Current Program

The Review Team considered all the benefits and risks outlined in the preceding section. The Team concluded that some of the risks outlined in the preceding section were either minor or their probability of occurrence was small and, thus, did not warrant a proposed change or recommendation for the current program. The recommendations outlined below, in addition to potentially increasing benefits towards achieving program goals, address the identified risks or potential problems considered by the Review Team to warrant a potential modification to the current program. Preceding each numbered recommendation is a brief summary of the issue.

⁶⁴ *Ibid.*

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Program goals and objectives

Issue LW1: *Present program goals for upriver bright fall Chinook are not expressed in terms of numeric outcomes that quantify intended benefits or goals. Harvest contributions vary widely in response to post-release survivals, marine conditions, and harvest regimes in the Columbia River. Like most other Mitchell Act funded programs, this hatchery program lacks specific goals for numeric accountability with respect to harvest, conservation, or other benefits.*

Recommendation LW1: Restate program goals to identify the number of harvestable adult upriver bright fall Chinook desired from this program in the ocean and lower Columbia River. For example, the current program size and desired post-release survivals leads to a mean harvest goal of 3,200 adult upriver bright fall Chinook per year.

Broodstock Choice and Collection

Issue LW2: *Transferring and releasing Little White Salmon upriver bright fall Chinook into the Yakima River may not be consistent with conservation goals for natural populations upstream of the pool behind McNary Dam. URB fall Chinook from the Little White Salmon River represent a genetically-segregated, introduced stock derived from upstream-migrating fish initially trapped at Bonneville Dam in the 1970's. Among fish released into the Yakima River, 35% of the CWT recoveries for returning adults are from the spawning grounds in the Yakima River. The current hatchery stock is not genetically integrated with natural populations in the Yakima River, thus posing genetic risks to restoring a viable, self-sustaining natural population. Another broodstock that is managed as a native mid-Columbia integrated population, for example Priest Rapids fall Chinook, may be a more appropriate stock for meeting the 1.7 million release into the Yakima River.*

Recommendation LW2: Work with the Yakama Nation to identify alternative broodstock sources for the Yakima River if a genetically integrated hatchery stock for assisting with recovery of naturally spawning populations in the Yakima River is desired.

Issue LW3: *Adult fish returning to the facility are not automatically enumerated. The adult fish are visually estimated as they enter the facility. An accurate count would help with ladder operations, broodstock collection, and surplusings.*

Recommendation LW3: Install an electronic fish counter between the ladder and the broodstock pond.

Hatchery and Natural Spawning, Adult Returns

Issue LW4: *The upriver bright fall Chinook from Little White Salmon NFH stray and spawn in the Big White Salmon River. Adults straying and spawning in the Big White Salmon River pose genetic and ecological risks ESA listed Lower Columbia River fall Chinook and other salmon species (e.g., coho salmon).*

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Recommendation LW4a: Assess the feasibility of creating additional terminal fisheries in the Lower Columbia River (including the Wind River, Drano Lake, and the Big White Salmon River) for URB fall Chinook returning to Little White Salmon NFH to reduce the number of strays and surplus fish returning to the facility **or**

Recommendation LW4b: Alternatively, reduce the size of the program and/or the number of fish released on station to reduce surplus adults returning to the hatchery and strays into the Big White Salmon River.

Incubation and Rearing

No issues were identified.

Release and Outmigration

No issues were identified.

Facilities/Operations

Issue LW5 *Little White Salmon NFH is under funded for operations, maintenance, and M&E, and has insufficient funding for major maintenance and infrastructure improvements. Little White Salmon NFH is funded by Mitchell Act, Grant County PUD, and BPA. This issue is primarily caused by a lack of Mitchell Act funding to cover program and facility costs, thus resulting in increasing gaps between funding needs and availability related to both inflation and increased aging of hatchery facilities. Fishery comanagers and partners have developed a Mitchell Act outreach team to address Mitchell Act facility and funding needs. Funding levels are currently sufficient for operations; however, there is a lack of funds to cover M&E activities.*

Recommendation LW5: Adopt or advocate the funding levels developed by the outreach team, including the development of a major maintenance budget and funding of the infrastructure improvements identified here in this report.

Issue LW6: *The current placement of the coded-wire tag detector in the spawning building impedes ergonomics and efficient processing of adult fish during spawning. The current size of the spawning building does not allow for the detector to be installed at the most appropriate location.*

Recommendation LW6: Expand the spawning area of the adult holding and spawning building to increase ergonomic efficiency and accommodate a coded-wire detector at the most appropriate location.

Issue LW7: *The water intake screen does not meet state and federal fish screen standards. Inadequate screening could result in injury or mortality to upstream fish populations and/or result in possible disease transmission to hatchery populations. Although this is not a priority under the ESA because neither anadromous fish nor bull trout are present in the upper Little*

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White Salmon Watershed, meeting current state and federal fish screen standards should be a standard for all facilities.

Recommendation LW7: Upgrade the intake screen NOAA Fisheries criteria.

Issue LW8: *Spring water availability fluctuates throughout the rearing season. Currently, spring water contribution to the water supply is visually estimated, then adjusted manually.*

Recommendation LW8: Install inline flow meters on the spring water intakes.

Research, Monitoring, and Accountability

Issue LW9: *Insufficient information exists on Drano lake terminal fisheries. Specifically, coded-wire tag recovery data is lacking .*

Recommendation LW9: Improve data collection on sport and tribal harvest and coded-wire tag recoveries in Drano Lake. This will improve the hatcheries ability to accurately assess the harvest benefits of the URB fall Chinook program. This information could also improve broodstock management.

Issue LW10: *Upriver bright fall Chinook from Little White Salmon NFH are spawning in the Big White Salmon River after listed tule fall Chinook and coho have spawned (see Issue LW5). The genetic and ecological impacts of upriver bright fall Chinook spawning after tule fall Chinook and coho in the Big White Salmon River is currently being investigated. Currently, redd counts and smolt trapping are performed and tissue samples are collected to identify genetic contribution to juvenile production in the Big White Salmon River. Genetic analyses are now being completed (three-year study to be completed in spring 2008) This genetic information is critical in order to build a fisheries management plan when Condit Dam is removed and efforts to recover natural populations in the Big White Salmon River are increased.*

Recommendation LW10a: Continue to supplement redd count and smolt trap information with genetic and ecological interaction studies. Continue to fund and conduct genetic analyses. Complete a fisheries management plan for restoration of the White Salmon River.

Recommendation LW10b: Investigate the possibility of creating a tribal terminal fishery on URB fall Chinook at the mouth of the Big White Salmon River, including the potential impacts on late-run summer steelhead.

Recommendation LW10c: Develop a PIT tag program so that adult returns can be assessed at Bonneville Dam. Fisheries can be targeted on URB fall Chinook from Little White Salmon NFH when they are detected at Bonneville Dam (see also Recommendation LW13).

Recommendation LW10d: Consider installation of a conservation weir in the Big White Salmon River to intercept and sort fish as they enter the Big White Salmon River.

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Issue LW11: *Downstream migration timing to Bonneville Dam and from Bonneville Dam to hatchery return is not well known . The use of PIT tags has the benefit of monitoring survival without the need to sacrifice fish, as in traditional coded-wire tagging. In addition, each fish is individually tagged and can be passively monitored during downstream passage and upstream migration past Bonneville Dam. Valuable information will be gained on passage timing and survival which can also be used for in-season harvest management.*

Recommendation LW11: PIT tag 15,000 subyearlings prior to release to establish timing and survival of downstream passage, and to assist with in-season harvest management of upstream-migrating adults past Bonneville Dam.

Issue LW12: *The facility has no clearly defined M&E program.*

Recommendation LW12: Develop a consistent and clearly defined M&E program and review on an annual basis (prior to ponding and coded-wire tagging of a broodyear).

Issue LW13: *The “visioned” function, purpose, and membership of Hatchery Evaluation Teams (HET) - as originally described during the “Fisheries: A Future Legacy”(USFWS, 1991) planning process - have been inconsistently applied regarding hatchery evaluations and fish production modifications. Meetings and communications between Service offices regarding the Little White/Willard NFH Complex fish programs and evaluations are infrequent. The Review Team believes that regular and recurring meetings and communications should occur with both internal and internal/external partner meetings. The Review Team recommendations below are based on the 1993 USFWS “Hatchery Evaluation Action Plan” with modifications by the Review Team.*

Recommendation LW13: Establish an internal hatchery evaluation team (HET) consisting of staff from the hatchery, the Lower Columbia River Fish Health Center (Willard, WA), the Columbia River Fisheries Program Office (Vancouver, WA), and the Abernathy Fish Technology Center (Longview, WA). This internal HET should meet twice annually to coordinate planning and activities (a) after smolts are released in the spring and (b) after adults return in the fall. These internal HET meetings should discuss results of on-going evaluations, tagging/marketing protocols and plans, adult and juvenile sampling for data collection, data management and reporting, fish program modifications, fish ponding densities and protocols, number of adult fish to be spawned, number of juvenile fish to be raised and released, disposition of excess juvenile fish on station, fish health and related issues (e.g., nutrition, physiology, genetics), and implementation of Hatchery Review Team recommendations. The HET can meet more often as necessary to discuss specific fish program or evaluation issues. The HET should record meeting minutes and distribute them to the HET and the appropriate line manager in the Regional Office. In addition, the HET should meet annually with comanaging partners and interested parties to share the results of ongoing evaluations and receive comments and suggestions regarding proposed future activities.

Education and Outreach

Issue LW14: *On-station outreach programs/plans are a low priority relative to proposed program changes. The visitors’ areas could be enhanced. Outreach efforts are limited and not coordinated with the Information and Education Columbia Gorge Program.*

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Recommendation LW14: Update the visitors' areas and incorporate Little White Salmon NFH into Columbia River outreach program.

Alternatives to Current Program

The Review Team considered the benefits and risks of the existing upriver bright fall Chinook program at Little White Salmon NFH and developed seven alternatives designed to reduce risks and/or increase benefits. The first alternative is the current program with all previously-described recommendations adopted. The last alternative is the "no hatchery" option. Following these descriptions of alternatives, the Review Team has identified a recommended alternative (or alternatives).

Alternative 1: Current program with recommendations

Release 2.0 million subyearling smolts directly from the hatchery into the Little White Salmon River (U.S. v. Oregon agreement). Transfer 1.7 million subyearlings to the Yakama Nation's Prosser Hatchery acclimation ponds between February and the first week of April for release into the Yakima River.

Pros

- Provides a sport and tribal terminal fisheries in Drano Lake, and non-terminal fisheries in the Columbia River and marine waters. Upriver bright fall Chinook are sought after for harvest, particularly by tribal fishers, because they return at a time and condition that makes the salmon very valuable.
- The current program propagates a disease free stock and poses little disease risk to hatchery and wild stocks.
- Program has relatively high productivity with a recruit per spawner rate of 7.6 recruits per spawner for the on-station release and 6.5 recruits per spawner for the fish released at Prosser Dam on the Yakima River (BY 1990-1999).

Cons

- The program continues to propagate a non-native, out-of-basin, out of ESU stock that poses genetic and ecological risks to naturally spawning populations within the Columbia Gorge region.
- The program poses straying risk to the lower Columbia fall Chinook ESU (i.e. natural populations of tule fall Chinook). Significant levels of straying into the Big White Salmon River have been documented.
- Straying of URB fall Chinook also occurs into natural production areas upstream of The Dalles Dam, including Snake River and Hanford Reach populations.

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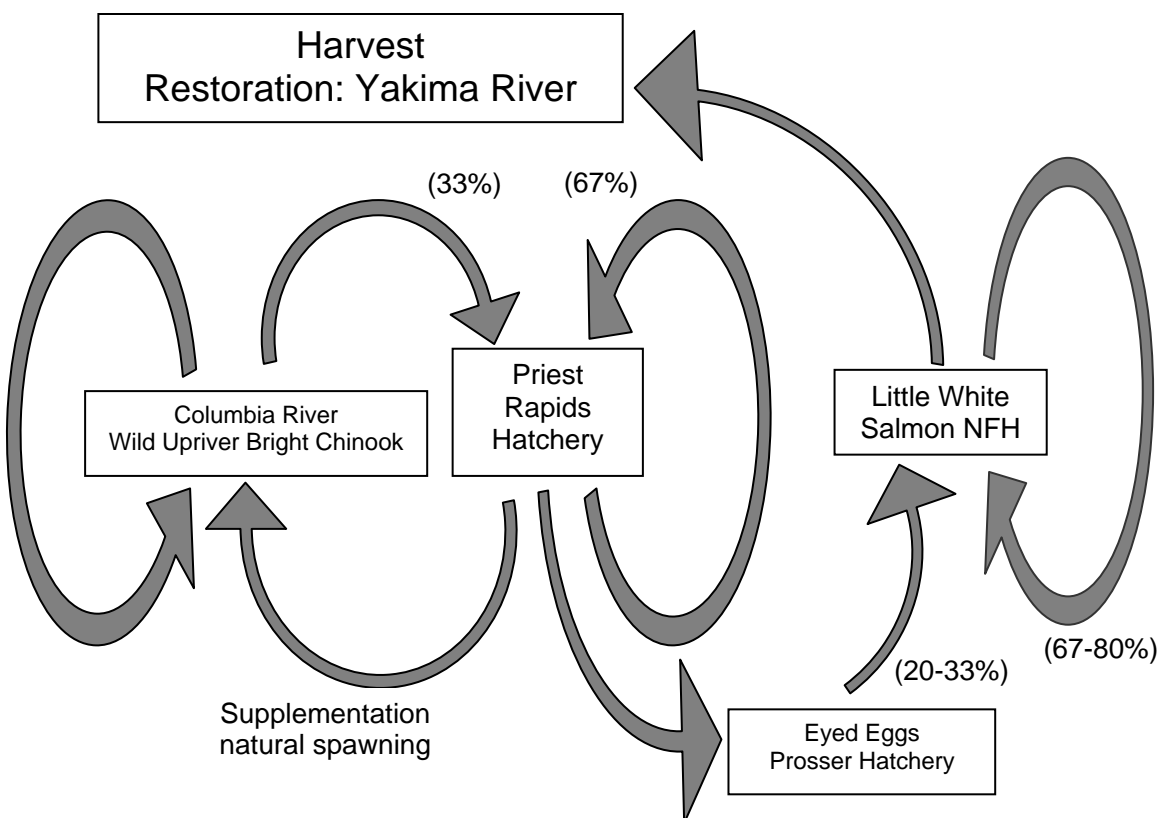
- URB fall Chinook at Little White Salmon NFH represent a segregated, hatchery-propagated stock for which the natural population origins are unknown. Continued transfer and stocking of URB fall Chinook from Little White Salmon NFH into the Yakima River poses genetic risk to the establishment of a self-sustaining, natural population in the Yakima River.
- Fisheries targeting upriver bright fall Chinook in the mainstem Columbia River is resulting in high incidental catch of several listed salmonid species, including Snake River B-run steelhead.
- The program continues to propagate a non-native, out-of- ESU stock that does not contribute to conservation objectives within the Columbia Gorge region.

Alternative 2: Convert current segregated program to an integrated harvest “stepping stone” upriver bright fall Chinook program (integrated with Priest Rapids hatchery stock) in support of upriver fisheries and restoration efforts.

Convert the entire Little White Salmon upriver bright fall Chinook program from a segregated to an integrated program by: (a) incorporating gametes from adults trapped at Priest Rapids Hatchery or from future upriver bright hatchery programs located upstream (e.g. Ringold Springs Rearing Facility), or (b) replacing the current broodstock with Priest Rapids stock. Supplementation releases into the Yakima River would be genetically linked to the Priest Rapids, Hanford Reach stock, not the Bonneville pool harvest mitigation stock. For example, 20% of the eyed eggs could be obtained from Priest Rapids Hatchery each year after transition is complete. This alternative would allow reducing on-site releases at Little White Salmon NFH and increasing releases upriver in support of John Day mitigation (see figure below). This may require infrastructure improvements at an upriver hatchery such as Ringold Springs Rearing Facility

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Pros

- This action would be consistent with tribal interests to increase upriver fishing opportunities.
- This creates the opportunity to utilize the stock for upriver fisheries and restoration purposes.
- Reduces the risk of releases into the Yakima River.
- Reduces the risk of straying into the Big White Salmon River and Wind River by reducing on-station releases at Little White Salmon NFH.

Cons

- Straying risks into the Big White Salmon River and Wind River will continue to exist.
- Reduces the terminal fishery in Drano Lake.
- Requires continued annual importation of gametes or eyed eggs from Priest Rapids or Prosser Hatcheries to Little White Salmon NFH.

Alternative 3: Terminate the current upriver bright fall Chinook program and use the rearing space in support of increased upriver bright fall Chinook production at facilities upstream of John Day Dam

This alternative will require infrastructure improvements at an upriver facility, such as Ringold Springs Rearing Facility, to accommodate upstream collection of adult broodstock and acclimation of hatchery-origin juveniles prior to release.

Pros

- Provides in-place in-kind mitigation for John Day Dam.
- Terminates release of upriver bright fall Chinook outside of their ESU.
- Increases tribal treaty fishing opportunities.
- Reduces straying of URB fall Chinook into Big White Salmon River.

Cons

- Loss of terminal sport and tribal fishery in Drano Lake.
- May require an egg isolation building to quarantine eggs upon transfer.

Alternative 4: Terminate the current upriver bright fall Chinook program and replace with tule fall Chinook

This alternative would terminate the current upriver bright fall Chinook program and replace with approximately the same number of tule fall Chinook salmon (approximately 2 million) for on-station release. The Yakama Nation's Yakima River upriver bright program would need to obtain their brood stock elsewhere. If rearing for the Yakima River program is also terminated, approximately 1.7 million additional tule fall Chinook salmon could be reared and released on-station.

Pros

- This would involve the rearing of a stock included in the ESU.
- Reduces the risk of straying by eliminating the rearing of an out-of basin stock and replacing it with an in-basin stock. This reduces straying risks to the Big White Salmon River.
- This would change the distribution of the ocean fishery from an Alaska and British Columbia to an ocean fishery in British Columbia, Washington and Oregon.
- Provides a backup facility for maintaining the Spring Creek NFH stock of tule fall Chinook.

Cons

- The risk of the impacts of straying from a hatchery stock on a natural population still exists.

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- A tule fall Chinook program at Little White Salmon NFH does not provide in-kind mitigation for the primary stocks lost by the construction of John Day Dam, but is a reasonable component for The Dalles mitigation.
- Tule fall Chinook are not as valuable to the tribal and sport fisheries as the upriver bright fall Chinook reared currently.
- Duplicates a program that already exists at Spring Creek NFH.
- Potential conflict of providing upriver bright fall Chinook salmon for the Yakama Nation's Yakima River program.

Alternative 5: Terminate the current upriver bright fall Chinook program and increase the spring Chinook program

This alternative would terminate the current upriver bright fall Chinook program and replace with spring Chinook salmon. This would potentially increase the spring Chinook program at Little White Salmon NFH by an additional 150,000 yearling smolts.

Pros

- Reduces the risk of straying to the Big White Salmon River. Spring Chinook salmon have a lower stray rate than upriver bright fall Chinook. Additionally, spring Chinook return at a different time than the naturally spawning tule fall Chinook in the Big White Salmon River.
- Spring Chinook are valuable to the sport fisheries in the lower Columbia.
- A spring Chinook program would reduce the incidental take on B-run steelhead and naturally spawning upriver bright fall Chinook from the Snake River.

Cons

- Depending on the size of the spring Chinook program, this alternative may require additional rearing space.
- This will eliminate ocean harvest and tribal commercial harvest of Little White Salmon NFH upriver bright fall Chinook.
- Spring Chinook are more difficult to rear from a disease perspective.
- The program does not provide in-kind mitigation for the primary stocks lost by the construction of John Day Dam.
- Replaces a program that produces 3.7 million upriver bright fall Chinook that result in an average return of 8,000 fall Chinook adults (BY 1990-1999, includes both Yakima River and on-station releases) with a small addition of 150,000 spring Chinook (at 0.3% SAR, increases the current return by 450 adults).

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- Potential conflict of providing upriver bright fall Chinook salmon for the Yakama Nation's Yakima River program.

Alternative 6: Expand the current upriver bright fall Chinook program at Little White Salmon/Willard NFH complex as part of John Day Dam mitigation (Spring Creek Reprogramming)

Under the proposed "Spring Creek Reprogramming", the rearing of 4.5 million upriver bright fall Chinook will be moved from Bonneville State Hatchery to Little White Salmon NFH, increasing the number of upriver bright fall Chinook reared at Little White Salmon NFH to 8.2 million. The on-station release would increase from 2 million to 5 million and a transfer of 1.5 million to Ringold Springs Rearing Facility for upriver release would be added. The transfer of 1.7 million eyed eggs and subyearlings to Prosser Hatchery for release into the Yakima River would be maintained.

The rearing of 4.5 million tule fall Chinook would be moved from Spring Creek NFH to Bonneville State Hatchery. This would reduce the number of tule fall Chinook reared at Spring Creek NFH to 10.5 million.

There are ongoing discussions among comanagers that could reduce the number of URB fall Chinook released on-station at Little White Salmon NFH with a resulting increase in release numbers in the mid-Columbia River upstream of its confluence with the Snake River.

Pros

- Increases the economic value to the tribes of fall Chinook fisheries by increasing the number of URB fall Chinook available for harvest relative to the number of tule fall Chinook.
- Eliminates the need for a portion of the tule fall Chinook to go through Bonneville Dam. This will likely increase post-release survival for that portion and provide more fish for marine and lower Columbia River fisheries.
- Expands the sport and tribal terminal fishery at Drano Lake.
- Same pros as Alternative 1 for Spring Creek NFH tule fall Chinook program regarding reduction in on-station releases from 15.1 million to 10.5 million subyearling smolts.

Cons

- Increase in production cost. Operation costs do not decrease significantly at Spring Creek NFH in conjunction with the production reduction of tule fall Chinook, and; therefore, do not compensate for the increase in cost for rearing the additional upriver bright fall Chinook at Little White Salmon NFH.
- May increase the risk of straying of out-of-basin, out-of-ESU upriver bright fall Chinook from Little White Salmon NFH into the Big White Salmon River and other watersheds in the region.
- Infrastructure improvements needed at Little White Salmon NFH and Ringold Springs.

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Alternative 7: Terminate current upriver bright fall Chinook program and establish a coho harvest program

Terminated the current upriver bright fall Chinook program and establish an early run coho program to support a terminal coho fishery in Drano Lake. This is related to the Willard NFH Alternative #2 for re-establishing a coho harvest program.

Pros

- Reestablishes a sport and tribal coho fishery in Drano Lake.
- Contributes to fisheries in the Columbia River and ocean harvest. Provides fish to tribal zone 6 fisheries (Bonneville Pool).
- Provides in-place, in-kind mitigation for losses in the Bonneville Pool region as a result of Bonneville Dam. Current upriver bright program does not meet this mitigation need.
- Potential egg source for upriver coho tribal restoration programs.
- Little White Salmon NFH has a long history of successfully rearing coho salmon.

Cons

- Less interest in terminal area coho fisheries compared to upriver bright fall Chinook.
- May pose straying risks into rivers in the Bonneville Pool where natural spawning of coho occurs and/or coho restoration programs are planned or underway (i.e. Hood River, Big White Salmon River, Klickitat River).
- Preferred broodstock for fisheries would not be the same as the preferred broodstock for conservation (early run coho preferred for fisheries and the late run is more compatible with natural production in the Gorge).
- Potential conflict of providing upriver bright fall Chinook salmon for the Yakama Nation's Yakima River program.

Alternative 8: Terminate the program and decommission the facility

Decommission hatchery in favor of alternative mitigation strategies such as habitat restoration, passage improvements, or alternative hatchery production at another site.

Pros

- Reduces the risk of straying to the Big White Salmon River that the currently reared out-of-basin populations have.
- Eliminates all risks associated with the current program.

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Cons

- Eliminates the program's contribution to ocean treaty harvest, Columbia River harvest, and terminal harvest in Drano Lake, including valuable sport and tribal fisheries.
- Eliminates the program's in-kind mitigation for John Day Dam.
- Substantially reduces or eliminates social and economic benefits of Little White Salmon NFH fish programs to the Gorge community at large.
- Reduces the Service's outreach capabilities for the Gorge region.

Recommended Alternatives

Immediate recommendation: Implement Alternative 1. Current program with implementation of all recommendations and concurrently begin discussions with co-managers to implement the long-term goal described below.

The current program includes an on-station release of 2.0 million sub-yearling smolts and a transfer of 1.7 million eyed eggs and subyearling pre-smolts to the Yakama Nation's Prosser acclimation ponds on the Yakima River. The on-station production supports multiple fisheries, and the Yakima River program is a harvest and supplementation program. Some of the Team's recommendations related to implementation of Alternative 1 include: (a) review, with the Yakama Nation and other co-managers, the broodstock management goals for URB fall Chinook at Little White Salmon NFH related to harvest and conservation goals in the Yakima River; (b) install an electronic fish counter from the hatchery ladder to the broodstock pond so that adult fish can be enumerated as they enter the facility; (c) create additional terminal fisheries and/or reduce the number of fish released on station to reduce surplus adults returning to the hatchery and straying to the Big White Salmon River; (d) update water intake screen; (e) PIT tag 15,000 smolts that are released on station; (f) establish a Service *Hatchery Evaluation Team* (HET); and (g) update the visitor's center and include Little White NFH into the Service's Columbia River fisheries outreach program.

Long-term goal (5-15+ years): Implement Alternative 3. Terminate the on-station release of upriver bright fall Chinook and replace with on-station rearing of upriver bright fall Chinook in support of hatchery programs upstream of John Day Dam. A much smaller release program could be maintained at Little White Salmon NFH to support terminal fisheries in Drano Lake.

The Review Team concluded that releases of hatchery-origin URB fall Chinook should be transferred from Columbia Gorge release sites to upriver areas, consistent with their natural historic distributions in the mid-Columbia region, unless appropriate steps can be taken to maximize fishery benefits while minimizing risks. Little White Salmon NFH could continue to rear URB fall Chinook to support programs in the mid-Columbia region, but on-station releases would be reduced to a level necessary to support a terminal fishery in Drano Lake. This proposed long-term approach is expected to confer most of the benefits realized by the current URB fall Chinook segregated hatchery program while reducing risks to naturally spawning fall Chinook populations in the Big White Salmon River (via reduced on-station releases) and naturally spawning populations in the Yakima River and adjacent regions. This long-term approach will

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require: (a) development of long-term cooperative agreements between the co-managers detailing responsibilities and funding needs, and (b) scheduled coordination meetings among co-managers.

Little White Salmon NFH Spring Chinook

Operator: U.S. Fish and Wildlife Service

Summary of Current Program

Goals

- **Harvest goal:** Support commercial, tribal, and recreational fisheries in the lower Columbia River and Drano Lake. Although no specific harvest goal is stated, the average smolt to adult survival (brood years 1979-2001) was 0.3%. Broodstock needs are about 1,170. Therefore on average about 1,830 spring Chinook are available for harvest.
- **Broodstock escapement goal:** Provide escapement back to the hatchery of at least 1,170 adults (410 males, 760 females) to account for pre-spawning mortality and past egg culling to control bacterial kidney disease in support of on-station release of 1,000,000 smolts and a skewed sex ratio of 65% females (117 adults are required for every 100,000 yearlings released or transferred to other programs).
- **Conservation goal:** The hatchery program has no specific conservation goal within the Little White Salmon River. Little White Salmon spring Chinook were derived from Carson stock and are not part of either the lower Columbia River Chinook ESU, which is listed as threatened, or the mid-Columbia River spring Chinook ESU which is not listed. However, Little White Salmon spring Chinook have been an important component of re-introduction efforts in the Umatilla and Walla Walla rivers (Umatilla Tribal programs). These two programs have since been discontinued at Little White Salmon NFH. The Umatilla program is now sustained by localized hatchery broodstock, and providing fish for the Walla Walla program has been resumed at Carson NFH.
- **Escapement goal for natural-origin adults:** There is no available habitat in the Little White Salmon River for spring Chinook salmon natural production. The hatchery is situated at the confluence with Drano Lake and there is an impassible falls at RM 2. Consequently, there is no specific escapement goal for a naturalized population in the river itself.
- **Research, education, and outreach goals:** No specific short or long term programs or plans currently exist.

Objectives

- Trap approximately 1,170 adults and spawn sufficient numbers of fish (approximately 900 adults) to yield a minimum 1.16 M eggs for 1.0 M smolts for on-station release. Release 1.0M yearling smolts directly from the hatchery into Little White Salmon River (U.S. v. Oregon agreement).
- Short-term program: trap an additional 293 adults and spawn sufficient numbers of fish to transfer up to 250,000 yearling spring Chinook to the Walla Walla River for direct release into that river. This was a Carson NFH program component that was temporary at Little White Salmon NFH until the brook trout issue at Carson NFH was resolved. New fish screens were installed on the water intake at Carson NFH in 2007. Operation of the new screens plus obligations outlined in an

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internal ESA Section 7 consultation allow the release of spring Chinook salmon into the Walla Walla River. Beginning in 2008, transfer of spring Chinook from Carson NFH will be resumed for the Walla Walla River reintroduction program.

Program Description

The spawning of spring Chinook salmon at the hatchery first occurred in 1967 when fish of unknown origin returned to the Little White Salmon River (Nelson and Bodle 1990). These fish could have been strays or descendants from previous attempts to rear spring Chinook from the McKenzie River (1916 brood), Salmon River (1925 brood), or Carson stock reared at Willard during the 1964 brood year. Since that time, fish were released into the Little White Salmon River from Willamette stock (Eagle Creek NFH), South Santiam State Fish Hatchery, Klickitat River stock, Ringold Springs stock, and Carson stock. The present stock is considered a derivative of the Carson stock. Part of the 1995 brood included adult fish trapped on the White Salmon River (progeny of Carson stock reared and released at Big White Salmon Ponds). Fish originating from White Salmon River adults (released in 1997) were the only fish released since 1985 that did not originate from adults returning to the hatchery.

The Little White Salmon/Willard NFH Complex (Complex) currently operates as part of the Columbia River Fisheries Development Program and is funded through the Mitchell Act - a program to provide for the conservation of Columbia River fishery resources. This program is a part of the mitigation for habitat loss resulting from flooding, siltation, and fluctuating water levels caused by Bonneville Dam. The Columbia River Fish Management Plan is currently under renegotiation, however, current production goals are generally consistent with the production goals in the expired plan.

Spring Chinook enter the hatchery holding ponds from mid-April to mid-August. Spawning occurs from early August to early September. A summary of numbers spawned from 1991 through 2002 is found in Section 7.4.2 of HGMP. Total adult returns ranged from 615 to 8,243, averaging 2,982 per year for this period.

From 1998 through 2007, 210K to 350K spring Chinook smolts were reared and transferred from Little White Salmon NFH to the Umatilla Tribe for acclimation and release in the Umatilla Basin. In the early years, eggs were from Little White Salmon NFH stock and Ringold stock. However, beginning in 1999, all eggs came from adults returning to the Umatilla Basin. Those eggs were transferred from the Tribe's Umatilla Hatchery to Little White Salmon NFH for hatch and rearing, prior to transfer back to the Umatilla Basin. In 2007, the program was discontinued after broodyear 2005 pre-smolts were transferred back to the Umatilla Basin for release in the spring of 2007.

Assessment of Current Program

Operational Considerations

Listed below are the principal operational components of the hatchery program that the Review Team considered as part of its review.

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Broodstock Choice and Collection

- An introduced “Carson stock” developed initially at Little White Salmon NFH in 1987.
- Trapping occurs mid-April to mid-August.; spawning occurs early August to early September. Hatchery ladder is closed at the end of spawning season to prevent stray Tule Fall Chinook from entering the hatchery.
- Do not belong to an ESU.
- Adults are held in two holding ponds prior to spawning and may be moved from pond to pond prior to spawning (pre-spawning mortality is approximately 2.5%).

Hatchery and Natural Spawning, Adult Returns

- Jacks are used in proportion to their composition among trapped males. From 1991-2002, 2% of the males spawned were jacks.
- Spawning is pairwise 1:1 if returns to the hatchery meet broodstock objectives; if short on males, some males are spawned twice (2:1).
- Very little straying documented from on-station releases. Approximately 2% of all coded-wire tag recoveries (74 fish) were recovered on spawning grounds (BY 1990-99 average).
- Based on coded-wire tag recoveries, an average of 10% of the spring Chinook handled during spawning and surplus sampling at Little White Salmon NFH came from strays from other hatcheries during 2000-2005 (CRiS database). Most of these strays originated from Carson NFH.
- BY1990-1999, SARs back to the hatchery averaged 0.3% (which includes adult strays from Carson NFH). Excluding strays, the SAR back to the hatchery averaged 0.2%.
- BY1990-1999, SAR including all recoveries (hatchery, harvest and spawning ground), excluding strays averaged 0.3%.
- Adult recoveries are split approximately 50:50, with ½ the recoveries from harvest and the other ½ at the hatchery. Recoveries in harvest should be considered a minimum since sport and tribal fisheries may under-report coded-wire tag recoveries in Drano Lake in some years.
- Excess eggs taken in some years to account for disease loss and to provide eggs to other programs if needed.
- Adults are treated with formalin treatment every other day while in brood pond; and are injected with erythromycin (15 mg drug/kg body weight) at approximately 30 days (early July) prior to spawning. Adults returning after early July are not injected (fish arriving less than three weeks before spawning are not injected).
- Eggs from high BKD risk females are culled or segregated to control BKD in the hatchery. In the past few years, more than 90% of the female adults have returned with no detectable BKD (and >98% are at no to very low levels by ELISA).

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Incubation and Rearing

- Eggs are initially loaded one female per tray (approx. 4,000 eggs per female) and reloaded at eye-up at 5,000 eggs per tray.
- Eggs on single pass spring or well water. Initial: 3 gpm, 5 gpm after hatch. Temp. 43-50 °F, average 47 °F.
- Surplus eggs are buried on station.
- A 70 micron drum filter is used for incubation water (applies to all stocks) with an alarm to monitor water flow.
- Formalin treatment on the incubated eggs 3-5 times per week (protocol: terminate 10 TU days before first hatch).
- Take 1700 TUs for hatch and yolk absorption to occur; transfer to nursery tanks for one week to initiate first feeding (December- January). Some are ponded outside directly.
- Ten nursery tanks at present. Additional nursery tanks would be useful, particularly under new White River spring Chinook constraints. Maximum rearing densities in nursery tanks is 0.3 DI in April.
- Raceways use river water with mean water temperature = 44 °F. Spring source is 48 °F and can be diverted into the lower bank raceways.
- Prophylactic feeding of antibiotics to juvenile spring Chinook occurs at Little White Salmon NFH. Little White Salmon NFH fish receive one treatment and Umatilla fish receive two treatments prior to transfer back to the Umatilla River.

Release and Outmigration

- All released fish are mass marked with adipose fin clips without *double-index tag* (DIT) groups for evaluating commercial harvest rates on unmarked fish because spring Chinook are not intercepted in ocean fisheries.
- Fish are not PIT tagged prior to release, but it could be useful for monitoring passage and in-river survivals.
- A total of 125,000 fish are coded-wire tagged prior to release: 75,000 CWT + ad-clip (funded by BPA) and 50,000 CWT + ad-clip (funded by Mitchell Act) at present for survival assessments and hatchery evaluation studies.
- The program attained a 0.3% smolt-to-adult returns (SAR) which includes harvest plus escapement back to the hatchery (BY1990-1999).
- Limited volitional release; screens are pulled one day before forced release.
- A saltwater challenge at 3% (30 ppt) is performed prior to release to evaluate survival. Fish are held for 24 hours in the saltwater solution.

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- Fish are released one raceway at a time sequentially.

Facilities and Operations

- See upriver bright fall Chinook at Little White Salmon NFH section.

Research, Education, and Outreach

- See upriver bright fall Chinook at Little White Salmon NFH section.
- A three-year assessment (BY 2002-04) was performed on baffled (75,000 cwt) vs. non-baffled (75,000 cwt) raceways. Adult returns from the study groups will be complete in 2009.

Benefit and Risk Assessment

BENEFITS CONFERRED TO THE PROPAGATED STOCK AND LOCAL COMMUNITY

In the context of all possible harvest, conservation, and other benefits that a hatchery program can confer to the propagated stock and local community,⁶⁵ the Review Team identified the following benefits of this hatchery program:

Harvest Benefits

- In 2006, approximately one-fourth of all spring Chinook mainstem sport harvest upstream of Bonneville Dam occurred in Drano Lake.
- The 10-year average (BY 1990-1999), based on expanded coded-wire tag recoveries, 53% were recovered at the hatchery (1,507), 45% in Columbia River harvest (1,289), 0% ocean harvest, and 2% spawning grounds (74). An important note is that the spring Chinook fisheries in Drano Lake are sampled for coded-wire tags and reported as Columbia River harvest.
- The 10-year average of Drano Lake spring Chinook catches reported by the state of Washington were 1,861 sport and 2,026 tribal for calendar years 1994-2003, which includes brood year 1990-99 returns. It appears that the Columbia River harvest reported from coded-wire tag recoveries may be a minimum estimate and may be under-reported for Drano Lake fisheries.
- Excess adults trapped at the hatchery are provided for tribal subsistence and ceremonial purposes and to food banks. An average 1,276 fish excess to broodstock were provided for food (1994-2003).

Conservation Benefits

- Hatchery program confers no direct conservation benefit.

Research, Education, Outreach and Cultural Benefits

- Tribal harvest and surplus adults trapped at the hatchery provide a cultural benefit to Columbia River tribes. Excess adults provided to tribes for ceremonial and subsistence purposes.

⁶⁵ See the "Components of This Report" section for a summary description of the potential benefits and risks considered by the Review Team.

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- The visitor facilities support 5,000 visitors per year that pass through the hatchery.
- Little White Salmon NFH staff make presentations about the facility to local clubs and organizations.

BENEFITS CONFERRED TO OTHER STOCKS, SPECIES, AND COMMUNITIES

In the context of all possible harvest, conservation, and other benefits that a hatchery program can confer to other species and stocks,⁶⁶ the Review Team identified the following benefits of this program:

Harvest Benefits

- For spring Chinook salmon releases into the Umatilla River from Carson and Little White Salmon NFHs, approximately 56% of recoveries were in harvest, 20% at a hatchery or trap, and 24% in spawning grounds (BY1996-2000 coded-wire tag recovery data).

Conservation Benefits

- Little White Salmon NFH spring Chinook has been an important source of fish for the reintroduction program in Umatilla and Walla Walla rivers. One long-term goal of these reintroduction programs is to provide harvest benefits to the Umatilla Tribe.

Research, Education, Outreach and Cultural Benefits

- Little White Salmon River and Drano Lake are considered a wildlife viewing area. Wildlife is attracted to the area to take advantage of adult carcasses.

RISKS POSED TO THE PROPAGATED STOCK AND LOCAL COMMUNITY

In the context of all possible genetic, demographic, ecological and other risks that a hatchery program can pose to the propagated stock,⁶⁷ the Review Team identified the following risks of the hatchery program:

Genetic Risks

- None identified.

Demographic Risks

- None identified.

Ecological Risks

- Ecological risk from antibiotic resistance in bacterial flora within the system from erythromycin injections and prophylactic use of medicated feeds for hatchery-reared fish, and antibiotics in effluent.

⁶⁶ *Ibid.*

⁶⁷ *Ibid.*

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Research, Education, Outreach and Cultural Risks

- None identified.

RISKS POSED TO OTHER STOCKS, SPECIES, AND COMMUNITIES

In the context of all possible genetic, demographic, ecological, and other risks that a hatchery program can pose to other stocks and species in a watershed,⁶⁸ the Review Team identified the following risks from the hatchery program:

Genetic Risks

- Straying of spring Chinook from on-station releases at Little White Salmon NFH has not been identified as significant risk, but deliberate transfers of Little White Salmon NFH spring Chinook could pose a genetic and/or ecological risk to populations in other watersheds. Additionally, transferring and releasing fish upriver increases the potential for straying. Straying from transfers has not been evaluated.

Demographic Risks

- Incidental catch of some listed steelhead occurs in the hatchery ladder during adult collection. However, there are very few steelhead caught and they are returned to the river live.

Ecological Risks

- Straying of spring Chinook from Little White Salmon NFH has not been identified as significant risk, but deliberate transfers of Little White Salmon NFH spring Chinook could pose a genetic and/or ecological risk to populations in other watersheds. Additionally, transferring and releasing fish upriver increases the potential for straying. Straying from transfers has not been evaluated.

Research, Education, Outreach and Cultural Risks

- None identified.

Recommendations for Current Program

The Review Team considered all the benefits and risks outlined in the preceding section. The Team concluded that some of the risks outlined in the preceding section were either minor or their probability of occurrence was small and, thus, did not warrant a proposed change or recommendation for the current program. The recommendations outlined below, in addition to potentially increasing benefits towards achieving program goals, address the identified risks or potential problems considered by the Review Team to warrant a potential modification to the current program. Preceding each numbered recommendation is a brief summary of the issue.

⁶⁸ *Ibid.*

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Program goals and objectives

Issue LW15: *Present program goals for spring Chinook released on-station are not expressed in terms of numeric outcomes that quantify intended benefits or goals. Harvest contributions vary widely in response to post-release survivals, marine conditions, and harvest regimes in the Columbia River. Like most other Mitchell Act funded programs, this hatchery program lacks specific goals for numeric accountability with respect to harvest, conservation, or other benefits.*

Recommendation LW15: Restate program goals to identify the number of harvestable adult spring Chinook desired from this program in the lower Columbia River and Drano Lake. For example, the current program size and desired post-release survivals leads to a 10-year average harvest goal of over 1,200 adult spring Chinook. Drano Lake sport and tribal fisheries need to be sampled consistently for coded-wire tag recoveries and evaluated with respect to harvest goals.

Broodstock Choice and Collection

Issue LW16: *The stated escapement goal for the program is not consistent between planning documents (e.g., 1,170 versus 900 adults) and may exceed the number of adults required for the current program to yield 1.0 million smolts for on-station release.*

Recommendation LW16: Clarify the broodstock collection/retention goal so that a single specific number of adult fish is established as the annual escapement goal for broodstock and a separate goal is established for the actual number of spring Chinook adults that need to be spawned to meet the 1.0 million yearling on-station release.

Hatchery and Natural Spawning, Adult Returns

No issues were identified.

Incubation and Rearing

Issue LW17: *Prophylactic use of erythromycin-medicated feed for the on-station release. Juvenile fish are given one 21-day treatment of erythromycin-medicated feed, to help control bacterial kidney disease (BKD) outbreaks. These treatments are given prophylactically (i.e. even when the fish do not show clinical signs of disease). The U.S. Department of Agriculture and other federal agencies have published warnings and advisories regarding the biological risks and potential overuse of antibiotics. The Review Team concluded that antibiotic use should only be used as a last resort to prevent disease and meet the minimal survival needs of hatchery-produced fish. Improved fish culture practices should be the first approach for preventing disease and maximizing survival.*

Recommendation LW17: Phase out the regularly-scheduled prophylactic use of erythromycin feed and develop criteria for therapeutic treatment. If the incidence of BKD increases after phase-out is complete, hatchery staff should evaluate rearing densities and consider a density reduction to reduce disease risks (see also LW20). For additional guidance,

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the Review Team plans to draft a “white paper” on the known benefits and risks of antibiotics in fish culture. This white paper would serve as a foundation for basin-wide recommendations and policies governing the use of antibiotics in federal hatcheries, consistent with existing federal regulations and guidelines.

Release and Outmigration

No issues were identified.

Facilities/Operations

See the Little White Salmon NFH upriver bright fall Chinook section.

Research, Monitoring, and Accountability

Issue LW18: For the twenty-two new baffled rearing raceways, the optimum rearing density for smolt to adult survival and adult contribution is unknown. Baffled versus unbaffled studies have been performed; however, understanding the optimum rearing density for the baffled containers have not.

Recommendation LW18: Perform a three-year paired baffled raceways test, comparing the current program’s standard rearing density of ~.2 to a lower density of ~.1. This may temporarily reduce on-station production. Groups of 75,000 coded-wire tags could be used for each density (see also LW21).

Issue LW19: Current application of coded-wire tags for spring Chinook at Little White Salmon NFH includes one group of 75,000 fish and another group of 50,000 fish tagged and may not represent the entire population at the hatchery. Since the populations between raceways can be different (age and size) and the pond environments can differ slightly (flow and flow pattern), tagged fish need to represent the entire population being monitored. In most NFH production programs salmon are spawned throughout the adult return to ensure that most segments of the run are represented in the resulting progeny. This procedure usually results in many different spawn “takes.” The fry are ponded by take/hatch date into a series of raceways that when fully populated differ in age of fish and size of fish (initially) between raceways. Production monitoring using coded-wire tags requires that the tags represent the entire population.

Recommendation LW19: Consult with Columbia River Fisheries Program Office to develop a consistent tagging strategy that accurately represents the entire population of progeny from all spawn groups. For example, one approach could be to apply the tags across several of the raceways. Instead of one group of 75,000 and one group of 50,000, change to two groups of 75,000 coded-wire tags, which can then be used in paired experimental groups (see LW20).

Issue LW20: Downstream migration timing of outmigrating smolts from Little White Salmon NFH to Bonneville Dam and of upstream migrating adults from Bonneville Dam back to the hatchery are not well known. The use of PIT tags has the benefit of monitoring survival without the need to sacrifice fish, as in traditional coded-wire tagging. In addition, each fish is

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individually tagged and can be passively monitored during downstream migration past Bonneville Dam and upon their return through Bonneville Dam ladder and to the hatchery. Valuable information will be gained on passage timing and survival, which can also be used for in-season harvest management.

Recommendation LW20: PIT tag 15,000 fish to establish migration timing and assist with in-season harvest management.

Issue LW21: *A number of PIT tagged Spring Chinook salmon annually enter the facility from Carson NFH as well as fish from other PIT tag studies.*

Recommendation LW21: Install a PIT tag detection system similar to Carson NFH to detect returning Carson adult spring Chinook salmon and other incidental PIT tagged adults that stray to Little White Salmon NFH.

Education and Outreach

See the Little White Salmon NFH upriver bright fall Chinook section.

Alternatives to Current Program

The Review Team considered the benefits and risks of the existing spring Chinook program at Little White Salmon NFH and developed five alternatives designed to reduce risks and/or increase benefits. The first alternative is the current program with all previously-described recommendations adopted. The last alternative is the “no hatchery” option. Following these descriptions of alternatives, the Review Team has identified a recommended alternative (or alternatives).

Alternative 1: Current program with recommendations

Pros

- Provides a sport and tribal terminal fisheries in Drano Lake and support for fisheries in the lower Columbia River. Spring Chinook are highly valued for harvest.
- Little White Salmon NFH spring Chinook has been an important source of fish for the reintroduction programs in other areas of the Columbia River basin.
- The current program has healthy productivity with a recruit per spawner rate of 3 recruits per spawner for the on-station release (BY 1990-1999).
- Provides a backup facility for maintaining the Carson NFH stock of spring Chinook.
- Adults return over a protracted period of time (April-August) provide extended fishing opportunities compared to other stocks.

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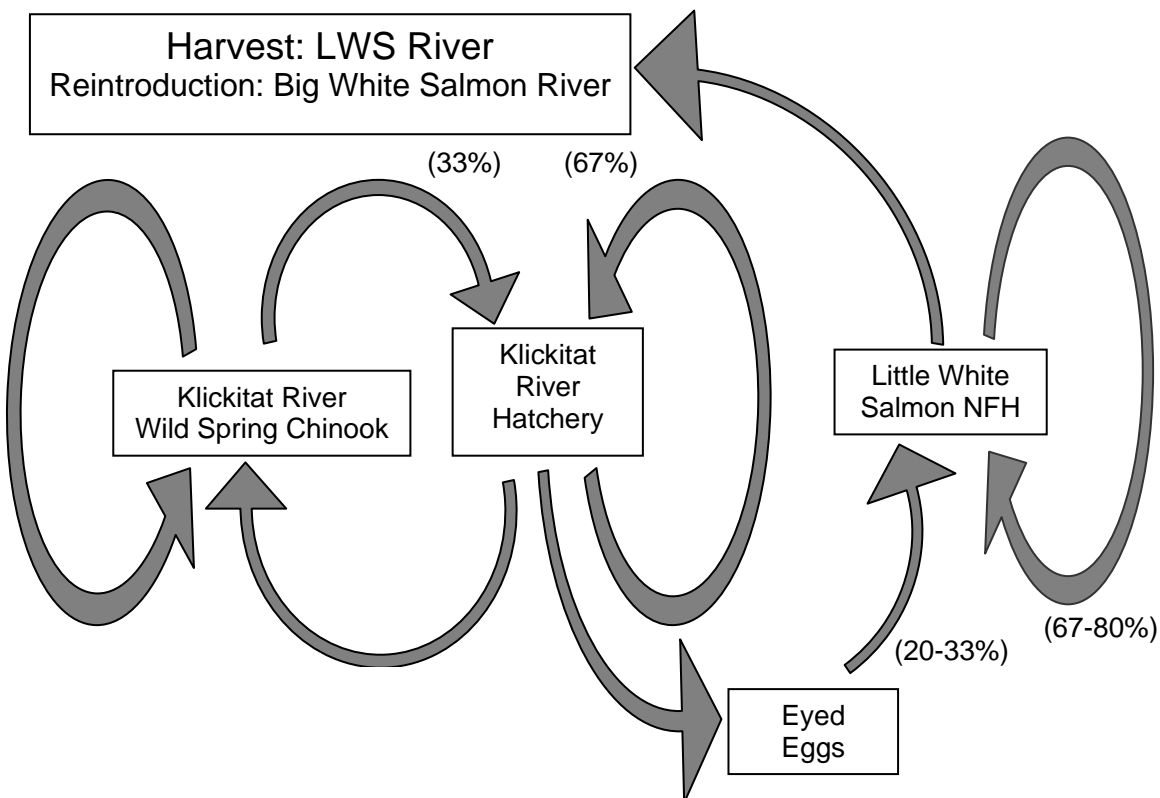
- Spring Chinook released from Little White Salmon NFH have a very high homing fidelity, with few fish straying into the Big White Salmon River or elsewhere. Any natural spawning of spring Chinook in Big White Salmon River is not considered a biological risk at the present time because (a) a natural population of spring Chinook is not present, and (b) spring Chinook enter and spawn in the Big White Salmon River *before* ESA listed fall Chinook.

Cons

- The program continues to propagate a non-native, out-of- ESU stock that does not contribute to conservation objectives within the Columbia Gorge region.

Alternative 2: Phase out current segregated spring Chinook harvest program (Carson stock) and replace with an integrated “stepping stone” spring Chinook harvest and conservation program (integrated with the Klickitat River hatchery stock).

Phase out existing Carson stock spring Chinook segregated–harvest program (over five years) and replace with a new “stepping stone” broodstock harvest and conservation program that is genetically integrated with the Klickitat River hatchery stock broodstocks that meet genetic integration guidelines (see following Figure).



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Pros

- Reduces straying risks by producing an in-basin spring Chinook stock considered part of the Lower Columbia River ESU, versus an out-of-basin non-ESU spring Chinook stock.
- This alternative results in a backup broodstock for the Klickitat Hatchery and provides an immediate source of fish for reintroduction of spring Chinook into the Big White Salmon River.
- Does not require taking natural-*origin* adults for inclusion of adult fish in the broodstock at Little White Salmon NFH.
- Provides a biological mechanism for reducing genetic straying risks to natural populations in the Bonneville Pool while maintaining tribal and recreational fisheries in Drano Lake and the lower Columbia River.
- Reduces risks of straying into the Big White Salmon River by propagating an integrated stock with the naturally adapted stock.
- Little White Salmon NFH broodstock would provide an annual outlet for surplus Klickitat Hatchery eggs that exceed broodstock or supplementation needs in the Klickitat River.
- Fish from the Little White Salmon NFH would be available to assist with restoration and recovery of spring Chinook in the lower Columbia Chinook ESU, if needed.
- Would provide the most appropriate stock for reintroducing spring Chinook to the Big White Salmon River.

Cons

- Eliminates the benefit of having a backup program for Carson NFH spring Chinook.
- Eliminates the “known” highly productive spring Chinook stock currently at Little White Salmon NFH that contributes significantly to sport and tribal fisheries in the Drano Lake terminal fishery and fisheries in the lower Columbia River.
- Increases on-station disease risks from BKD, a vertically transmitted disease. The Little White Salmon spring Chinook adults return with a very low prevalence of detectable BKD.
- The current Klickitat Hatchery program may not be large enough to support this alternative in the near term.
- Klickitat hatchery spring Chinook broodstock historically included Carson NFH spring Chinook.
- Infrastructure improvements for trapping adult spring Chinook in the Klickitat River and rearing their offspring at the Klickitat Hatchery will most likely be required before this alternative can be implemented. Achieving an integrated hatchery stock at Klickitat Hatchery will require improved capabilities for trapping wild fish for broodstock. Genetic studies show divergence between wild and hatchery populations in the Klickitat River.

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- Will require differential marking of fish Klickitat strain fish released from LWS NFH to differentiate between program returns and spring Chinook strays, predominantly from Carson NFH), that currently are incorporated into the broodstock.
- The Klickitat Hatchery may have difficulty developing an integrated broodstock of Klickitat River Spring Chinook, due to the lack of adequate trapping sites available to collect wild broodstock.
- There may be insufficient number of surplus eggs available from the Klickitat integrated broodstock to meet the requirements to implement a stepping stone integrated program at Little White Salmon NFH.
- The Klickitat Hatchery has not started an integrated broodstock program, but plans do so once the Klickitat Subbasin Anadromous Fishery Master Plan has been approved and modifications to the Lyle Falls trap have been completed.

Alternative 3: Terminate the current spring Chinook program and increase the current upriver bright fall Chinook production for on-station release

Terminate the existing spring Chinook production and replace it with an additional 4.8 million upriver bright fall Chinook.

Pros

- This would meet the current, full Service commitment of 8.5 million upriver bright fall Chinook smolts for in-kind mitigation for John Day Dam at Little White Salmon NFH.
- Increases contribution to ocean treaty harvest, Columbia River harvest, and terminal harvest in Drano Lake, including valuable tribal and sport fisheries.
- Reduces the likelihood of BKD outbreaks at Little White Salmon NFH because upriver bright fall Chinook stock are more resistant to infection by *Renibacterium* sp. than spring Chinook.

Cons

- Eliminates the extended fishing opportunity (April-August) that is currently provided by the spring Chinook fishery.
- Increases straying risk of additional upriver bright fall Chinook into the Lower Columbia River ESU, particularly the Big White Salmon River.
- Increases the potential for incidental harvest of B-run steelhead from the Snake River in fisheries targeting URB fall Chinook.
- Inconsistent with the long-term recommend alternative for the Little White Salmon NFH upriver bright fall Chinook program.

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Alternative 4: Terminate the current spring Chinook program and use the rearing space in support of increased upriver bright fall Chinook production at facilities upstream of John Day Dam

Provides space for rearing an additional 4.8 million upriver bright fall Chinook. This compliments alternative 3 in the Little White Salmon NFH upriver bright fall Chinook section. This will require infrastructure improvements at an upriver hatchery such as Ringold Springs Rearing Facility

Pros

- Provides in-place in-kind mitigation for John Day Dam.
- Terminates release of non-ESU spring Chinook.
- Increases tribal treaty fishing opportunities for upriver bright fall Chinook.
- Eliminates straying risks of Little White Salmon NFH spring Chinook to other watersheds, although straying of spring Chinook from Little White Salmon NFH is not considered a significant risk.

Cons

- Loss of sport and tribal fisheries of spring Chinook in lower Columbia River and Drano Lake.
- May require an egg isolation building to quarantine URB fall Chinooks eggs from upriver facilities upon transfer to Little White Salmon NFH.

Alternative 5: Hatchery production for restoration of naturally spawning populations in the Big White Salmon River (emphasis on spring Chinook, coho and possibly chum) (can be combined with Alternative 1 or 2)

Use the Little White Salmon NFH to rear fish for reintroduction of native species in the Big White Salmon River after the removal of Condit Dam. This could include spring Chinook, tule fall Chinook, coho, chum, bull trout and steelhead. This would also include the recommendations for rehabilitation of Big White Ponds and a reconstruction of a conservation weir for broodstock collection and management of the naturally spawning population on the Big White salmon River (see Spring Creek NFH tule fall Chinook current program recommendations).

Prior to removal of Condit Dam, the Service should collect adult and juvenile tissue samples and conduct genetic analyses for Chinook, coho and steelhead currently inhabiting the Big White Salmon River. This would determine stock compositions of naturally spawning adults and contribution to juvenile production in the Big White Salmon River. This would require continuing the estimation of adult spawning and juvenile production abundance. This is related to recommendation SC4a.

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Pros

- The number of facilities with a diverse array of rearing environments in relative close proximity to the Big White Salmon River makes Carson NFH, Little White Salmon NFH, Willard NFH and Spring Creek NFH attractive sites for rearing fish for reintroduction.
- The removal of Condit Dam offers a unique opportunity in the Columbia River Basin to test a large-scale reintroduction project of an entire river system.
- Offers the opportunity to jump-start populations in the Big White Salmon River that were depleted by the construction of Condit Dam and later, of Bonneville Dam.
- Provides a broodstock collection and acclimation site at Big White Ponds on the Big White Salmon River and allows for the control of hatchery influence on the natural populations in the Big White Salmon River.
- Reduces the risk of straying to the Big White Salmon River that the currently reared out-of-basin populations have.

Cons

- Reduces the amount of rearing space available for the current production of fish for ocean treaty harvest, Columbia River harvest, terminal harvest in Drano Lake, including valuable sport and tribal fisheries.
- The program does not provide in-kind mitigation for the primary stocks lost by the construction of John Day Dam.
- The cost of the construction, operation and maintenance of a conservation weir, the rehabilitation of Big White Ponds and other facility improvements is high.
- May increase the risk of disease transfer within the hatchery.

Alternative 6: Terminate the spring Chinook program (and upriver bright fall Chinook program) and decommission the facility

Decommission hatchery in favor of alternative mitigation strategies such as habitat restoration, passage improvements, or alternative hatchery production at another site

Pros

- Eliminates the propagation of a non-native, out-of- ESU stock that does not contribute to conservation objectives within the Columbia Gorge region.

Cons

- Eliminates the program's contribution to Columbia River harvest, and terminal harvest in Drano Lake, including valuable sport and tribal fisheries.

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- Substantially reduces or eliminates social and economic benefits of Little White Salmon NFH fish programs to the Gorge community at large.
- Reduces the Service's outreach capabilities for the Gorge region.
- Eliminates the backup facility for Carson NFH spring Chinook.

Recommended Alternatives

Immediate recommendation: Implement Alternative 1. Current program with implementation of all recommendations and concurrently begin discussions with co-managers to implement the long-term goal described below.

In the interim, Alternative 1 (current program with implementation of all recommendations) should be implemented until the contingencies associated with infrastructure improvements to the Klickitat Hatchery are resolved.

Long-term goal (5-15+ years): Implement Alternative 2. Phase out the current segregated spring Chinook harvest program (Carson stock) and replace with an integrated “stepping stone” spring Chinook harvest and conservation program (Klickitat River stock) in support of terminal fisheries and restoration of naturally spawning populations in the Big White Salmon River after infrastructure improvements for the Klickitat Hatchery are in place.

Adopt all facility and infrastructure recommendations for the current spring Chinook program at Little White Salmon NFH but work with the Yakama Nation and staff of the Klickitat Hatchery to develop a “stepping stone” broodstock that is genetically integrated with the Klickitat Hatchery stock of spring Chinook. This “stepping stone” approach would not require direct take of wild fish for broodstock at Little White Salmon NFH. The Klickitat River stock has been identified by WDFW as the appropriate stock for restoration of spring Chinook in the Big White Salmon River. Such an approach would contribute demographically towards conservation and harvest objectives for spring Chinook in the Lower Columbia Chinook ESU (Bonneville Pool), while continuing harvest opportunities for spring Chinook in Drano Lake and the mainstem Columbia River. Under this alternative, the Klickitat Hatchery would develop an integrated broodstock by incorporating wild spring Chinook (captured at Lyle Falls) into their broodstock, and this integrated broodstock would then provide eyed eggs or gametes annually to Little White Salmon NFH to meet genetic broodstock requirements at this latter facility via the stepping stone approach.

Willard NFH (Wenatchee River) Coho

Operator: U.S. Fish and Wildlife Service

Summary of Current Program

Goals

- **Harvest goal:** The long-term goal is to establish self-sustaining hatchery and natural populations of coho salmon in the Wenatchee River in sufficient numbers and viability to support tribal and non-tribal fisheries.
- **Broodstock escapement goal:** The broodstock collection goal is 1,464 adult coho (673 females) per year based on an average fecundity of 2,750 eggs per female. Adult coho are trapped for broodstock at Dryden Dam on the mainstem Wenatchee River. If the weekly broodstock collection goal is not met at Dryden Dam, then adult coho will be trapped concurrently at Tumwater Dam and on Icicle Creek at Leavenworth NFH.
- **Conservation goal:** Develop locally adapted, self-sustaining, naturally spawning populations of coho salmon in the Wenatchee River by the year 2026. Once natural populations have been established, natural-origin fish will be included in the broodstock with the ultimate goal that the proportion of the broodstock composed of natural-origin fish (*pNOB*) will exceed the proportion of naturally spawning coho composed of hatchery-origin fish (*pHOS*).
- **Escapement goal for natural-origin adults:** Achieve a 3-year mean escapement in excess of 1,500 natural origin coho salmon per year in the Wenatchee River upstream of Tumwater Dam.
- **Research, education, and outreach goals:** Test the hypothesis that artificial propagation and out-of-basin hatchery stocks can be used to re-establish self-sustaining hatchery and natural populations in the Wenatchee River. Use the results of feasibility studies and assessments in the Wenatchee River as a foundation for reintroduction efforts elsewhere. Studies done in this phase will inform future decisions about whether the long-term vision can be achieved.

Objectives

- Transfer 670,000 eyed eggs derived from adults trapped in the Wenatchee River (at Dryden Dam) to the Willard NFH in December and January.
- Transfer 650,000 yearling smolts at 19-21 fish per pound. from Willard NFH back to the Wenatchee River and Leavenworth NFH in February through late March/early April for acclimation and release at multiple sites in the Wenatchee River watershed.

Program Description

The Yakama Nation, with assistance from the Service, conducts this program with the goal of reintroducing coho salmon to the Wenatchee River, Washington. The program was initiated in

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1999 with the release of hatchery-origin coho from Eagle Creek and Willard NFHs (lower Columbia “early-returning” stocks) in 1999. The initial goal of the program was to establish a self-sustaining hatchery-propagated stock in the Wenatchee River. That goal has been achieved. At the present time, returning hatchery-origin adults are trapped in the Wenatchee River at Dryden Dam (near Cashmere, WA) and Tumwater Dam, and at Leavenworth NFH on Icicle Creek. Adult coho are transported to Entiat NFH (on Entiat River) and spawned. Fertilized eggs are incubated initially at Entiat NFH. Eyed eggs are transferred from Entiat NFH to Willard NFH for hatching and rearing. Yearling coho are transferred back to the Wenatchee River for acclimation and release from several locations, including Leavenworth NFH. At the present time, returning hatchery-origin adults in the Wenatchee River are used exclusively for broodstock. Current goals of the program are to establish naturally spawning populations and then integrate natural-origin fish into the broodstock as part of a naturalized, Wenatchee River stock. Willard NFH currently receives 670,000 eyed eggs annually and transfers back approximately 650,000 yearling pre-smolts (19-21 fish/lb.) for acclimation and release in the Wenatchee River one year later. The long-term goal is to attain a level of abundance and viability sufficient to support tribal harvest and conservation goals in the Wenatchee River. The Wenatchee River coho program is reviewed here for the purpose of evaluating Service options and potential priorities for Willard NFH and the Little White Salmon / Willard NFH complex.

Assessment of Current Program

Operational Considerations

Listed below are the principal operational components of the hatchery program that the Review Team considered as part of its review.

Broodstock Choice and Collection

- The Wenatchee River coho stock was derived from “early-returning”, lower Columbia River hatchery stocks. These stocks have a common ancestry derived historically, beginning in the 1950s, from natural populations in the Toutle and Sandy rivers and have been propagated as self-sustaining hatchery populations at Eagle Creek and Willard NFHs for decades. The Willard NFH coho program, one source of fish reintroduced into the Wenatchee River, was terminated in 2004 (because of reductions in Mitchell Act funding). Adults are trapped for broodstock in the Wenatchee River at Dryden Dam and, if needed, at Tumwater Dam and Icicle Creek at Leavenworth NFH.

Hatchery and Natural Spawning, Adult Returns

- Adult return to the Wenatchee River. Adults trapped for broodstock are transferred, held, and spawned at Entiat NFH on the Entiat River.

Incubation and Rearing

- Fertilization and initial incubation occurs at the Entiat NFH. Eyed eggs are transferred to Willard NFH for hatching and subsequent rearing to the yearling pre-smolt stage.

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- Eyed eggs are received from Entiat NFH and the Peshastin egg incubation facility.
- 5,000 eyed eggs are loaded per tray at 3 gpm at Willard NFH. Flow rates are increased to 4 gpm after eyed eggs are shocked and dead eggs removed.
- Eggs are hatched in the incubation trays. After egg yolk absorption, fry are transferred to indoor nursery tanks (early February- March) for initial feedings. Fry are transferred from nursery tanks to outside raceways during the first week of May (650,000 fry into 20 raceways).
- All the fish in each raceway receive a unique, raceway-specific coded wire tag (100% CWT) but no adipose-fin clips. The fishery management goal is 100% escapement of these fish back to the Wenatchee River as adults. Fish in several ponds also get PIT tags. Blank wire tags are also applied (in the dorsal musculature immediately below the adipose fin) to fish intended to be released into Nason Creek so that they can be distinguished as adults at Dryden Dam from fish that had been released at other locations in the Wenatchee River (snout tagged).
- Raceways have tepee covers that work well. Density indexes are approximately 0.19 for yearlings in January and stay below 0.25 prior to transfer back to Wenatchee River in February through late March/early April.
- Twenty outdoor raceways are used for the program.

Release and Outmigration

- All releases occur in the Wenatchee River watershed. No on station releases at Willard NFH occur.

Facilities and Operations

- Two wells supply the nursery with 41.7⁰ F water (1500 gpm available). Well water is used for incubation. Little White Salmon River water is used for rearing in outside raceways (39-46⁰ F.).
- The hatchery facilities include 450 incubation trays (30 stacks of 15 trays each), 52 indoor nursery tanks, and 50 outdoor raceways.
- Water rights = 50 cfs for river water.
- Domestic water (200 gpm) is available and could potentially be utilized.
- Pollution abatement. Normal discharge water flows into the river. All cleaning effluent water is diverted into the abatement pond and effluent water from pond drains into a drain field.
- Security OK. Water alarms OK.
- Willard NFH has a demonstrated capability to rear URB fall Chinook. Facility has worked well for fall Chinook, spring Chinook, and coho.

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Research, Education, and Outreach

- See Little White Salmon Upriver Bright Fall Chinook section

Benefit and Risk Assessment

BENEFITS CONFERRED TO THE PROPAGATED STOCK AND LOCAL COMMUNITY

In the context of all possible harvest, conservation, and other benefits that a hatchery program can confer to the propagated stock and local community,⁶⁹ the Review Team identified the following benefits of this hatchery program:

Harvest Benefits

- None identified during this stage of development. Long-term goal of program is to provide for sustainable fisheries when surplus brood stock and natural production goals are met.

Conservation Benefits

- The program has achieved its first major goal: establish a self-sustaining, hatchery propagated stock of coho salmon in the Wenatchee River that does not need to rely on broodstock or fish from outside the basin. This is considered a major accomplishment.

Research, Education, Outreach and Cultural Benefits

- Long-term goal is to create self-sustaining natural populations that can provide fish for hatchery broodstocks and contribute to harvest opportunities for Columbia Basin tribes and sport fishers.
- The program is providing a large amount of information on reintroducing a stock that is extirpated.
- Education and outreach benefits identified through Little White Salmon NFH.

BENEFITS CONFERRED TO OTHER STOCKS, SPECIES, AND COMMUNITIES

In the context of all possible harvest, conservation, and other benefits that a hatchery program can confer to other species and stocks,⁷⁰ the Review Team identified the following benefits of this program:

Harvest Benefits

- None realized to date; however, the long-term goal of the program is to create a self-sustaining population that will contribute to tribal and sport fisheries in the Wenatchee River.

⁶⁹ See the "Components of this Report" section for a summary description of the potential benefits and risks considered by the Review Team.

⁷⁰ *Ibid.*

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Conservation Benefits

- Increases marine nutrient deposition in upper Columbia streams that may have been deprived due to the extirpation of several salmon populations.

Research, Education, Outreach and Cultural Benefits

- Education and outreach benefits through reintroduction programs in the Wenatchee region as laid out in the Yakama Nation Coho Master Plan.
- Future goal is create a self-sustaining population that will contribute to harvest opportunity for Columbia Basin tribes and sport fishers.

RISKS POSED TO THE PROPAGATED STOCK AND LOCAL COMMUNITY

In the context of all possible genetic, demographic, ecological and other risks that a hatchery program can pose to the propagated stock,⁷¹ the Review Team identified the following risks of the hatchery program:

Genetic Risks

- None identified.

Demographic Risks

- None identified.

Ecological Risks

- None identified.

Research, Education, Outreach and Cultural Risks

- None identified.

RISKS POSED TO OTHER STOCKS, SPECIES, AND COMMUNITIES

In the context of all possible genetic, demographic, ecological, and other risks that a hatchery program can pose to other stocks and species in a watershed,⁷² the Review Team identified the following risks from the hatchery program:

Genetic Risks

- The Review Team did not assess this issue. Refer to the Yakama Coho Master Plan.

⁷¹ *Ibid.*

⁷² *Ibid.*

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Demographic Risks

- Potential disease risks involved in the transfers of juveniles from Willard NFH to Leavenworth NFH; however, the risks are being managed through established fish health protocols for the program and the established transport permitting system.
- Refer to the Yakama Coho Master Plan for non-rearing related risks.

Ecological Risks

- Refer to the Yakama Coho Master Plan for non-rearing related risks.

Research, Education, Outreach and Cultural Risks

- None identified.

Recommendations for Current Program

The Review Team considered all the benefits and risks outlined in the preceding section. The Team concluded that some of the risks outlined in the preceding section were either minor or their probability of occurrence was small and, thus, did not warrant a proposed change or recommendation for the current program. The recommendations outlined below, in addition to potentially increasing benefits towards achieving program goals, address the identified risks or potential problems considered by the Review Team to warrant a potential modification to the current program. Preceding each numbered recommendation is a brief summary of the issue.

Program goals and objectives

Issue WI1: The coho reintroduction program, as outlined in the Yakama Nation Master Plan, is considered a feasibility and experimental project. The project has achieved its first major goal of establishing self-sustaining, hatchery propagated runs back to the Wenatchee River (Phase I of the reintroduction program).

Recommendation WI1: Continue to assist the Yakama Nation in securing funding and providing facilities to support the program. The program has the potential of conferring highly significant, long-term conservation and harvest benefits in the Wenatchee River and elsewhere.

Broodstock Choice and Collection

No issues were identified. Refer to the Yakama Nation Master plan for more information.

Hatchery and Natural Spawning, Adult Returns

No issues were identified. Refer to the Yakama Nation Master plan for more information.

Incubation and Rearing

No issues were identified. .

Release and Outmigration

No issues were identified. Refer to the Yakama Nation Coho Master Plan for more information.

Facilities/Operations

No issues were identified.

Research, Monitoring, and Accountability

Issue WI2: An extensive monitoring and evaluation program is currently conducted by the Yakama Nation, as described in the Yakama Nation Coho Master Plan. However, once the coho are transferred off-station from Willard NFH to other National Fish Hatcheries (Leavenworth NFH Complex), fish production records are no longer consistently available to the Service. Hatchery records at National Fish Hatcheries need to meet Service reporting standards. Utilizing the Service hatchery record keeping system would also assist the Yakama Nation in their evaluations and fish culture practices.

Recommendation WI2: Include hatchery data reporting requirements in an agreement between the Service and the Yakama Nation. This agreement would include reporting requirements for fish culture data, including numbers of juvenile fish released and adult returns. The Yakama Nation could use the Service's hatchery record keeping system maintained by Leavenworth NFH complex and the Columbia River Fisheries Program Office.

Education and Outreach

See the Little White Salmon NFH upriver bright fall Chinook section.

Alternatives to Current Program

The Review Team considered the benefits and risks of the existing coho program at Willard NFH and developed six alternatives designed to reduce risks and/or increase benefits. The first alternative is the current program with all previously-described recommendations adopted. The last alternative is the "no hatchery" option. Following these descriptions of alternatives, the Review Team has identified a recommended alternative (or alternatives).

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Alternative 1: Current program with recommendations

Pros

- Continues support of a regionally approved coho reintroduction program in the Wenatchee River.
- Willard NFH has a long history of successfully rearing coho.
- Since there are no on-station releases, the program poses few risks to natural populations in the Little White Salmon River and Bonneville Pool.
- Provides support for tribal trust responsibilities of the Service.

Cons

- Reduces or eliminates the potential for using Willard NFH to support other recovery programs (e.g. White River spring Chinook) or higher priority harvest mitigation programs (e.g. upriver bright fall Chinook).

Alternative 2: Reinstitute a coho harvest program with releases in Little White Salmon River, while retaining current coho program in support of Wenatchee River reintroduction.

Eagle Creek NFH could be the broodstock source for reestablishing a coho release/harvest program at Willard NFH. .

Pros

- Willard NFH has a long history of successfully rearing coho salmon.
- Reestablishes a sport and tribal coho fishery in Drano Lake.
- Contributes to fisheries in the Columbia River and ocean harvest. Provides fish to tribal zone 6 fisheries (Bonneville Pool).
- Provides in-place, in-kind mitigation for losses in the Bonneville Pool region as a result of Bonneville Dam.
- Willard NFH, instead of Eagle Creek NFH, could be a potential egg source for other upriver tribal restoration programs (e.g., Yakima River, Snake River). Willard NFH is closer geographically to upriver restoration sites than other coho production facilities below Bonneville Dam (e.g., Eagle Creek NFH), thus reducing transportation time. Potentially frees up space at Eagle Creek NFH to support conservation hatchery programs in the Clackamas and Willamette River basins if the Yakima River reintroduction program, currently conducted at Eagle Creek NFH, is transferred to Willard NFH.
- Would not require termination of the ongoing Wenatchee River coho program at Willard NFH.

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Cons

- May pose straying risks into rivers in the Bonneville Pool where coho restoration programs are planned or underway (i.e. Hood River, Big White Salmon River, Klickitat River).
- Reduces or eliminates the potential for using Willard NFH to support ESA recovery programs (e.g. White River spring Chinook) or higher priority harvest mitigation programs (e.g. upriver bright fall Chinook).
- If the Yakima River coho reintroduction program is transferred from Eagle Creek NFH to Willard NFH, then disease risks of transferring viruses to other fish populations (i.e., in the Yakima River) would increase because Eagle Creek NFH is a virus-free facility, but Willard NFH is a virus-positive facility.
- Complicates broodstock collection at Little White Salmon NFH because coho and upriver bright return times overlap.
- Fish health policy requires very stringent pathogen testing if eggs are transferred from Willard NFH (virus-suspect) to Yakima and/or Snake rivers instead of from Eagle Creek NFH (virus-negative).

Alternative 3: Implement a bull trout program for reintroduction in Big White Salmon River and other sites

Willard NFH may be the most appropriate NFH in the Columbia River basin for rearing bull trout (because of coldwater supply) if artificial propagation is deemed a priority for recovery of bull trout in the Big White Salmon River or other watersheds (e.g., Clackamas River).

Pros

- Willard NFH may be particularly useful for propagating bull trout because of the availability of cold water for rearing.
- Bull trout is a priority species for the Service.
- Supporting the recovery of bull trout addresses Service ESA trust responsibilities.
- National Fish Hatcheries have been successful at culturing bull trout (i.e., Creston NFH in Montana).
- The Service's draft bull trout recovery plan recommends an investigation of the feasibility of using hatchery production for bull trout recovery: in particular, reintroductions where stocks are believed to be extirpated.

Cons

- Bull trout is a difficult species to culture (e.g. highly piscivorous, don't take to feed as well, etc.).
- May reduce production for other priority programs.

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- May require facility modifications such as chilling capabilities.

Alternative 4: Terminate the existing coho program and replace with upriver bright fall Chinook from Little White Salmon NFH to accommodate both the F1 and F2 components of the White River [Wenatchee River subbasin] Spring Chinook program at LWS NFH

For more information, see the alternatives for White River (Wenatchee) spring Chinook in the Little White Salmon/Willard NFH complex alternatives section.

Pros

- Supports recovery of an ESA-listed, “endangered” stock.
- Maintains the production of a highly-valued fall Chinook harvest mitigation program.
- Contributes to fisheries in Drano Lake, the Columbia River and ocean harvest.

Cons

- Terminates or relocates a regionally approved coho reintroduction program in the Wenatchee River.

Alternative 5: Terminate the existing coho program and replace with Little White Salmon upriver bright fall Chinook (as part of Spring Creek NFH Reprogramming)

Pros

- Maximizes the economic value of the tribes fall season fisheries by creating a different balance of stocks in their fisheries by increasing available URBs and decreasing tule fall Chinook abundance.
- Improves mitigation responsibility for John Day Dam.
- Expands the sport and tribal terminal fishery at Drano Lake.

Cons

- Terminates or relocates a regionally approved coho reintroduction program in the Wenatchee River.
- May increase the risk of straying of out-of-basin, out-of-ESU upriver bright fall Chinook from the Little White Salmon River into the Big White Salmon River and other watersheds in the region.

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- Inconsistent with the Review Team’s recommended long-term alternative to terminate on-station releases of upriver bright fall Chinook at Little White Salmon NFH at relocate adult broodstock collection and releases to locations upstream of John Day Dam.

Alternative 6: Discontinue hatchery program and decommission the facility

Pros

- Willard NFH is an older facility. Decommissioning the facility would reduce the need for future major maintenance investments.

Cons

- Terminates or relocates a regionally approved coho reintroduction program in the Wenatchee River.
- Eliminates the potential for using Willard NFH to support recovery programs (e.g. White River spring Chinook) or higher priority harvest mitigation programs (e.g. upriver bright fall Chinook).
- Reduces support for tribal trust responsibilities of the Service.
- Reduces the Service’s outreach capabilities for the Gorge region.

Recommended Alternatives

The Team supports alternatives 1 and 3 as reasonable options for Willard NFH. These two alternatives – maintain the current coho program and assist with bull trout reintroductions and recovery - may not be mutually exclusive. The team did not prioritize the two supported alternatives. Rather, program “sunsets” and new program developments lead to the immediate, short-term, and long-term goals described below. The Team does not support alternatives 2 (coho harvest program), 5 (increased on-station releases of upriver bright fall Chinook) or alternative 6 (decommission the hatchery).

Immediate recommendation: Alternative 1 (current program with recommendations). This program supports the coho reintroduction program for the Wenatchee River as outlined in the Yakama Nation Master Plan. Continued support needs to consider the following points:

- Discuss the term of the program or possible modifications to the program with the Yakama Nation.
- Discuss possible reductions to the program with the Yakama Nation regarding the short and long-term goals listed below.

Short-term goals (up to 15 years): Alternative 3 (Implement a bull trout recovery program).

Willard NFH may be the only NFH in the area that has suitable (cold) water to support bull trout culture. This alternative would likely be a very small program and may not impact the current Yakama

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coho reintroduction effort. The following points should be considered in preparation for bull trout recovery programs:

- The Willard NFH Hatchery Evaluation Team (HET) should review existing bull trout recovery plans.
- The Willard NFH HET should contact the Service's Oregon Fish and Wildlife Office in Portland, WDFW, and ODFW to explore recovery possibilities.
- The Willard NFH HET should contact other offices regarding past or existing bull trout culture programs to review techniques.

Long-term goal (15+ years): A specific long-term goal was not identified by the Team. The Team expects that re-introduction and recovery programs, such as those for coho salmon and potentially bull trout, would be discontinued at some point in the future as they demonstrate success and achieve their goals. By design, hatchery programs at Willard NFH could be dynamic and flexible to respond to constantly changing conservation and harvest priorities. Consequently, the Team's more generic long-term goal would be to remain flexible and support opportunities for additional recovery efforts or to support harvest.

Little White Salmon/Willard NFH Complex Alternatives

Little White Salmon and Willard NFHs are managed together as a complex on the Little White Salmon River. This relationship offers opportunities not available if each facility is managed separately.

The Alternatives listed below are primarily intended to provide Review Team perspectives regarding various options related to implementation of a conservation-recovery program for White River spring Chinook in the Wenatchee River basin (see section on White River spring Chinook in Appendix B).

Alternative 1: Implement White River (Wenatchee) Spring Chinook F2 rearing program (ongoing since April 2006)

Little White Salmon/Willard NFH Complex currently rears 150,000 F2 White River Spring Chinook received as eyed eggs from F1 captive broodstock held and spawned at AquaSeed Corporation in Rochester, Washington. The continued rearing of F2 White River spring Chinook can be achieved in conjunction with the Review Team's recommended alternatives for Little White Salmon and Willard NFHs.

Pros

- Supports recovery of an ESA-listed, "endangered" stock. This stock of spring Chinook has been identified with distinct biological attributes.
- Considered a highly valued stock for the mid-Columbia river region.
- Program has strong co-manager support.
- Propagation of F2 fish at Little White Salmon or Willard NFHs reduces the risk of catastrophic loss by separating broodstock and F2 generation rearing so they occur at separate locations.

Cons

- Increases disease risk at Service facilities and the potential for increased drug application.
- Requires extensive rearing space for a relatively small program.
- Limits options for high-priority programs for the Columbia River Gorge region.
- Does not provide in-place or in-kind harvest mitigation for lower Columbia River dams.

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Alternative 2: Implement White River (Wenatchee) Spring Chinook F1 captive broodstock program

Eyed eggs pumped from spring Chinook redds in the White River (Wenatchee) would be transferred directly to the LWS/Willard Complex for hatching, grow-out, and captive rearing to sexual maturity rather than hatched and reared at AquaSeed Corporation. The transferred program would continue ongoing efforts by developing three new F1 brood lots with a maximum of 510 fish per brood lot. Captive rearing to sexual maturity would occur at Little White Salmon NFH. A feasibility study should be performed to determine how effectively spring Chinook adults could be reared at Little White Salmon NFH.

Pros

- Supports recovery of an ESA-listed, “endangered” stock. This stock has been identified with distinct biological attributes.
- Considered a highly valued stock for the mid-Columbia river region.
- Reduces the risk of catastrophic loss by separating broodstock and F2 generation rearing.
- Does not require the termination of the existing coho program at Willard NFH.

Cons

- This alternative may conflict with expanded production of upriver bright fall Chinook for proposed John Day and The Dalles dam mitigation program.
- Increases disease risk and the potential for increased drug application at Service facilities.
- Requires extensive rearing space for a relatively small program.
- Programs conducted elsewhere have demonstrated mixed success for captively-rearing Chinook salmon to sexual maturity in freshwater (e.g., Methow Hatchery, WDFW) compared to the successes achieved in seawater (Manchester Research Station, NOAA Fisheries).
- Biologists have limited experience and success rearing captive Chinook in raceways versus circular tanks. Little White Salmon is currently equipped with large raceways but no circular tanks.
- Limits options for high-priority programs for the Columbia River Gorge region.
- May conflict with the expanded production of upriver bright fall Chinook for John Day and The Dalles dam mitigation.
- Does not provide in-place, in-kind harvest mitigation for lower Columbia River dams.
- Requires significant infrastructural changes to Willard NFH and Little White Salmon NFH (e.g., covered raceways at Little White Salmon NFH, effluent disinfection for Willard NFH, and possibly Little White Salmon NFH, traveling screen for spring water at Willard NFH, nursery tank covers). If the White River fish are to be reared at Willard NFH, effluent disinfection is considered

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necessary to prevent disease transmission to fish in the Little White Salmon River and at the Little White Salmon NFH.

- Comanager concern regarding conflicts with other priorities for Little White Salmon/Willard NFH.

Alternative 3: Reduce existing programs and implement White River (Wenatchee) Spring Chinook F1 captive broodstock and F2 rearing programs

This alternative combines Alternatives 1 and 2 with implementation of both components of the White River spring Chinook program at the Little White Salmon / Willard NFH Complex.

Pros

- Supports recovery of an ESA-listed, “endangered” stock. This stock has been identified with distinct biological attributes.
- Considered a highly valued stock for the mid-Columbia river region.
- The F2 portion of the program has strong co-manager support.
- Same pros as Alternatives 1 and 2.

Cons

- Risk of catastrophic loss by rearing captive broodstock (F1) and F2 generations at the same complex.
- Increases disease risk and the potential for increased drug application.
- Requires extensive rearing space for the relatively small size of the program.
- Limits options for high-priority programs for the region.
- Mixed success captively-rearing Chinook salmon to sexual maturity in freshwater versus seawater.
- Limited experience rearing captive Chinook in raceways versus circular tanks.
- Does not provide in-place, in-kind harvest mitigation for lower Columbia dams.
- May conflict with the expanded production of upriver bright fall Chinook for John Day/The Dalles mitigation.
- Requires significant infrastructural changes to Willard NFH and Little White Salmon NFH (e.g., covered raceways at Little White Salmon NFH, effluent disinfection for Willard NFH and possibly Little White Salmon NFH, traveling screen for spring water at Willard NFH, nursery tank covers). If the White River fish are to be reared at Willard NFH, effluent disinfection is considered

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necessary to prevent disease transmission to fish in the Little White Salmon River and at the Little White Salmon NFH.

- Comanager concern regarding conflicts with other priorities for Little White Salmon/Willard NFH.
- Same cons as Alternatives 1 and 2.

Alternative 4: Use Carson Depot Springs incubation facility for conservation and recovery of listed populations in the lower Columbia (e.g., assist with recovery of chum salmon)

Use Carson Depot Springs incubation facility to rear fish for the recovery of listed populations. Fall chum in the upper Columbia Gorge (e.g. Wind River, Big White Salmon River, Hood River), in particular, may be a suitable target stock. At the present time, very limited harvests on chum salmon occur in the ocean and Columbia River and is incidental to fisheries directed at other species. Columbia River commercial fishery historically harvested chum salmon in large numbers (80,000-650,000 in years prior to 1943); however, from 1965-1992, landings averaged less than 2,000 chum, and since 1993, less than 100 chum have been harvested annually. Beginning in the 1990s, November commercial fisheries were curtailed, and retention of chum was prohibited in Columbia River sport fisheries. Currently, incidental harvest of Columbia River chum is limited to less than 5% of the annual return.

Pros

- Carson Depot Springs is currently available for incubation and is isolated from other hatchery populations.
- Targets the recovery of ESA-listed populations.
- Hatchery actions have been identified by the state of Washington to reduce the near-term extinction risks to chum.
- Big White Ponds would be available for acclimation and release into the Big White Salmon River.

Cons

- May conflict with the expanded production of upriver bright fall Chinook for John Day and The Dalles dam mitigation.
- May require the construction or utilization of additional rearing facilities and/or acclimation sites on targeted rivers (not including Big White Salmon River).
- Infrastructure improvements, such as security and circular starter tanks, and effluent disinfection/treatment, would be required at Carson Depot Springs.
- An artificial propagation program for chum salmon would impose a “broodstock mining” risk given the relatively low abundance of fall chum in the lower Columbia River.

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- Precludes use of Carson Depot Springs for incubation of upriver bright fall Chinook eggs for the Klickitat Hatchery upriver bright fall Chinook program, which is currently under comanager discussion.

Recommended Alternatives

The Team ***primarily*** supports alternative 1 ***or*** 2. These alternatives, White River spring Chinook F2 rearing ***or*** F1 captive brood development, are considered of equal priority by the Team. However, supporting ***both*** programs (alternative 3) ***may be*** a viable option as well, although, the Review Team has concerns regarding the risk of a catastrophic event causing the loss of the entire program if both F1 and F2 programs are conducted within the same complex. The HRT is also concerned that the infrastructure space required to implement alternative 3 would jeopardize other high priority programs within the complex (e.g., Wenatchee River coho reintroduction program at Willard NFH). Alternative 4, use of Carson Depot for conservation and recovery programs, is also highly supported by the Team. Although Carson Depot is part of the complex, its parallel use should not impact the White River spring Chinook alternatives listed above. Again, the HRT did not specifically prioritize the alternatives. Rather, program priorities are implied within the short and long-term goals listed below.

Immediate recommendation: Implement *either* Alternative 1 *or* 2 (F2 *or* F1 White River spring Chinook support). Support for either program needs to consider the following points:

- The Team’s “facility evaluation” paper with respect to specific facility capacities⁷³.
- Availability of alternate facilities outside the LWS/Willard Complex to support whichever program that is not supported within the Complex.
- The Service needs to also consider impacts to existing high priority programs already ongoing within the Complex.

Short-term goals (up to 15 years):

1. **Continued support of the immediate recommendation.** During this period the Service should consider the following:
 - Maintain frequent communication with the co-managers regarding program monitoring and success as it relates to the future phasing out of the White River spring Chinook program as described in the HGMP for that program.
 - Be prepared for program “re-direction” (adaptive management), short or long term, depending on program success and shifting conservation and harvest priorities relative to future benefit-risk assessments.
2. **Alternative 4. Use of Carson Depot Springs incubation facility for conservation and recovery of ESA-listed populations in the lower Columbia River.** Actions required include:

⁷³ The facility evaluation paper is located in the White River (Wenatchee) spring Chinook section of Appendix B

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- Immediate facility and infrastructure improvements (e.g., nursery tanks, security, effluent disinfection and treatment, etc.) in anticipation of a high priority program or emergency contingencies that could use the facility.
- Initiate co-manager discussions to identify programs that could include this auxiliary incubation facility.

Long-term goal (15+ years): The Team did not identify a specific long-term goal or program for the complex as a whole, other than those identified for specific hatcheries within the complex.

The Team's expectation and optimistic view is that the LWS/Willard Complex support of recovery programs will be successful and discontinued as they demonstrate success. We also expect that more opportunities will arise to assist with other recovery needs as the Service demonstrates success and willingness to accept new challenges. Consequently, the Team's more generic long-term recommendation for the Complex is for the Service to remain flexible and seek opportunities for additional recovery programs or harvest support in response to shifting comanager priorities for conservation and propagation of fishery resources in the Columbia River basin.

VII. Conclusions

The Review Team concluded that the current spring Chinook salmon program at the Carson NFH is providing a significant harvest mitigation benefit within the Wind River basin and in fisheries in the mainstem lower Columbia River. Recent ongoing studies and other available information indicate that ecological interactions between hatchery-origin spring Chinook and natural populations of steelhead within the Wind River basin are either minor or nonsignificant. In general, the spring Chinook program at Carson NFH appears to be providing significant harvest benefits with little biological risks to natural populations in the Wind River.

The Review Team similarly concluded that the current tule fall Chinook program at Spring Creek NFH is providing significant harvest mitigation benefits to tribal fisheries in the Bonneville pool and to recreational and commercial fisheries in the mainstem lower Columbia River and coastal waters of the United States and Canada. However, the current water supply and reuse system pose demographic and fish health risks to the hatchery stock, and the Team recommends that the size of the program be reduced from 15.1 million to 10.5 million fall Chinook subyearlings to reduce those risks via lowered rearing densities.

The fall Chinook stock at Spring Creek NFH was initially developed in the early 1900's from natural-origin adult spawners in the Big White Salmon River; consequently, the Review Team supports the use of this stock and facilities at Spring Creek NFH to assist with recovery of fall Chinook populations in the Big White Salmon River after removal of Condit Dam. The Team advises the Service to complete genetic stock identification work on present natural spawners in the Big White Salmon River and work with co-managers to develop a restoration strategy for the natural population in this watershed. The Team also recognizes that the presence of nearby large-scale hatchery production programs at Spring Creek and Little White Salmon NFHs require means of controlling or excluding most hatchery-origin adults from the natural production areas of the Big White Salmon River.

The Team was somewhat uncomfortable with the present lack of defined recovery strategies for listed fall Chinook, coho, and chum salmon in tributaries of the Bonneville Pool. The Big White Salmon River in particular was not addressed in the development of the state of Washington component of the Lower Columbia Recovery Plan. The Team understands that inter-agency discussions are ongoing concerning restoration of salmon and steelhead in the Big White Salmon River following the scheduled removal of Condit Dam, but a detailed restoration strategy has not yet been developed. The Team advises the Service to closely track completion of the Lower Columbia Recovery Plan and adjust future program goals for Gorge NFHs consistent with forthcoming recovery strategies.

The Review Team concluded that the current upriver bright (URB) fall Chinook program at Little White Salmon NFH is providing significant harvest mitigation benefits to tribal and recreational fisheries in the Bonneville pool, particularly Drano Lake, and recreational and commercial fisheries in the mainstem lower Columbia River and coastal waters of the United States and Canada. However, the Team was concerned with the genetic and ecological impacts of this introduced mid-Columbia stock on the viability and recovery of natural populations of fall Chinook that are included with the Lower Columbia River Chinook ESU. The Team was also concerned about biological and management inconsistencies between the current URB fall Chinook stock propagated at Little White Salmon NFH and conservation/restoration goals for URB fall Chinook in the Yakima River and mid-Columbia region. The Team concluded that the current program and on-station releases of URB fall Chinook at Little White Salmon NFH should be terminated and replaced with on-station rearing of URB fall

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Chinook from hatchery programs operated upstream of John Day Dam. A much smaller release program could be maintained at Little White Salmon NFH to support terminal fisheries in Drano Lake.

As a long-term goal, the Team recommends reducing the number of URB fall Chinook released in the Bonneville pool region and increasing the number of fish released upstream within historic natural population areas of URB fall Chinook. Such a management adjustment would also serve the goal of providing in-place and in-kind mitigation for the loss of upriver bright fall Chinook spawning habitats inundated by the pools behind John Day Dam and other projects (e.g., McNary Dam). As noted above, this long-term approach will require cooperative agreements among co-managers.

Large hatchery fall Chinook mitigation programs, such as those at Little White Salmon and Spring Creek NFHs, release large numbers of juvenile fish into the lower Columbia River. The Team is aware of little information which allows fishery managers to assess any impacts which these programs may have on the continued viability of listed naturally spawning fall Chinook salmon in the lower Columbia River, including the Columbia River estuary. The Team encourages further assessment of this possible interaction and future adjustment to hatchery programs, as necessary, to reduce or eliminate possible adverse effects on natural populations.

The Review Team concluded that the current spring Chinook salmon program at Little White Salmon NFH is providing a significant harvest mitigation benefit within Drano Lake and in fisheries in the mainstem lower Columbia River. The Team proposes that the Service work closely with the Yakima Nation and the Washington Department of Fish and Wildlife to transition to a suitable local broodstock such as the Klickitat spring Chinook stock. This would allow the present mitigation program to proceed with reduced impact on nearby natural population areas and would allow this program to support the proposed reintroduction of spring Chinook into the Big White Salmon River.

The Review Team concluded that the current coho salmon reintroduction program at Willard NFH is providing a long-term conservation benefit to salmonid ecosystems in the Wenatchee River and tributaries of the upper Columbia River. The Team notes that the facilities and water supply at Willard NFH are capable of playing an important role in several proposed conservation and reintroduction programs. The Team expects that the current coho program at Willard NFH will eventually be phased out and supplanted by other conservation programs as upper river facilities are developed to support this reintroduction program and as natural reproduction of coho in the upper Columbia River increases.

Overall, the Team concludes that the four National Fish Hatcheries in the Columbia River Gorge region are playing a valuable and effective role in partially mitigating for the effects of habitat loss and mortality caused by hydroelectric development in this section of the Columbia River. These hatchery facilities are also uniquely situated to support reintroduction and restoration of native salmon species in tributary streams of the Columbia River Gorge and elsewhere while continuing to provide fishery benefits in the region.

Appendices

Appendix A: All-H Analyzer (AHA) output for salmon and steelhead stocks in the Columbia Gorge Province

(Available from the Columbia Basin Hatchery Review website,
www.fws.gov/pacific/fisheries/hatcheryreview/reports.html/)

Appendix B: Columbia Gorge Briefing Document; Summary of Background Information

Available from the Columbia Basin Hatchery Review website,
www.fws.gov/pacific/fisheries/hatcheryreview/reports.html/

Appendix C: Comments on Draft Report and Review Team Responses

Available from the Columbia Basin Hatchery Review website,
www.fws.gov/pacific/fisheries/hatcheryreview/reports.html/

Appendix D. Complete Text of Comment Letters Received from Stakeholders

Available from the Columbia Basin Hatchery Review website,
www.fws.gov/pacific/fisheries/hatcheryreview/reports.html/

Appendix E: Columbia Gorge NFH Operations and Maintenance Costs Summary

Available from the Columbia Basin Hatchery Review website,
www.fws.gov/pacific/fisheries/hatcheryreview/reports.html/

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The mission of the U.S. Fish and Wildlife Service is working with others to conserve, protect and enhance fish, wildlife, plants and their habitats for the continuing benefit of the American people.

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