



❖ Central Puget Sound

Overview

This region includes the Puyallup River, Green River, Lake Washington, and East Kitsap Peninsula sub-regions. For the purposes of this review, the Scientific Group reviewed the hatchery programs involving each identified sub-regional salmonid stock (for example, Puyallup River spring chinook). The review included a consideration of the program's effects on all other hatchery and naturally spawning regional salmonid stocks (see tables below under Stock Status). This chapter provides an overview of the Central Sound region and each sub-region, followed by reviews and recommendations for each salmonid stock that has an associated hatchery program.

FISHERIES⁵³

Chinook, wild winter-run steelhead, sockeye, pink and chum salmon harvest management in the Central Sound region is directed primarily towards the needs of natural production and secondarily for harvest of surplus hatchery production. Coho harvest management in Lake Washington and the Green River is directed primarily toward surplus hatchery production and secondarily toward the needs of natural production. Hatchery winter-run steelhead management is directed toward full removal of hatchery-timed fish, to minimize potential interactions with wild steelhead. Pre-terminal harvests of hatchery and wild-origin fish occur primarily in Canada, Washington ocean fisheries, the Strait of Juan de Fuca and mid Puget Sound. Marine terminal fisheries include recreational and commercial net fisheries in Management Areas 9, 10 and 11. Extreme terminal harvests on mixed hatchery- and natural-origin fall chinook, sockeye, coho and chum occur in Elliott Bay and the Green River, Lake Washington, Sinclair Inlet, Commencement Bay and the Puyallup River.

Significant freshwater harvests of chinook, coho, chum and steelhead occur in the Duwamish-Green, and Puyallup River systems. Where possible, harvests are scheduled and located to target hatchery-origin fish and minimize the harvest of depressed stocks. Terminal harvest of hatchery- and wild-origin White River spring chinook occurs incidental to a small, Puyallup Tribe ceremonial fishery that is incorporated into test fishery data. The Muckleshoot Tribe conducts a limited, directed fishery for White River chinook on the Muckleshoot Reservation. There is normally no targeted terminal harvest of Puyallup River odd-year pink salmon because of their overlap in migration timing with White River chinook. There is no targeted winter run steelhead fishery in the Puyallup River. Winter run steelhead are caught in the river as by-catch during the coho and chum fisheries. Summer-run steelhead harvest management in the Central Sound region is directed at harvest of surplus hatchery production in the Green River. Sea-run cutthroat management is based entirely on natural production and does not include any directed commercial fishery.

CONSERVATION⁵⁴

All Puget Sound chinook are currently managed under the *Puget Sound Comprehensive Chinook Management Plan: Harvest Management Component*, March 23, 2001. The intent of this plan is to

⁵³ Provided by Darrell Mills, Washington State Department of Fish and Wildlife; Paul Hage, Muckleshoot Tribe; Chris Phinney, Puyallup Tribe; and Jay Zischke, Suquamish Tribe, November 2002.

⁵⁴ Ibid.

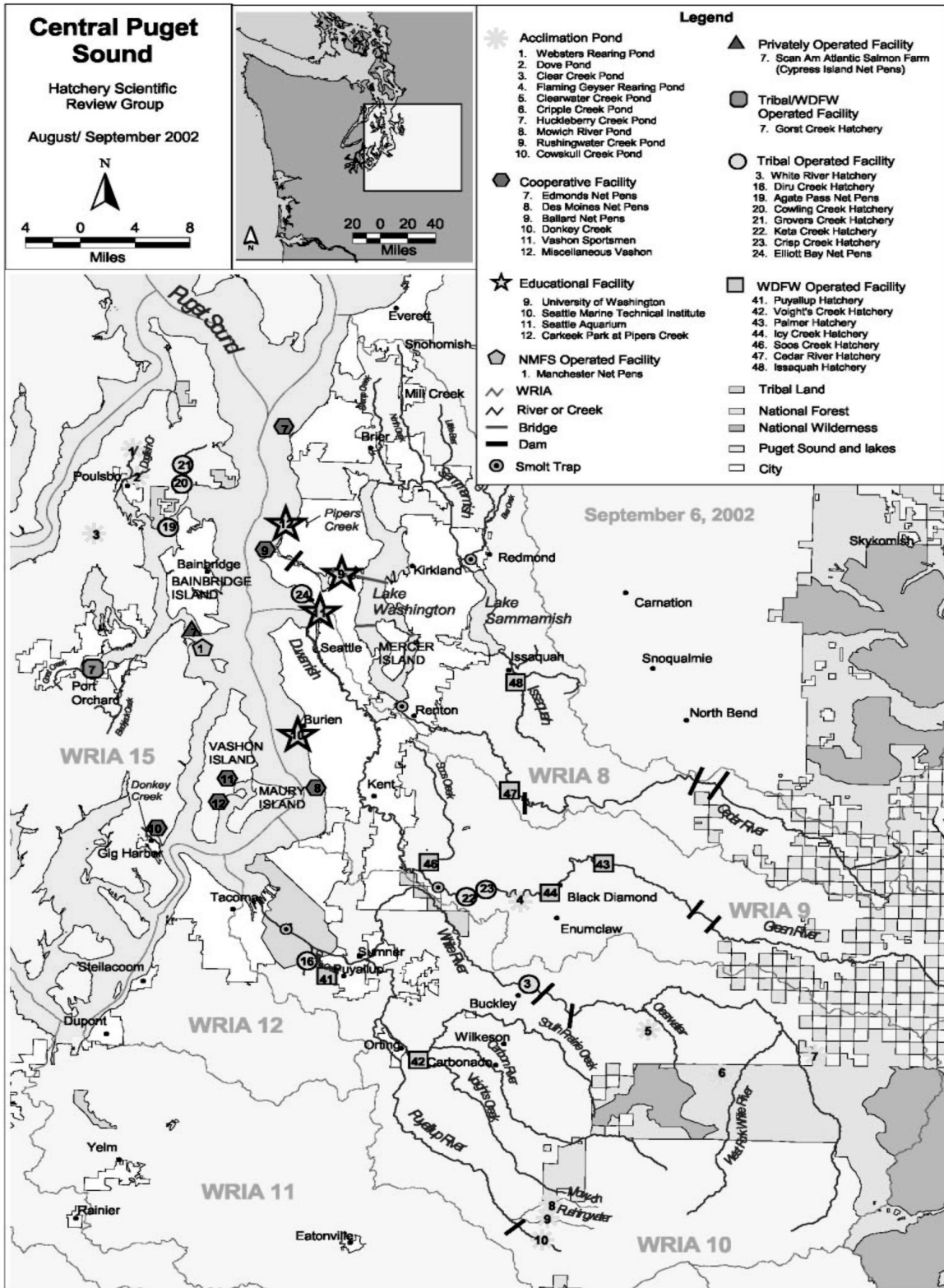


maintain exploitation rates on natural chinook populations at or below levels that will allow them to rebuild if habitat conditions improve to allow greater natural production. In basins where habitat continues to degrade, hatchery production will continue to be necessary to maintain naturally spawning populations. All spring chinook hatchery enhancement efforts within the Puyallup River Basin are aimed at conserving the native White River stock. South Puget Sound coho stocks are currently managed to harvest surplus hatchery production under the co-managers' *Comprehensive Coho Management Plan*.

Natural-origin chum have been managed for fixed escapement goals, with different goals set for odd-year and even-year returns. Sockeye conservation and supplementation efforts are focused solely in the Lake Washington/Cedar River system and include both habitat enhancements and mitigated artificial production enhancements. Odd-year pinks are managed so that the expected natural spawning escapement meets or exceeds the goals for the rivers in the region. The goal of wild winter steelhead management is to consistently exceed the established escapement goal. Under the management strategy for sea-run cutthroat, minimum size limits were set so that the majority of females would be allowed to spawn at least once. Harvest under this scenario is allowed only where stocks are thought to be healthy and such harvest is consistent with management objectives.

HATCHERY SCIENTIFIC REVIEW GROUP

Puget Sound and Coastal Washington Hatchery Reform Project





PUYALLUP RIVER

Overview

HABITAT⁵⁵

The Puyallup River Basin was one of the earliest areas of Puget Sound settled by Euro-Americans. They prized this basin for its deep-water embayment, large tracts of pristine old growth forests, fertile river valley soils and abundant runs of salmon. Homesteads and settlements began appearing as early as 1850 and the new arrivals initiated a series of actions to modify the landscape to fit their needs. Dredging and filling of the estuary started in the late 1800s and was largely completed by 1930. Two hydroelectric dams impassable to salmonids were completed shortly after 1900. An extensive system of levees, dikes and revetments were started in the early 1900s, and continue to be maintained today. In 1906, the White River was diverted into the Puyallup River Basin, almost doubling flows in the lower Puyallup River. All of these actions have affected the biological processes necessary for natural production of salmonids.

Today, the Puyallup River Basin has a population of over 241,500 in 14 incorporated communities and unincorporated Pierce and King counties, including the state's third largest city, Tacoma. The most extensive development occurs along the Interstate 5 corridor and along state routes that lead east and west from the Interstate. Extensive urban growth, heavy industry, a large, modern marine port, an extended revetment and levee system and agriculture have combined to significantly alter the natural landscape.

Commencement Bay, once a highly-productive estuarine environment, has lost more than 98% of its historical inter-tidal and sub-tidal habitat. The remaining habitat is separated and, in places, contaminated with chemicals that further reduce its value to organisms and their biological processes. The Puyallup, White and Carbon rivers are all contained within a revetment and levee system for their lower 26, eight and five miles, respectively. These channel containment structures have removed the natural sinuosity of the rivers and the spawning and rearing habitats that were once present. The two hydroelectric dams, and a later flood control project on the White River, have blocked salmon from their historical habitat and reduced their geographical distribution. Numerous other impassable barriers exist on smaller tributary streams that further reduce available spawning and rearing habitats. Land use practices have eliminated the opportunities for large and small woody debris recruitment and heavily affected riparian buffers.

The Puyallup Basin drains an area of approximately 1,065 square miles, has over 728 miles of rivers and streams that flow over 1,287 linear miles. Salmonid habitat in the Puyallup River basin is controlled by basin-scale characteristics including water quality and quantity, sediment sources and associated transport, aggradation and deposition, nutrient supply, and hydro-modifications.

The headwaters of the Puyallup, Carbon and White Rivers originate inside Mount Rainier National Park. Habitat in this area is considered quite pristine. The Mount Baker/Snoqualmie National Forest forms a ring around the national park. Outside this ring lies another ring of large, private, commercial

⁵⁵ *Water Resource Inventory Area (WRIA) 10 Limiting Factors Analysis, Washington Conservation Commission, John Kerwin, July 1999.*



timber landholdings (Weyerhaeuser, Rainier and Plum Creek timber companies) and state-owned timber lands that are managed for timber production, recreation and other uses. Moving westward, towards Tacoma, there is a mix of agricultural, residential, urban and industrial areas. The closer one gets to the Interstate 5 corridor and Tacoma, the higher the degree of development and industrialization.

Annual average rainfall in the basin ranges from 40 inches at the City of Puyallup to 70 inches at Electron Dam. Mountain snow pack has been recorded at up to 150 inches. Eighty percent of this precipitation occurs in the fall and winter months. Sixty percent of the Puyallup Basin lies at an elevation between 1,000 and 4,000 feet, an area where neither rain nor snow predominates. This topographical feature often leads to moisture conditions that are capable of generating tremendous amounts of runoff. These flood events normally occur in the winter months and are followed by less severe spring runoffs generated by snowmelt.

In spite of widespread habitat degradation within the Basin, there still exist functioning and productive areas. The South Prairie Creek sub-basin continues to be the backbone of natural salmonid production. Steelhead trout, chinook, pink, coho and chum all successfully reproduce within this sub-basin. The middle and upper reaches of the White River and associated tributaries have the potential to be highly productive if significant passage problems associated with the Lake Tapps Diversion Dam and Tacoma Water Pipeline in the lower reaches can be successfully addressed and riparian areas are allowed to recover. The upper Puyallup River sub-basin has the potential to naturally produce significant numbers of coho, steelhead and potentially a reintroduced spring chinook run if downstream smolt passage problems at the Electron Dam can be successfully addressed. Both the upper Puyallup and White rivers are predominantly within US Forest Service and private commercial timberlands. They have been afforded a certain amount of protection from the effects of urbanization and development, compared to urban areas in Puget Sound lowlands. However, both the upper Puyallup and upper White River watersheds suffer from present and past timber harvest practices that reduce the ability for riparian areas to provide wood and shade to the river and stream channels, and these continue to contribute fine sediments from road construction and landslides.



STOCK STATUS⁵⁶

Stocks	Hatchery Program?	Biological Significance (L=Low, M=Intermediate, H=High)			Population Viability (L=Critical, M=At Risk, H=Healthy)			Habitat (L = Inadequate, M = Limiting, H = Healthy)			Harvest Opportunity (O = None, L = Occasional, M = Most years, H = Each year)		
		Goals			Goals			Goals			Goals		
		Now	Short-Term	Long-Term	Now	Short-Term	Long-Term	Now	Short-Term	Long-Term	Now	Short-Term	Long-Term
Puyallup River Fall Chinook	Y	M	M	H	M	M	M	L	L	M	H	H	H
White River Spring Chinook	Y	H	H	H	L	L	M	L	L	M	L	M	H
Puyallup River Coho	Y	M	M	M	L	L	M	L	L	M	H	H	H
White River Coho	N	M	M	M	M	M	M	M	M	M	H	H	H
Puyallup River Chum	N	M	M	M	M	M	M	L	L	L	H	H	H
Diru Creek Hatchery Chum	Y	L	L	L	H	H	H	L	L	L	H	H	H
Puyallup River Pink	N	H	H	H	H	H	H	M	M	M	L	M	M
Puyallup River Winter Steelhead	N	M	M	M	M	M	M	L	L	M	O	L	H
Puyallup River Hatchery Winter Steelhead	Y	L	L	L	L	L	M	L	L	M	H	H	H
White River Winter Steelhead	N	M	M	M	M	M	M	L	L	M	H	H	H
White River Hatchery Winter Steelhead	Y	L	L	L	L	L	M	L	L	M	H	H	H
Puyallup/White Sea-Run Cutthroat	N	M	M	M	M	M	M	M	M	M	H	H	H
Puyallup/White Bull Trout	N	H	H	H	L	L	M	L	L	M	O	L	M

Biological significance is determined by considering a number of specific factors relating to stock origin, biological attributes and population subdivisions, with the stock defined as being of either low, intermediate or high significance.

Population viability is determined by considering a number of specific factors such as age class structure, spawner escapement and proportion of hatchery-origin fish in natural spawning, with the stock's viability defined as being either critical, at risk or healthy. This rating refers to the stock's ability to sustain itself in the natural environment (except in the case of a segregated harvest program, in which case the ratings are low, medium and high and refer to the stock's ability to sustain itself in the culture environment).

The stock's spawning, freshwater, migration and estuarine *habitat* is rated as either inadequate (target stock is unproductive and the population will go extinct, even without terminal harvest), limiting (target stock is productive enough for the population to sustain itself at a low level terminal harvest) or healthy (productivity of the stock is high and the population is capable of growth and supporting significant terminal harvest).

Harvest opportunity is rated according to whether the goal is to provide no directed harvest opportunity, occasional opportunity, opportunity most years, or opportunity each year.

HATCHERIES

*Diru Creek Hatchery*⁵⁷

Diru Creek Hatchery is located on Diru Creek, a tributary to Clarks Creek in Puyallup, Washington. The Puyallup Tribe of Indians operates the facility with Puyallup Tribe and Bureau of Indian Affairs funding. The approximately two acre site consists of the hatchery, office, back-up generator buildings and hatchery manager's residence. Programs at the facility supplement tribal chum harvest and restoration of chinook in the Upper Puyallup River.

⁵⁶ This table contains ratings for all the salmonid stocks in the sub-region, as provided by the managers. For a more detailed definition of these ratings, see HSRG Scientific Framework and Hatchery Review Program, Benefit/Risk Tool chapter.

⁵⁷ Information provided by Blake E. Smith, Puyallup Tribe, August 2002.



Voights Creek Hatchery⁵⁸

Voights Creek Hatchery is located on Voights Creek, a tributary to the Carbon River, which flows into the Puyallup River. The hatchery is on Highway 162, two miles east of the town of Orting and one half-mile from the confluence of the two rivers at Carbon river mile four. Voights Creek Hatchery is owned and operated by WDFW and financed through the State General Fund. There are two residences, one hatchery building, one storage/shop building and a freezer building. There is one gravity intake and a pump intake. The hatchery building utilizes vertical incubators. There are five 10' x 100' standard ponds, four 20' x 80' ponds, two asphalt 200' x 35' rearing ponds, one gravel 300' x 30' rearing/adult trapping pond, and four 15' x 3' starter ponds. Voights Creek Hatchery rears fall chinook, coho and steelhead.

Puyallup River Hatchery⁵⁹

Puyallup River Hatchery is located at the head waters of Clarks Creek, a spring-fed tributary to the Puyallup River at river mile 5.75. The hatchery sits on 110 acres, in the city limits of Puyallup. The hatchery is owned and operated by WDFW and financed through the State Wildlife Fund. There is a duplex and a single residence, a hatchery building and a shop/garage/office building. There are two gravity intakes and one pump intake. The hatchery building uses vertical and shallow troughs. There are 16-40' round ponds, eight 10' x 80' raceways, six 10' x 100' raceways, two 10' x 130' gravel bottom raceways, and one 90' x 60' gravel bottom rearing pond (currently being used as a secondary settling pond for pollution abatement). Steelhead are reared from various stocks including, Bogachiel, Tokul Creek, and fish returning to the Voights Creek Hatchery.

White River Hatchery⁶⁰

White River Hatchery is located in southeastern King County, three-fourths of a mile east of Highway 410, near the town of Enumclaw. The hatchery is adjacent to the White River and Puget Sound Energy's (PSE) hydro-diversion dam at river mile 24.3. There is one hatchery building, a generator building, surface water intake building, domestic water pump house and two residences. Water is supplied by six wells and a surface water intake system. There are four 8' x 95' x 3' concrete raceways, and one 96' x 52' x 4' concrete rearing pond. Within the hatchery building is the incubation room, containing 192 Heath Trays in 24 stacks of eight, and a start tank room with 16 intermediate 11' x 3' x 2' fiberglass tanks. The hatchery is funded and operated by the Muckleshoot Indian Tribe. The land and hatchery complex are currently owned by PSE.

⁵⁸ Information provided by Brodie Antipa and Darrell Mills, WDFW, August 2002.

⁵⁹ *Ibid.*

⁶⁰ Information provided by Richard Johnson, Muckleshoot Tribe, November 2002.



Puyallup River Fall Chinook

Puyallup Tribe and Washington Department of Fish and Wildlife

Stock Goals:	Current	Short-Term	Long-Term
<i>Biological Significance</i>	Medium	Medium	High
<i>Population Viability</i>	At Risk	At Risk	At Risk
<i>Habitat</i>	Inadequate	Inadequate	Limiting
<i>Harvest Opportunity</i>	High	High	High
Hatchery Program:			
<i>Purpose</i>	Harvest and Conservation		
<i>Type</i>	Integrated		

PROGRAM DESCRIPTION

This program began in 1917 with <100 adults from Voights Creek. Green River Hatchery chinook eggs and juveniles have supplemented this program. For the past 20 years, the program has been maintained with adult returns to Voights Creek Hatchery. Puyallup River fall chinook belong to the South Puget Sound, Hood Canal and Snohomish Summer and Fall GDUs. Two million fingerlings are released in the drainage (1.6 million on-station at Voights Creek, 180,000 on-station at Diru Creek Hatchery, 100,000 at Mowich Creek Acclimation Pond, 100,000 at Cow Skull Creek Acclimation Pond, 20,000 outplanted into Hylebos Creek). Since 1999, up to 1,000 surplus hatchery adult chinook have been given to the Puyallup Tribe to reintroduce above Electron Diversion Dam in the upper Puyallup watershed. Adult collection, spawning, incubation and rearing occurs on-station at Voights Creek. Adult collection and eyeing for Diru Creek and acclimation pond releases occurs at Voights Creek. Hatching and rearing for Diru Creek release and early rearing for acclimation ponds and Hylebos Creek outplants occurs at Diru Creek.

OPERATIONAL CONSIDERATIONS

- Since 1942, an average of 85% of fish released originated from Voights Creek Hatchery brood stock. All releases from the Diru Creek program since brood year 1988 have been Voights Creek Hatchery stock.
- The hatchery stock at Voights Creek has had three coded wire tag groups applied since 1988, the last being the 1997 brood year. The Diru Creek on-station release has had limited coded wire tagging in brood years 1984–86, 1997 and 2000–01. Acclimation pond releases have been coded wire tagged for brood years 1998–01. There are plans to continue coded wire tagging for four years for the on-station release, and five years for the acclimation pond release.
- Mass marking of the Voights Creek Hatchery stock began with the 1999 brood year (brood year 1998 was 50% marked).
- Contribution of hatchery origin returns to South Prairie Creek natural spawners is approximately 15%. Contribution of hatchery origin recruits to natural spawning populations is generally unknown elsewhere in the river system, because of limited visibility.
- Diru Creek returns are assumed to stray 100% because of lack of adequate attraction water.



- Contribution of natural origin recruits to the hatchery population is unknown.
- Comparative sizes of the hatchery and naturally produced juveniles are unknown.
- Juvenile passage issues constrain the short-term conservation program to reintroduce fall chinook above the Electron Dam.

BENEFITS AND RISKS

A. Consistent with short-term and long-term goals?

This program provides annual harvest consistent with the goal described, and apparent demographic benefits. The current conservation benefit of the program is questionable, because of uncertainties about the composition of the hatchery broodstock and the effect of hatchery straying on the naturally spawning component of the population.

B. Likelihood of attaining goals?

Both the historical and current contribution of natural origin fish to the hatchery broodstock is unknown. Since there has been no planned infusion of natural origin recruits into the hatchery broodstock, there is a risk that the hatchery component of this population has significantly diverged from the natural component. There is also a risk that because of long-term straying from the hatchery, the natural spawning component has been swamped by hatchery releases and is not currently adapted to the natural environment. This creates a risk of loss of viability from domestication to the naturally spawning component. Hatchery releases also create a potential risk of competition to naturally produced fall chinook.

C. Consistent with goals for other stocks?

There is a risk to the biological significance of White River spring chinook, due to potential introgression of genes from the fall chinook programs. The inability to correctly identify fall chinook at the Buckley Trap also poses a domestication risk to White River spring chinook, by restricting the use of natural origin recruits for that program. There is also a potential competition risk from this program to White River spring chinook juveniles. The lack of adequate pollution abatement facilities at both Voights Creek and Diru Creek may be adversely affecting the receiving habitat for chinook and other natural stocks.

RECOMMENDATIONS

- Continue adult releases for reintroduction above Electron Dam, to minimize domestication risks. This will require improved juvenile downstream passage at the Dam. Once this occurs, incorporate escapement needs for this element of the program into harvest planning, to ensure that fish are not available only when there is a surplus.
- Develop a long-term plan to naturalize the fall chinook population, both in the hatchery and on the spawning grounds above and below the Electron Dam.
- Manage this program to allow natural origin fish to drive adaptation, to the extent possible in these highly-urbanized watersheds. In order to do this, the goal should be for natural fish to constitute an average of at least two-thirds of the naturally spawning population.
- Determine the natural spawning escapement and its composition (hatchery- and natural-origin), and the number and composition of the resulting recruitment.
- Construct an acclimation and adult collection pond at Clarks Creek, with adequate attraction to reduce straying of fish released from Diru Creek.
- Implement rearing and release protocols that result in smolts that rapidly migrate during the normal outmigration period.



- Differentially mark fish from different release sites and strategies to evaluate survival and straying to the natural fall chinook component and the White River.
- Discontinue the pooling of gametes and adopt spawning protocols that maximize the effective population size of the hatchery component (see HSRG Area-Wide Recommendations).
- Consider semi-natural rearing, to increase survival and perhaps reduce domestication.
- Address the need for pollution abatement ponds, and adult holding and collection facilities.

COMMENTS

- Understanding the composition of the natural spawning population in a glacial stream may require development of a sampling plan that relies on methods other than visual observations, such as an estimate based on the change in ratio of marks by removal.
- A need exists to address two uncertainties: 1) whether natural reproduction is driven primarily by natural- or hatchery-origin adults; and 2) whether natural reproduction is self-sustaining.

MANAGERS RESPONSE

The Puyallup Tribe concurs with the recommendations of the HSRG for Diru Creek.

WDFW generally supports the recommendations of the HSRG, but notes that:

- The target proportion of natural origin fish in the hatchery broodstock and in natural spawning areas is a complex topic that will require additional analyses and discussion; and
- Additional funding will be required to upgrade the facilities as recommended.



White River Spring Chinook

Muckleshoot Indian Tribe, Puyallup Tribe, Washington Department of Fish and Wildlife

Stock Goals:	Current	Short-Term	Long-Term
<i>Biological Significance</i>	High	High	High
<i>Population Viability</i>	Critical	Critical	At Risk
<i>Habitat</i>	Inadequate	Inadequate	Limiting
<i>Harvest Opportunity</i>	Occasional	Most Years	Each Year
Hatchery Program:			
<i>Purpose</i>	Conservation and Harvest		
<i>Type</i>	Integrated		

PROGRAM DESCRIPTION

The current White River spring chinook stock derives from fish collected in the Puyallup and White rivers from the late 1970s through the early 1980s, when the entire spring chinook run was trapped and moved into the hatchery, or raised as captive brood at Hupp Springs Hatchery in South Puget Sound. At one point, fewer than 30 fish per year remained. Captive brood was reared at the NMFS Manchester site and the South Sound Net Pens, to rapidly expand the program. This stock is the only stock in the South Puget Sound Spring Chinook GDU. It is maintained at White River Hatchery (operated by the Muckleshoot Indian Tribe), which began its program with transfers from Hupp Springs' production. This stock is also maintained through adult returns to Minter Creek Hatchery in the South Sound region. A White River spring chinook salmon recovery plan was prepared in 1996, with the long-term goal of developing a self-sustaining, wild stock that could support harvest. The current program includes the on-station release of 260,000 fingerlings and 90,000 yearlings, and the release of up to 820,000 fingerlings from acclimation ponds (250,000 from Clearwater River Pond, 490,000 from Huckleberry Creek Pond and 80,000 from Cripple Creek Pond). Releases at the acclimation ponds fluctuate based on availability of broodstock. Adult collection, incubation and rearing for the on-station releases occur at White River Hatchery (260,000 fingerlings and 90,000 yearlings). Attaining the release of 830,000 from acclimation ponds requires incubation and early rearing at various stations including Hupp Springs, Voights Creek and Minter Creek.

OPERATIONAL CONSIDERATIONS

- Hatchery fish are marked with coded wire tags prior to release. Currently, nine different tag groups are used.
- A ventral clip has been applied to the acclimation pond releases since 1999.
- These different treatments have not been well evaluated in the past, but evaluation will be possible as three year-olds return this year.
- All returning fish are captured and examined, with non-coded wire tagged fish excluded from the hatchery broodstock. These unmarked fish likely include Puyallup River fall strays, endemic fall



chinook from the White River, returns from natural spawning White River springs, and unmarked returns from the acclimation pond releases.

- Surplus fish from the Hupps Springs program are planted in the acclimation ponds. Transfer from Hupp Springs/Minter Creek Hatchery has occurred at the eyed egg, fry and fingerling stages. Transfers have ranged from zero to 300,000 individuals during the last four years (1998–01).
- Some eggs from the White River Hatchery have been shipped for rearing to Minter Creek and then Voights Creek.
- Early lots go to the acclimation ponds, which could result in amplification or differential mortality of a non-representative sample of the run.
- There has been a 20–25% loss of broodstock during holding in recent years.

BENEFITS AND RISKS

A. Consistent with short-term and long-term goals?

This program is consistent with short-term harvest goals, but may not be consistent with providing regular harvest in the long-term because lack of local adaptation may impede or delay recovery to a harvestable level. The program has clearly provided demographic and conservation benefits, and has been critical to maintaining the White River gene pool. Until 2002, gene flow between the Hupp Springs program and the White River Hatchery has been in one direction only—from Hupp Springs to the White River. A five percent contribution of White River Hatchery males was made to Hupp Springs production in 2002. This program still presents a divergence risk between the two hatchery stocks and provides no opportunity for local adaptation for the Hupp Springs stock. Additionally, natural-origin recruits are excluded from the White River Hatchery, to prevent inclusion of non-White River genes. This strategy, intended to prevent one risk, will prolong the process of local adaptation and increases the risks from domestication.

B. Likelihood of attaining goals?

The program has achieved the goal of conserving the gene pool. The probability of developing a self-sustaining, integrated, harvestable run will depend on local adaptation and the recovery of the habitat.

C. Consistent with goals for other stocks?

The composition of the fall chinook run returning to the White River is poorly understood. These fish could represent a unique gene pool endemic to the White River. Their status and conservation needs should be addressed. There is a potential predation risk on pinks.

RECOMMENDATIONS

- Incorporate natural-origin recruits into the broodstock, taking care to ensure that these are of White River spring chinook origin. Use DNA markers and external marks to positively identify natural-origin, White River spring chinook. Develop a plan to accomplish this and begin taking actions in the short-term. Introduce an average of 10–20% natural spawning broodstock, though no more than 10% of the natural run in a given brood year.
- Stock the acclimation ponds with a representative sample of the run, to maintain within-population diversity.
- Discontinue Hupp Springs releases into the White River, to allow the White River population to locally adapt. The White River spring chinook program should be maintained exclusively at in-basin facilities. This recommendation should not be construed as implying that recovery goals for this stock have been fully achieved. Continued hatchery supplementation and habitat improvement are still essential for long-term recovery.



- Finalize and report ongoing genetic research on White River spring and fall chinook stocks, to distinguish between them.
- Evaluate the productivity of natural-origin versus hatchery-origin White River chinook, in order to determine the appropriate long-term role of the hatchery program.

COMMENTS

- The gene banking and conservation role of the Hupp Springs program has been successful in dealing with demographic risks to this stock. The assumption underlying the HSRG's recommendation to halt Hupp Springs releases is that the benefits of allowing the population in the White River to drive the local adaptation of the stock outweigh current demographic risks to the population.
- The current program is not consistent with developing a locally adapted, self-sustaining run because of its reliance on out-of-region transfers.⁶¹
- One option available to the managers would be to transport all or some portion of adults returning from prior Hupp Springs releases in the next few years to upriver spawning locations in the White River. This assumes that the managers are confident that there is no disease risk from this transport.

MANAGERS RESPONSE

The Puyallup Tribe is an active member of the South Sound Spring Chinook Technical Committee and concurs with the comments on this program provided by that committee (*see Appendix C?*).

WDFW agrees that the gene banking and conservation role of the Hupp Springs program has been successful, but believes that additional discussions with the affected tribes are necessary prior to eliminating releases into the White River.

⁶¹ See HSRG Area-Wide Recommendation on out-of-region transfers.



Puyallup River Coho

Puyallup Tribe and Washington Department of Fish and Wildlife

Stock Goals:	Current	Short-Term	Long-Term
<i>Biological Significance</i>	Medium	Medium	Medium
<i>Population Viability</i>	Critical	Critical	At Risk
<i>Habitat</i>	Inadequate	Inadequate	Limiting
<i>Harvest Opportunity</i>	Each Year	Each Year	Each Year
Hatchery Program:			
<i>Purpose</i>	Harvest and Conservation		
<i>Type</i>	Integrated		

PROGRAM DESCRIPTION

This program began in 1917 with native Voights Creek adults. The program is maintained by returns to the hatchery, but represents a composite of local and Puget Sound stocks. It is expected that native-origin stocks predominate. Voights Creek coho are considered unique in the Puget Sound hatchery system in that they are a fairly early returning/spawning stock and in every third year, returns are slightly earlier than the other two years. 980,000 yearlings are released into the Puyallup drainage (780,000 on-station, 200,000 at Rushingwater Creek acclimation pond). Since the mid 1990s, up to 4,000 surplus hatchery adult coho have been given to the Puyallup Tribe to reintroduce above Electron Diversion Dam in the upper Puyallup watershed. Adult collection, incubation, early rearing for acclimation ponds and rearing for on-station release occur at Voights Creek Hatchery.

OPERATIONAL CONSIDERATIONS

- The hatchery stock has an extensive tagging history, as an indicator stock for South Sound coho, and is mass marked with an adipose fin clip.
- There has been a significant history of off-station coho releases throughout the basin. Releases were intensive for nearly 20 years, primarily using Voights Creek stock.
- Because hatchery releases were not identifiable, the composition of the hatchery and naturally spawning stock has been unknown until 2000–01 returns.
- Contribution of hatchery origin returns to natural spawning in index reaches for 2000 and 2001 were 25% and 12%, respectively.
- Contribution of natural origin recruits to hatchery returns for 2000 and 2001 were 0.9% and 2.1%, respectively.
- Hatchery escapement has exceeded 30,000 fish in seven of the last ten years, well in excess of spawning needs.
- Juvenile passage issues constrain the effort to reintroduce coho above the Electron Dam.



BENEFITS AND RISKS

A. Consistent with short-term and long-term goals?

This program provides annual harvest consistent with the goal described and apparent demographic benefits, but the current conservation benefit of the program is questionable because of uncertainties about the composition of the hatchery broodstock and the effect of hatchery straying on the naturally spawning component of the population.

B. Likelihood of attaining goals?

Both the historical and current contribution of natural origin fish to the hatchery broodstock is unknown, although the two most recent years indicate that there is little contribution from natural origin coho to the hatchery population. Since there has been no planned infusion of natural origin recruits into the hatchery broodstock, there is a risk that the hatchery component of this population has significantly diverged from the natural component. There is also a risk that, because of extensive off-station releases and strays from the hatchery, the natural spawning component has been swamped by hatchery releases and is not currently adapted to the natural environment. This creates a risk of loss of viability from domestication to the naturally spawning component. Hatchery releases also pose potential competition and predation risks to naturally produced coho in the basin.

C. Consistent with goals for other stocks?

There is a potential risk of predation to pink, chum and spring and fall chinook stocks.

RECOMMENDATIONS

- Continue adult releases for reintroduction above Electron Dam, to minimize domestication risks. Since hatchery coho returns routinely exceed escapement needs, there does not appear to be a need to provide additional consideration for this program in harvest planning. The HSRG recognizes that there is an existing legal agreement regarding the release of 200,000 smolts for use by the Puyallup Tribe. The HSRG recommends that this program be converted into an equivalent adult supplementation program.
- Improve juvenile downstream passage at Electron Dam.
- Develop a long-term plan to naturalize the coho population, both in the hatchery and on the spawning grounds above and below the Electron Dam.
- Manage this program to allow natural origin fish to drive adaptation, to the extent possible in these highly-urbanized watersheds. In order to do this, the goal should be for natural fish to constitute an average of at least two-thirds of the naturally spawning population.
- Ensure gene flow from the natural population to the hatchery population, by introducing natural-origin recruits.
- Implement rearing and release protocols resulting in smolts that migrate rapidly during the normal outmigration period
- Discontinue the pooling of gametes and adopt spawning protocols that maximize effective population size of hatchery component (see HSRG Area-Wide Recommendations).
- Consider semi-natural rearing to increase survival and perhaps reduce domestication.
- Address the need for pollution abatement ponds, and adult holding and collection facilities.
- Consider resizing the program to reduce surplus returns to the hatchery.
- Switch the index stock to Minter Creek, because Puyallup coho have life history characteristics that do not represent other coho stocks in Central and South Puget Sound.



- If stocks cannot be adequately integrated, consider operating this program as a segregated harvest program.

COMMENTS

- A need exists to address two uncertainties: 1) whether natural reproduction is driven primarily by natural- or hatchery-origin adults; and 2) whether natural reproduction is self-sustaining.

MANAGERS RESPONSE

WDFW generally supports the recommendations of the HSRG but notes that:

- The target proportion of natural origin fish in the hatchery broodstock and in natural spawning areas is a complex topic that will require additional analyses and discussion;
- Additional funding will be required to upgrade the facilities as recommended; and
- Maintenance of the Puyallup stock is valuable as a measure of fishery harvest rates, regardless of its representation of natural production.

The Puyallup Tribe agrees with the recommendations of the HSRG. However, since the program has just recently been reduced by 400,000 smolts per year, the Tribe would like to continue monitoring the program with WDFW to determine its appropriateness in meeting harvest and conservation goals.



Diru Creek Hatchery Chum

Puyallup Tribe

Stock Goals:	Current	Short-Term	Long-Term
<i>Biological Significance</i>	Low	Low	Low
<i>Population Viability</i> ⁶²	High	High	High
<i>Habitat</i>	Inadequate	Inadequate	Inadequate
<i>Harvest Opportunity</i>	Each Year	Each Year	Each Year
Hatchery Program:			
<i>Purpose</i>	Harvest		
<i>Type</i>	Segregated		

PROGRAM DESCRIPTION

The Diru Creek Hatchery chum program began in 1977 with Finch Creek chum from Minter Creek Hatchery in the South Sound region. In 1991, the Finch Creek stock was replaced with Chambers Creek winter run chum. By 1993, the program became self-sustaining and is currently maintained by Diru Creek adult returns. This is one of two stocks in the South Puget Sound winter chum salmon GDU. Approximately two million fry (1.7 million at 454 fish per pound in April; 300,000 at 1,100 fish per pound in March) are released on-station. 50,000 eyed eggs are released into Puget Creek. Adult collection, spawning and incubation occur at Diru Creek.

OPERATIONAL CONSIDERATIONS

- None.

BENEFITS AND RISKS

A. Consistent with short-term and long-term goals?

There is a potential straying risk to Puyallup chum. Individuals are not marked and cannot be distinguished from wild spawners. It is unknown how many wild chum enter the hatchery broodstock and how many Diru Creek Hatchery chum are spawning in the Puyallup River.

B. Likelihood of attaining goals?

The likelihood of attaining goals is unknown, due to lack of monitoring and evaluation.

C. Consistent with goals for other stocks?

There is a potential competition risk to pink and chum.

⁶² In the case of a segregated harvest program, population viability ratings are low, medium and high and refer to the stock's ability to sustain itself in the culture environment.



RECOMMENDATIONS

- Differentially mark fed and unfed fry releases to monitor and evaluate the program's contribution to harvest and straying.
- Consider converting to an integrated program with local broodstock, to reduce straying risk.
- Develop a pollution abatement facility at this hatchery.
- Institute strict disinfection procedures where possible.

COMMENTS

- It is especially important to periodically monitor segregated harvest programs, in order to evaluate straying, as well as to evaluate whether natural spawners from the Puyallup River are being incorporated into the broodstock.
- Otolith marking should work for these fish if they are too small to adipose fin clip.

MANAGERS RESPONSE

The Puyallup Tribe concurs with the recommendations of the HSRG for Diru Creek.



Puyallup River Hatchery Winter Steelhead

Washington Department of Fish and Wildlife

Stock Goals:	Current	Short-Term	Long-Term
<i>Biological Significance</i>	Low	Low	Low
<i>Population Viability</i> ⁶³	Low	Low	Medium
<i>Habitat</i>	Inadequate	Inadequate	Limiting
<i>Harvest Opportunity</i>	Each Year	Each Year	Each Year
Hatchery Program:			
<i>Purpose</i>	Harvest		
<i>Type</i>	Segregated		

PROGRAM DESCRIPTION

This program released transplants from Puyallup Hatchery (Chambers Creek stock) into the mainstem Puyallup and Carbon rivers from the 1950s until the 1990s. The Puyallup Tribe maintained a separate winter steelhead program at Diru Creek until the late 1990s, using Chambers Creek origin stock. That program has since been eliminated. Beginning in the mid 1990s, most steelhead were acclimated and released from the Voights Creek Hatchery, to facilitate broodstock recovery and reduce adult straying. Currently, volitionally returning adults maintain this program, because the in-stream weir has been inoperative since 1996. When egg take goals cannot be met with locally adapted fish, transplants are used from Bogachiel and Tokul Creek hatcheries (both Chambers Creek derivatives). 180,000 yearlings are released on-station at Voights Creek. Adult collection, spawning, incubation and rearing occur on-station. Occasionally, returns provide eggs in excess of program need. These may be reared and released as yearlings at Puyallup Trout Hatchery.

OPERATIONAL CONSIDERATIONS

- All releases are adipose fin clipped.
- Smolts are released at seven to nine per pound, around May 1.
- Single pair matings are used.
- Surface water from Voights Creek is used for rearing.

BENEFITS AND RISKS

A. Consistent with short-term and long-term goals?

The program is being operated in a manner consistent with its short- and long-term goals. It is providing a valuable harvest opportunity. Interbreeding of the hatchery stock with the naturally spawning stock is reduced by the differences in spawn time.

⁶³ In the case of a segregated harvest program, population viability ratings are low, medium and high and refer to the stock's ability to sustain itself in the culture environment.



B. Likelihood of attaining goals?

There is a strong likelihood that program goals will continue to be met, although recent trends in adult returns are a concern and probably related to poor ocean conditions.

C. Consistent with goals for other stocks?

There is the potential for genetic interaction with naturally spawning winter steelhead, but this is likely to be reduced for the reason stated in A, above.

RECOMMENDATIONS

- Implement Area-Wide Recommendations regarding establishing a regional system of wild steelhead management zones, where streams are not planted with hatchery fish and are instead managed for native stocks. Fishing for steelhead in these zones would not be incompatible with this approach, but no hatchery-produced steelhead should be introduced. Such zones would reduce the risk of naturally spawning fish interbreeding with hatchery fish, and provide native stocks for future fisheries programs. To meet harvest goals, hatchery releases may be increased in those streams selected for hatchery production.
- Select both wild and hatchery streams based on stock status and a balance of large and small streams and habitat types.
- The HSRG encourages the use of locally-adapted stock (of Chambers Creek origin) for those streams. Decrease reliance on other facilities (such as Tokul Creek or Bogachiel hatcheries) to backfill shortages in locally adapting hatchery stock. Actions such as harvest restrictions should be implemented to achieve 100% local broodstock.
- Manage the hatchery stock to maintain its early spawn timing and reduce the likelihood of interaction with naturally spawning steelhead.
- Include adult collection capability wherever steelhead are released, to capture as many adults from the returning segregated population as possible. Discontinue releases where adults cannot be collected at return.
- Size the hatchery program in a manner that achieves harvest goals with minimal impact on wild populations.
- Release hatchery yearling steelhead smolts between May 1 and May 15, at target size of six fish to the pound, and a condition factor of less than 1.0.
- Conduct a workshop to implement this wild steelhead management zones concept.
- Implement monitoring and evaluation as a basic component of both wild steelhead management zones and hatchery harvest streams.
- Investigate the reasons for the recent decline in adult winter steelhead returns, formulate a working hypothesis for the decline, and take appropriate actions.
- Take extra preventative measures, since this is a relatively new program and the hatchery has a history of costiasis, furunculosis, “ich” and cold water disease. Fish health staff should be consulted as soon as a problem is suspected, so early diagnosis and treatment can be implemented.
- Disinfect equipment used in rearing ponds between uses, to reduce the risk of pond-to-pond transfers of infections.



COMMENTS

- Establishment of wild steelhead management zones should reduce the chances of ecological and genetic interactions with hatchery steelhead and help to ensure the availability of founding stocks for hatchery purposes should the need for such stocks arise.

MANAGERS RESPONSE

WDFW appreciates the HSRG recommendations on Wild Steelhead Management Zones, but notes:

- A “white paper” on this topic could increase our understanding of HSRG concerns and recommended remedies.
- As a companion to the HSRG white paper, WDFW proposes to conduct a series of workshops on steelhead during 2003 to discuss recent research, performance of the hatchery programs, and management options (including integrated and segregated programs).
- Implementation of any changes in the steelhead program will require consultation with the Fish and Wildlife Commission and the affected tribes.

WDFW supports the HSRG recommendation for improved monitoring, but notes that additional funding will be required.



White River Hatchery Winter Steelhead

Washington Department of Fish and Wildlife

Stock Goals:	Current	Short-Term	Long-Term
<i>Biological Significance</i>	Low	Low	Low
<i>Population Viability</i> ⁶⁴	Low	Low	Medium
<i>Habitat</i>	Inadequate	Inadequate	Limiting
<i>Harvest Opportunity</i>	Each Year	Each Year	Each Year
Hatchery Program:			
<i>Purpose</i>	Harvest		
<i>Type</i>	Segregated		

PROGRAM DESCRIPTION

20,000 yearlings from Puyallup Hatchery are outplanted into the White River at river mile 23. Adult collection takes place at Puyallup and Voights Creek hatcheries. Eggs are eyed at Voights Creek. Hatching and rearing occurs at Puyallup. Eyed eggs may be transferred in from Tokul Creek or Bogachiel hatcheries, to make up an egg take shortfall.

OPERATIONAL CONSIDERATIONS

- This is not an independent broodstock.
- All releases are adipose fin clipped.
- Smolts are released at seven to nine per pound, around May 1.
- Single pair matings are used.
- Early spawn timing of the hatchery stock reduces genetic interaction with naturally spawning fish.
- Surface water from Clarks Creek is used for rearing.
- Adults from releases are partially trapped at Buckley Trap and recycled to the White River.

BENEFITS AND RISKS

A. Consistent with short-term and long-term goals?

The program is being operated in a manner consistent with its short- and long-term goals. It is providing for valuable harvest opportunity. Interbreeding of the hatchery stock with the naturally spawning stock is reduced by the differences in spawn time.

B. Likelihood of attaining goals?

There is a strong likelihood that program goals will continue to be met, although recent trends in adult returns are a concern and probably related to poor ocean conditions.

⁶⁴ In the case of a segregated harvest program, population viability ratings are low, medium and high and refer to the stock's ability to sustain itself in the culture environment.



C. Consistent with goals for other stocks?

There is the potential for genetic interaction with naturally spawning winter steelhead, but this is likely to be minimized for the reason stated in A, above.

RECOMMENDATIONS

- Discontinue releases into the White River, as part of an Area-Wide Recommendation regarding a regional system of “wild steelhead management zones.” In the interim, return adults from Buckley Trap to Voights Creek, for use as locally adapted broodstock.

COMMENTS

- Establishment of wild steelhead management zones should reduce the chances of ecological and genetic interactions with hatchery steelhead and help to ensure the availability of founding stocks for hatchery purposes should the need for such stocks arise.
- Releases previously programmed for White River could be switched to Puyallup or Voights Creek hatcheries.

MANAGERS RESPONSE

WDFW appreciates the HSRG recommendations on Wild Steelhead Management Zones, but notes:

- A “white paper” on this topic could increase our understanding of HSRG concerns and recommended remedies.
- As a companion to the HSRG white paper, WDFW proposes to conduct a series of workshops on steelhead during 2003 to discuss recent research, performance of the hatchery programs, and management options (including integrated and segregated programs).
- Implementation of any changes in the steelhead program will require consultation with the Fish and Wildlife Commission and the affected tribes.

WDFW supports the HSRG recommendation for improved monitoring, but notes that additional funding will be required.



EAST KITSAP

Overview

HABITAT⁶⁵

The streams draining into Puget Sound from the east half of the Kitsap Peninsula are numerous, but rather small in comparison to those of the west half. They represent typical, lowland type streams with generally moderate gradients. Considerable deciduous growth, interspersed with stands of conifers, farmland, and urban/suburban development is common on all streams. Many of the streams originate from lakes, ground water run-off, or swamp-like headwater wetlands, which in several instances drain to both Puget Sound and Hood Canal tributaries. None of the streams are supported by snow run-off, as the maximum elevation is less than 500 meters. Stream profile characteristics are, for the most part, pool-riffle in nature with water quality and aquatic insect production highly conducive to anadromous fish production.

The numerous streams in East Kitsap primarily support chum, coho, steelhead and cutthroat trout. In addition, chinook use has been identified in some of the larger streams. Sockeye are sporadically observed in several streams, but no established populations have been observed. Adult and juvenile salmonid distribution is limited by natural and human-caused migration barriers, but may also be significantly influenced by decreased numbers of returning spawning adults (the extent of stream area used may decrease as adult or juvenile fish abundance declines), or by impaired habitat conditions that do not provide suitable spawning or rearing conditions. Most current distribution knowledge is based on contemporary stock assessment work (since 1965-1970), and likely represents a more confined distribution than occurred historically, when habitat and fish populations were healthier.

The climate is characterized by mild, wet winters, and warm, dry summers. The average summer temperature range is 70–80 degrees F during the day and 50–60 degrees F at night. The average winter temperature is 40–50 degrees F in the day and 30–40 degrees F at night. Precipitation patterns are characterized by frequent rainfalls of low intensity. Precipitation varies from 39” at Bremerton to more than 50” near Alexander Lake/Green Mountain.

Sinclair Inlet

The Sinclair Inlet watershed drains an area of 27,492 acres, including the creeks that flow into Sinclair Inlet (primarily along the southern shore) and the Beaver Creek watershed to the east. The watershed includes 57 miles of saltwater frontage, approximately 46 lakes with 9.7 miles of shoreline, and greater than 62 miles of streams. The watershed is characterized by many small streams that drain relatively small areas. Gorst and Blackjack creeks are the main dischargers of freshwater into the Inlet. Forest land covers 7,626 acres or about 28 percent of the watershed (20% in public ownership, 68% in private woodlots, 12% in commercial forest land). In 1990, greater than 95% of the forest land were stands over ten years of age. Rural/agricultural areas cover 10,627 acres, or about 37% of the watershed (35% covered with grass/shrubs, 64% covered with trees). Bremerton and Port Orchard are the major urban areas with additional retail centers in Gorst, Manchester and Annapolis. Kitsap

⁶⁵ East Kitsap Salmon and Steelhead Habitat Limiting Factors Report, Don Haring, Washington Conservation Commission, November 2000.



County designates approximately 6,658 acres (24%) of this watershed as urban. The remainder of the watershed is characterized by large parcels of pasture, forest, single-family homes, small farms, and low-intensity commercial uses.

Dyes Inlet

The Dyes Inlet sub-watershed drains an area of 30,289 acres, including the creeks that flow into Dyes Inlet and Port Washington Narrows. Approximately 40% of the watershed is within the urban area (12,231 acres) designated by Kitsap County. Bremerton and Silverdale are the major urban areas, with smaller retail centers at Chico, Tracyton and Kitsap Lake. The Jackson Park Naval Reservation, Camp Wesley Harris, and parts of the Bangor Naval Reservation are located within the watershed. The remainder of the watershed is characterized by large parcels of land used for pasture, forest, wetlands, single-family homes, small farms, and low-intensity commercial uses. Dyes Inlet is characterized by many small streams that drain relatively small areas. Clear, Barker, and Chico creeks are the main dischargers of freshwater into Dyes Inlet. Dyes Inlet contains a diverse array of land uses. Land use in the watershed was estimated to be 25% forested, 29% rural/agricultural, 40% urban, and 6% other (lakes, wetlands, military, parks, etc.). There has been extensive conversion of rural/agricultural/forest land to urban (residential and commercial) area since 1989, particularly in the Clear Creek and Barker Creek watersheds.

Port Orchard

The Port Orchard sub-watershed lies between the Sinclair Inlet and Dyes Inlet sub-watersheds (to the south and west) and the Liberty Bay/Miller Bay sub-watershed to the north. It includes those streams that flow from the west to Port Orchard, from the Kitsap Peninsula, and those that flow from the west side of Bainbridge Island on the east side of Port Orchard.

Liberty Bay/Miller Bay

The Liberty Bay/Miller Bay watershed drains an area of 27,629 acres. Approximately 48% (13,224 acres) of the watershed was identified as residential land use in 1994, with parcels varying from less than one acre to 10 acres, with 52% of the platted residential area developed at that time. Poulsbo and the marine waterfront have the highest concentrations of residential use. Land use was estimated to be: 21% (5,654 acres) commercial forest land, nine percent (2,587 acres) agricultural land (mostly small non-commercial farms), one percent (325 acres) commercial/industrial land, two percent (466 acres) military land, and two percent (640 acres) miscellaneous land use. An additional 17% (4,733 acres) was identified as open land that is likely being held for recreational purposes or as future real estate investments. This watershed experienced rapid development from 1980–90, with an increase in housing units and population of 29%. This rapid rate of development has continued through the 1990s. Many homes are located near the shore zone of the watershed, increasing possible septic effluent loading and other non-point pollutants to marine waters.

Port Madison to Foulweather Bluff

This area extends from Miller Bay, at the northwest corner of Port Madison, north to Foulweather Bluff.

Bainbridge Island

Bainbridge Island lies on the eastern side of East Kitsap, and is approximately 3.5 miles wide and 10.5 miles long, including approximately 17,607 acres. It is one of the largest islands in Puget Sound. Bainbridge Island experienced rapid growth from 1980–90, with the population growing by 3,532 people (28.7%) to approximately 15,846. The population is projected to grow to nearly 22,000 by the



year 2010. Residential development is concentrated in and around population centers and along the marine shoreline. In recent years, there has been a marked increase in the conversion of tree-covered and agricultural land to residential development. Urban development in the Winslow area has also increased. The Island has about 50 miles of shoreline. The shoreline is irregular and forms bays, harbors, coves, and lagoons. Major sand spits form Point Monroe, Wing Point, and Battle Point. The shoreline topography varies from relatively flat or gently sloping to steep with nearly vertical bluffs. Much of the land near the shore has steep slopes with a narrow, flat area next to the shore.

STOCK STATUS⁶⁶

Stocks	Hatchery Program?	Biological Significance (L=Low, M=Intermediate, H=High)			Population Viability (L=Critical, M=At Risk, H=Healthy)			Habitat (L=Inadequate, M=Limiting, H=Healthy)			Harvest Opportunity (0=None, L=Occasional, M=Most years, H=Each year)		
		Now	Goals		Now	Goals		Now	Goals		Now	Goals	
			Short-Term	Long-Term		Short-Term	Long-Term		Short-Term	Long-Term		Short-Term	Long-Term
Grovers Creek Hatchery Fall Chinook	Y	L	L	L	H	H	H	L	L	L	H	H	H
Agate Pass Sea Pen Coho	Y	L	L	L	H	H	H	H	H	M	H	H	H
East Kitsap Coho	Y	L/M	L/M	L/M	M	M	M	M	L/M	L	H	H	H
East Kitsap Fall Chum	Y	M	M	M	M	M	M	M/H	M/H	M/H	H	H	H
Blackjack Early Chum	N	H	H	H	M	M	H	M	M	L	H	L	L
Donkey Creek Chum	Y	L	L	L	M	M	H	L	L	M	H	H	H
East Kitsap Winter Steelhead	N	M	M	M	L	L	L	M	L/M	L	0	0	0
East Kitsap Sea-Run Outthroat	N	M	M	M	M	M	M	M	M	M	H	H	H

Biological significance is determined by considering a number of specific factors relating to stock origin, biological attributes and population subdivisions, with the stock defined as being of either low, intermediate or high significance.

Population viability is determined by considering a number of specific factors such as age class structure, spawner escapement and proportion of hatchery-origin fish in natural spawning, with the stock's viability defined as being either critical, at risk or healthy. This rating refers to the stock's ability to sustain itself in the natural environment (except in the case of a segregated harvest program, in which case the ratings are low, medium and high and refer to the stock's ability to sustain itself in the culture environment).

The stock's spawning, freshwater, migration and estuarine **habitat** is rated as either inadequate (target stock is unproductive and the population will go extinct, even without terminal harvest), limiting (target stock is productive enough for the population to sustain itself at a low level terminal harvest) or healthy (productivity of the stock is high and the population is capable of growth and supporting significant terminal harvest).

Harvest opportunity is rated according to whether the goal is to provide no directed harvest opportunity, occasional opportunity, opportunity most years, or opportunity each year.

HATCHERIES

*Grovers Creek Hatchery*⁶⁷

Grovers Creek Hatchery is located on Grovers Creek, which empties into Miller Bay on the northern Kitsap peninsula. The hatchery is owned and funded by the Suquamish Tribe, in trust, even though it is off the reservation. Grovers Creek Hatchery rears Grovers Creek fall chinook.

⁶⁶ This table contains ratings for all the salmonid stocks in the sub-region, as provided by the managers. For a more detailed definition of these ratings, see HSRG Scientific Framework and Hatchery Review Program, Benefit/Risk Tool chapter.

⁶⁷ Provided by the Suquamish Tribal Fisheries Department, August 2002.



Gorst Creek Rearing Ponds⁶⁸

Gorst Creek Ponds are located at river mile 0.7 of Gorst Creek, which empties into the marine waters of Sinclair Inlet. The program was initiated in 1981 and is a cooperative effort between the Suquamish Tribe and WDFW. The facility uses 20 cubic feet per second of surface water through two 100,000 cubic foot earth ponds and two 75,000 cubic foot concrete raceways to raise 2.1 million fingerling and 100,000 yearling chinook annually. The program was founded with Grovers Creek broodstock, of Green River origin.

Agate Pass Sea Pens⁶⁹

The Agate Pass Sea Pens are located in Agate Pass, between Bainbridge Island and northern Kitsap County. The program was initiated in 1981 and is a cooperative effort between the Suquamish Tribe and WDFW. The pens rear 600,000 coho smolts (currently from Minter Creek Hatchery, due to geographic proximity). The facility was upgraded to a single spar-buoy pen (70,500 cubic feet) in 1998. Maximum density was reduced from one pound to one-quarter pound per cubic foot.

Cowling Creek Hatchery⁷⁰

Cowling Creek Hatchery is located on both the north and south branches of Cowling Creek, which drains into Miller Bay. The hatchery is owned and operated by the Suquamish Tribe. The adult recapture and spawning facility is located immediately downstream from the hatchery. The hatchery program was founded with local broodstock from Chico Creek from 1977–81. Cowling Creek chum are used to supplement East Kitsap chum populations.

Donkey Creek RSI Site⁷¹

The Donkey Creek remote site incubator (RSI) site is located less than one quarter-mile from the tidewater of Gig Harbor on City of Gig Harbor land. The facility is operated by the Gig Harbor Fisherman's Club and financed through the Washington State Aquatic Lands Enhancement Account. The facility consists of approximately 15 RSIs, a small intake dam on a culvert, and a gravity feed pipe line. The Donkey Creek RSI rears Johns Creek chum via Elson Creek and more recently Minter Creek hatchery returns (see South Sound Regional Review, Minter Creek Hatchery Chum). This is a late-timed chum stock native to Johns Creek, near Shelton, but established now at Minter Creek.

⁶⁸ *Ibid.*

⁶⁹ *Ibid.*

⁷⁰ *Ibid.*

⁷¹ Provided by Darrell Mills and Chuck Baranski, WDFW, August 2002.



Grovers Creek Hatchery Fall Chinook

Suquamish Tribe

Stock Goals:	Current	Short-Term	Long-Term
<i>Biological Significance</i>	Low	Low	Low
<i>Population Viability</i> ⁷²	High	High	High
<i>Habitat</i>	Inadequate	Inadequate	Inadequate
<i>Harvest Opportunity</i>	Each Year	Each Year	Each Year
Hatchery Program:			
<i>Purpose</i>	Harvest		
<i>Type</i>	Segregated		

PROGRAM DESCRIPTION

This program was founded in 1978 with Finch Creek broodstock. Green River and Deschutes broodstock were used in 1979–81. These stocks are all of Green River origin. Since 1981, this program has been maintained by adult returns to Grovers Creek Hatchery. These chinook are one of many stocks that belong to the South Puget Sound, Hood Canal, and Snohomish Summer and Fall GDUs. 2.75 million fingerling smolts (two million on-station at Gorst Creek Rearing Ponds, 500,000 on-station at Grovers, 200,000 on-station at Dogfish Creek Rearing Ponds, 50,000 on-station at Clear Creek Rearing Ponds) and 150,000 yearlings (on-station at Gorst Creek) are released into the drainage. Adult collection for all programs occurs at Grovers. Spawning, incubation and early rearing for Grovers Creek, Dogfish and Clear Creek, and one million of the Gorst Creek program fish takes place at Grovers Creek. Incubation for the remaining one million of the Gorst Creek program fish takes place at Minter Creek Hatchery in the South Sound region. This is a tagged indicator stock under the Pacific Salmon Treaty, as well as a double index tag group for selective fishery evaluation.

OPERATIONAL CONSIDERATIONS

- Fall chinook from Minter Creek would be used if there was a shortfall.

BENEFITS AND RISKS

A. Consistent with short-term and long-term goals?

The program is generally consistent with the goals for the stock.

B. Likelihood of attaining goals?

The program has had consistently good survival and harvest goals are met. There is some potential risk of disease, due to transfer to and from Minter Creek.

⁷² In the case of a segregated harvest program, population viability ratings are low, medium and high and refer to the stock's ability to sustain itself in the culture environment.



C. Consistent with goals for other stocks?

There are potential ecological risks, due to competition with other salmonids in the marine environment. There are potential nutrient benefits in recipient streams (e.g. Gorst Creek).

RECOMMENDATIONS

- Develop on-site incubation capability to eliminate the need for transfers. In the short term, Minter Creek-bound eggs should be eyed at a Suquamish Tribal facility, to reduce disease risk.
- Continue the exemplary efforts to evaluate ecological interactions in the near shore marine areas, and adapt the program consistent with the findings.
- Review whether, under current conditions, a smaller program would still achieve program goals.
- Discontinue “back filling” with Minter Creek stock.

COMMENTS

- The Gorst Creek habitat restoration project offers an exceptional opportunity for public education and involvement.

MANAGERS RESPONSE

The Suquamish Tribe agrees with the recommendations of the HSRG and notes the following:

- The Tribe is hoping to continue the instream natural origin recruit/hatchery origin recruit and outmigrant trap, natural rearing studies, and nearshore beach seining for several years.
- The natural spawning that does occur has been observed to clean up gravel for the benefit of later arriving coho and chum, and provide significant marine nutrients into the stream/riparian zone.
- Although the project is located on City of Bremerton park land, the majority of the park use is by County residents, local schools and sports clubs.
- Even within the complexities of recovery planning for listed Puget Sound chinook, this chinook program continues to provide significant harvest opportunities for both treaty and non-treaty fishers. The Tribal partnership with WDFW and local sports clubs has been crucial to the success of this program. The tagged Grovers releases provide a valuable indicator utilized within the management of chinook stocks coast-wide.



Agate Pass Sea Pen Coho

Suquamish Tribe

Stock Goals:	Current	Short-Term	Long-Term
<i>Biological Significance</i>	Low	Low	Low
<i>Population Viability</i> ⁷³	High	High	High
<i>Habitat</i>	Healthy	Healthy	Limiting
<i>Harvest Opportunity</i>	Each Year	Each Year	Each Year
Hatchery Program:			
<i>Purpose</i>	Harvest		
<i>Type</i>	Segregated		

PROGRAM DESCRIPTION

This program began in 1981 as a cooperative effort with WDFW. Fish transfers from Minter Creek Hatchery (out-of-region) maintain this program. The Minter Creek coho stock derived historically from Minter Creek, and the Green and Skagit rivers (these introductions halted around 1980). 350,000 yearlings are released into Puget Sound from Agate Pass Sea Pens. Adult collection, spawning, incubation and early rearing take place at Minter. Intermediate rearing prior to salt water transfer takes place at Coulter Creek Hatchery (also out-of-region).

OPERATIONAL CONSIDERATIONS

- These fish are adipose fin clipped and a portion is coded wire tagged as an indicator stock under the Pacific Salmon Treaty.
- Agate Pass Sea Pen production peaked at 650,000 coho in 1996, and was reduced to 350,000 in 2000, due to Tribal funding shortfalls.

BENEFITS AND RISKS

A. Consistent with short-term and long-term goals?

The program is consistent with the goals for the stock.

B. Likelihood of attaining goals?

Poor survival of yearlings prior to release limits harvest benefits.

C. Consistent with goals for other stocks?

Continuous introductions of out-of-region stock preclude local adaptation and risk introgression with any remaining East Kitsap native stock (especially in streams in the southern portion of East Kitsap).

⁷³ In the case of a segregated harvest program, population viability ratings are low, medium and high and refer to the stock's ability to sustain itself in the culture environment.



RECOMMENDATIONS

- Transfer yearlings to sea pens in March, rather than January, to assure a more advanced stage of physiological development.
- Review whether harvest goals could be met with a smaller net pen program. This would also reduce the risks associated with straying (see comments for East Kitsap coho program).

COMMENTS

- This is a situation in which the out-of-region stock (Minter Creek) may be more appropriate than the in-region option (Green River), in that Minter Creek fish are apt to be better adapted to East Kitsap's small streams.
- See comments for East Kitsap coho.

MANAGERS RESPONSE

The Suquamish Tribe agrees with the recommendations of the HSRG and notes the following:

- The Tribe has already reduced Agate Pass Sea Pen production from 650,000 to 350,000.
- In addition to the stream morphology similarities, Minter stock coho fry were planted extensively in all the larger East Kitsap streams for 20 years, ending in 1999.
- The Agate Pass Sea Pen program has historically provided robust harvest opportunities for both treaty and non-treaty fishers. The proximity to the Port Madison Indian Reservation continues to be a valuable element to the Tribe



East Kitsap Coho

Suquamish Tribe

Stock Goals:	Current	Short-Term	Long-Term
<i>Biological Significance</i>	Low/Medium	Low/Medium	Low/Medium
<i>Population Viability</i>	At Risk	At Risk	At Risk
<i>Habitat</i>	Limiting	Inadequate/Limiting	Limiting
<i>Harvest Opportunity</i>	Each Year	Each Year	Each Year
Hatchery Program:			
<i>Purpose</i>	Conservation and Education		
<i>Type</i>	Integrated		

PROGRAM DESCRIPTION

WDFW provides 15,000 eyed eggs from Minter Creek Hatchery in the South Sound region to Port Orchard Rotary, and 50,000 to Ollala Elementary School. The Suquamish Tribe receives 50,000 eyed eggs from Minter Creek, incubates and rears them at Grovers Creek Hatchery to 200 fish per pound, mass marks and transfers 5,000 to Dove Pond (operated by Dogfish Trout Unlimited), 10,000 to Ross Pond on Steele Creek, 2,500 to Indianola Creek, 2,500 to Kitsap Creek, 10,000 to Thompson Creek, 5,000 to Cleaver Pond (no outlet), 5,000 to Reservation Pond (no outlet), 2,000 to North Kitsap High School, 2,000 to South Kitsap High School, and 2,000 to Illahee Creek.

OPERATIONAL CONSIDERATIONS

- None.

BENEFITS AND RISKS

A. Consistent with short-term and long-term goals?

The program imports out-of-region eggs, and is therefore not strictly consistent with goals for stocks in the East Kitsap sub-region. The importance of these inconsistencies depends upon the biological significance and viability of the population in the recipient streams (see comments below), and on the contribution of the outplanted fish to natural spawning.

B. Likelihood of attaining goals?

The program is not integrated with the natural stock and does not confer any direct conservation benefit to streams with potentially viable natural production. The program provides educational benefits and indirect conservation benefits by increasing public awareness of the importance of habitat to fish.

C. Consistent with goals for other stocks?

Effects on other stocks are unknown, but probably not significant due to the size of the program and the generally poor survival of the fry released.



RECOMMENDATIONS

- Mark a sufficient number of these releases to periodically monitor and evaluate straying into natural spawning populations.
- Evaluate the cumulative effects of this program and the Agate Pass Sea Pen program on potentially viable coho populations, especially in the southern portion of the East Kitsap sub-region (see comments below).

COMMENTS

- Northern streams are smaller and less able to support coho populations than those in the southern half of the East Kitsap sub-region. It is therefore important to understand the distribution of straying effects. They may matter little in the north, but be a problem for viable southern natural populations.
- The co-managers might, for example, consider the feasibility of managing the southern populations for natural production (with or without supplementation, using local broodstock), while providing harvest opportunities in the north through a (perhaps smaller) segregated Agate Pass Sea Pen program.
- With a better understanding of the genetic composition in southern streams, and with information about straying from the sea pen program in the north, it might be possible to manage for multiple goals.
- The HSRG supports and encourages the educational benefit this well-designed program provides.

MANAGERS RESPONSE

The Suquamish Tribe agrees with the recommendations of the HSRG, and agrees there will be utility in on-going studies examining straying and genetic complexity. The Tribe suggests that these results will need to be blended with current information correlating productivity losses with land use practices, to determine the best future management course for these coho stocks.



East Kitsap Fall Chum

Suquamish Tribe

Stock Goals:	Current	Short-Term	Long-Term
<i>Biological Significance</i>	Medium	Medium	Medium
<i>Population Viability</i>	At Risk	At Risk	At Risk
<i>Habitat</i>	Limiting/Healthy	Limiting/Healthy	Limiting/Healthy
<i>Harvest Opportunity</i>	Each Year	Each Year	Each Year
Hatchery Program:			
<i>Purpose</i>	Harvest and Conservation		
<i>Type</i>	Integrated		

PROGRAM DESCRIPTION

This program derives from a wild chum population collected originally from Chico Creek in Central Puget Sound. The program has been maintained from adult returns to Cowling Creek Hatchery since 1981. This stock is one of three in the Central Puget Sound Fall Chum GDU. Broodstock and egg collections occur at Cowling Creek. All eggs (two million) are incubated to the eyed stage at the hatchery, at which point 1.5 million of them are transferred to egg boxes in various drainages in East Kitsap, for release as unfed fry (300,000 at Webster's Rearing Pond on Dogfish Creek, 300,000 at Clear Creek, 300,000 at Steele Creek, 300,000 at Barker Creek, and 300,000 at Johnson Creek). Remaining eggs (500,000) are hatched and reared to 450 fish per pound at Cowling Creek and released on station.

OPERATIONAL CONSIDERATIONS

- No chum returning to Cowling Creek are passed upstream to spawn.
- Only chum returning to Cowling Creek Hatchery are used as broodstock; there has been no infusion of wild genes into the population since 1981.
- Releases are not marked in any way.
- Harvest apparently targets unfed, but not fed, fry releases.

BENEFITS AND RISKS

A. Consistent with short-term and long-term goals?

The program is consistent with the short- and long-term goals for harvest. Conservation goals for reintroduction of chum into a number of streams are being met. The conservation program, however, is limited by the lack of introduction of genes from wild spawning salmon necessary to maintain an integrated program. This program provides ancillary educational benefits that have mobilized watershed stewardship groups.



B. Likelihood of attaining goals?

The program provides annual harvest, but is limited due to the life stage used. Without program changes, it is uncertain whether the conservation goal will be attained.

C. Consistent with goals for other stocks?

The program presents no obvious risks to other stocks, and is thus consistent with the goals for these stocks.

RECOMMENDATIONS

- Develop a long-term plan for a fully integrated program, both in the hatchery and on the spawning grounds. Manage this program to allow natural origin fish to drive adaptation, to the extent possible in these rapidly-urbanizing watersheds. In order to do this, the goal should be for natural fish to constitute an average of at least two-thirds of the naturally spawning population.
- Increase the harvest benefit by targeting the Cowling Creek population.
- Release fed fry into the smaller creeks. This is more likely to support harvest, and fed fry have a higher survival rate than unfed fry.
- Stop introductions in one or more of the creeks, to determine whether the populations are self-sustaining. Develop criteria for what constitutes self-sustaining populations in these creeks, so that the program can be halted when it is no longer needed. If populations prove not to be self-sustaining, review the program with respect to the approaches used, its goals or its utility.

COMMENTS

- A successful reintroduction of chum into small creeks in East Kitsap would benefit chum habitat conservation, since it may provide a motive for protecting these creeks, and because of the beneficial in-creek activity of the fish (e.g., gravel-cleaning).
- Chico Creek habitat maintenance or improvement is critical to the long-term viability of this program.

MANAGERS RESPONSE

The Suquamish Tribe generally supports the recommendations of the HSRG, but notes the following:

- The current unfed fry program has been substantially reduced.
- Targeting the Cowling Creek population is one possibility for increasing the harvest benefit. However, the original Tribal goal was to use Cowling Creek as a broodstock source to drive a fishery based on fed chum released elsewhere.
- Rapid anthropomorphic landscape changes are occurring throughout East Kitsap, combined with accelerating ground water withdrawals. The Tribe has attempted to provide a gene bank of Chico chum at Cowling Creek Hatchery. The hatchery is used for a modest enhancement/education program as well as a potential future terminal fishery targeting on artificial (fed) production, should East Kitsap natural production diminish. The Tribe recognizes the need to import Chico gametes annually into Cowling Creek Hatchery, but has lacked the funding/manpower to follow through with this plan.



Donkey Creek Chum

Washington Department of Fish and Wildlife

Stock Goals:	Current	Short-Term	Long-Term
<i>Biological Significance</i>	Low	Low	Low
<i>Population Viability</i>	At Risk	At Risk	Healthy
<i>Habitat</i>	Inadequate	Inadequate	Limiting
<i>Harvest Opportunity</i>	Each Year	Each Year	Each Year
Hatchery Program:			
<i>Purpose</i>	Harvest and Education		
<i>Type</i>	Integrated		

PROGRAM DESCRIPTION

This program was started in the late 1960s using a Hood Canal stock from Finch Creek. The program was self-sustaining until the late 1990s, when a decision was made to change to a more local stock (a late-run, South Sound stock from John's Creek, introduced to Minter Creek Hatchery via Elson Creek Hatchery, both in the South Sound region). This Minter Creek stock is one of two fall chum stocks in the South Sound GDU. One million unfed are fry released into Donkey Creek from remote site incubators. Adult collection and spawning occur at Minter, as does the eyeing of eggs.

OPERATIONAL CONSIDERATIONS

- Releases are all unmarked.
- The intention is to continue the program until returns to Donkey Creek genetically resemble a South Sound stock, rather than a Hood Canal stock.
- Donkey Creek may become part of a city park, in which case it would be ideally located for educational purposes.

BENEFITS AND RISKS

A. Consistent with short-term and long-term goals?

The program provides modest educational benefits by involving citizens in salmon recovery, but harvest benefits are unknown (see B, below).

B. Likelihood of attaining goals?

It seems likely that some harvest is being achieved because even without supplementation, the program was at one time self-sufficient. However, no effort to evaluate harvest benefit is being attempted. The present program does produce a modest educational benefit.

C. Consistent with goals for other stocks?

There is a risk of straying into a nearby creek (Crescent Creek) that supports a native fall chum



population. However, the level of straying and genetic introgression has apparently not been determined.

RECOMMENDATIONS

- Discontinue the transfer of eggs from Minter Creek for the Donkey Creek program.
- Reduce the program's size, to make the primary purpose educational, informing the public about the value to salmon of habitat improvement.
- Collect eggs from spawners returning to Donkey Creek for release as unfed fry; in addition, allow natural spawning to occur.
- Enhance the educational and cultural values provided by this program. Consult HSRG operational guidelines for ways to improve the educational benefits.⁷⁴

COMMENTS

- A chum program based on releases of one million unfed fry is not likely to produce any significant harvest benefit.
- Downsizing the program to satisfy an educational goal should reduce the risk of straying and interbreeding with other local chum stocks.
- By keeping the program small, it should not be necessary to continue the present program to the stage where Donkey Creek returnees genetically resemble South Sound chum.

MANAGERS RESPONSE

WDFW supports the recommendations of the HSRG, but notes that additional discussion with the affected tribes and cooperators are needed regarding the size of the program.

⁷⁴ See HSRG Scientific Framework and Hatchery Review Program, chapter on Hatchery Operational Guidelines.



GREEN RIVER

Overview

HABITAT⁷⁵

This region is roughly contiguous with Water Resource Inventory Area (WRIA) 9, made up of the Green/Duwamish watershed and the Central Puget Sound watershed (the short independent streams that drain to Puget Sound from Elliott Bay south to the Puyallup watershed and the associated shorelines of Puget Sound). For salmon habitat conservation planning purposes, the streams on Vashon/Maury Island and its Puget Sound shorelines also are included in WRIA9. WRIA9 is bordered on the north by the Lake Washington/Cedar/ Sammamish watershed (WRIA 8) and to the south by the Puyallup/White River watershed (WRIA10).

The Green/Duwamish River is the largest freshwater component of WRIA 9. The Green/Duwamish River watershed begins in the Cascade Mountains, about 30 miles northeast of Mount Rainier, and flows for over 93 miles to Puget Sound at Elliott Bay in Seattle. Historically, the White, Green, and Cedar (via the Black) rivers flowed into the Duwamish River, and the system drained an area of over 1,600 square miles. Because of the diversion of the White River in 1911 and the Cedar River in 1916, the Green/Duwamish drainage area has been reduced to 556 square miles.

The Green/Duwamish River supported an average yearly run (fish returning to the river and those caught in the fisheries) of about 41,000 adult chinook during the period from 1968–96. The Green River has not experienced the same decline in naturally spawning chinook that has occurred in other Puget Sound rivers, but these numbers may be masked by a high rate of hatchery chinook that stray into the spawning grounds. There is very little reliable historical sources of information on anadromous and resident salmonid species abundance in the Duwamish/Green River basin. Historically, runs of chinook (spring and summer/fall stocks), pink, coho, chum, winter steelhead and cutthroat trout were present. Summer steelhead were also likely present in low numbers. There is limited evidence that sockeye spawn and rear in the basin.

Major engineered changes in the river and estuary (diversion of flows, creation of dams, and channel confinement by levee and revetment) have created conditions detrimental to fish and fish habitat. Channel complexity has been reduced, tidal marshes and flats have been eliminated, and connections with the old river side-channels have been severed. In addition, loss of connection between the river and its floodplain and other riparian areas interferes with the natural recharge functions of cold groundwater from flood infiltration and with the supply of gravel and large woody debris from riparian areas. Loss of fresh-to-saltwater transition habitat in the estuary reduces the available juvenile and adult transition and holding areas and the invertebrate food supply.

Numerous habitat types occur within this watersheds nearshore environment, including eelgrass meadows, kelp forests, flats, tidal marshes, sub-estuaries, sand spits, beaches and backshore, banks and bluffs, and marine riparian vegetation. Over the past century, the Duwamish Estuary and Elliott

⁷⁵ *Salmon And Steelhead Habitat Limiting Factors, Water Resource Inventory Area (WRIA) 9, Washington State Conservation Commission, January 2001.*



Bay have undergone substantial changes, as the area developed into an industrial seaport and urban center. Before 1906, the large, unregulated, freshwater outflow of the original Duwamish River built and maintained a large and relatively dynamic estuary in the lower Duwamish Valley. The hills now occupied by Seattle and West Seattle originally constrained the river delta. Based on early maps, the estuary was characterized by a sinuous channel and several tributaries. These stream channels would have been constantly changing, as is typical of a low-gradient river with substantial periodic sediment-laden flood flows.

Beginning as early as 1895, tide flats and salt marshes along the Duwamish River and the Seattle waterfront were filled with soil cut from hilly areas to the east and with sediments dredged to create protected harbor areas. In the early 1900s, the natural estuary was greatly modified by the construction of Harbor Island, the East and West waterways, and the Duwamish shipping channel. Creation of the waterways resulted in the replacement of 9.3 miles of meandering river with the 5.3-mile straightened channel that exists today.

Urban and industrial development over the past century has greatly modified shoreline habitats in the Duwamish Estuary and Elliott Bay. With the exception of the Magnolia Bluff area, virtually 100% of the estuary and bay shoreline has been modified with various types of armoring including levees and dikes, riprap, bulkheads and seawalls, rubble or steepened mud banks. In Elliott Bay, over-water structures are the prominent shoreline modifications, occupying over 65% of the bay shore. Behind the over-water structures, riprap and seawalls predominate, although exposed sand and mud substrates are present as well.

Land use activities have resulted in many direct and indirect impacts to salmon habitat. Loss of riparian vegetation has increased temperature and reduced leaf and insect inputs to the river, affecting the base of the salmon food chain. Increases in run-off volume have disrupted the timing and magnitude of flows, increased erosion, and carried pollutants into streams, first from agricultural, then urban sources. Pipes, culverts, ditches, and dams have resulted in blockages to fish passage and changes to the movement of gravel and large woody debris.

Water quality has been affected throughout the watershed. Wastewater and industrial discharges accentuated the effects of land use changes by reducing dissolved oxygen, altering temperatures, and releasing a variety of chronic contaminants, particularly in the lower Green River and Duwamish estuary. Erosion from agriculture, forestry, urban construction, and other activities increased the load of sediment entering the river, plugging spawning gravel and suffocating salmon eggs. Failing septic systems are also a problem in some rural and nearshore areas. Pesticides and fertilizers from farms, gardens, and yards have also altered water quality. Some common pesticides are believed to interfere with detection of olfactory cues by salmon, in addition to having direct toxicity and indirect food chain effects.

Watershed-Wide Habitat Improvement Projects

The WRIA 9 Technical Committee has developed an interim conservation and recovery strategy for the Green/Duwamish Watershed that will improve salmonid habitat. The strategy is based on the current state of knowledge of watershed conditions, including 13 habitat factors of decline and ecological principles. The strategy helps identify priority early actions for salmon conservation and recovery in the WRIA. The strategy will be revisited periodically and revised as appropriate as new information is collected and critical examination of issues yields additional insights into WRIA 9 and Puget Sound salmon conservation needs.



The WRIA 9 Strategy identifies three high-priority watershed goals for salmon conservation and recovery:

- **Protect currently functioning habitat** primarily in the Middle Green River sub-watershed and the nearshore areas of Vashon/Maury Island.
- **Ensure adequate juvenile salmon survival** in the Lower Green River, Elliott Bay/Duwamish, and nearshore sub-watersheds. Meeting this goal involves several types of actions, including protecting currently functioning habitat, restoring degraded habitat, and maintaining or restoring adequate water quality and flows.
- **Restore access for salmon** (efficient and safe passage for adults and juveniles) to and from the upper Green River sub-watershed.

The strategy identifies restoring fish access to the upper Green River sub-watershed as a high priority goal. The sub-watershed may be large enough to act as refugia for salmon, able to seed downstream areas once appropriate access and habitats have been established. In addition, the strategy recommends protection of currently functioning habitats and habitat-forming processes, restoration and enhancement of habitat along the mainstem and tributaries, and operation of Howard Hanson Dam in a manner that will reduce its adverse effects on flows, available habitat, and water quality downstream. The strategy also calls for filling data gaps concerning the Upper Green River, such as those regarding baseline habitat quantity and quality and juvenile out-migration.

STOCK STATUS⁷⁶

Stocks	Hatchery Program?	Biological Significance (L=Low, M = Intermediate, H =High)			Population Viability (L=Critical, M = At Risk, H = Healthy)			Habitat (L = Inadequate, M = Limiting, H = Healthy)			Harvest Opportunity (0 = None, L = Occasional, M = Most years, H = Each year)		
		Goals			Goals			Goals			Goals		
		Now	Short-Term	Long-Term	Now	Short-Term	Long-Term	Now	Short-Term	Long-Term	Now	Short-Term	Long-Term
Green River Fall Chinook	Y	M	M	M	M	M	H	M	M	M	H	H	H
Green River Coho	Y	M	M	M	M	M	H	L	L	L	H	H	H
Aquarium Hatchery Coho	Y	M	M	M	M	M	M	L	L	L	H	H	H
Burien Coho	Y	L	L	L	L	L	L	L	L	L	H	H	H
Des Moines Net Pen Coho	Y	L	L	L	L	H	H	M	M	M	H	H	H
Elliott Bay Net Pen Coho	Y	M	M	M	M	M	M	M	M	M	H	H	H
Vashon Coho	Y	L	L	L	L	L	L	L	L	L	H	H	H
Aquarium Hatchery Chum	Y	L	L	L	M	M	M	L	L	L	M	M	M
Vashon Chum	Y	L	L	L	L	L	L	L	L	L	M	H	H
Green River Chum	Y	L	L	M	M	M	M	L	L	L	M	M	M
Green River Winter Steelhead	Y	M	M	M	M	M	M	M	M	M	H	H	H
Green River Hatchery Winter Steelhead	Y	L	L	L	L	M	H	M	M	M	H	H	H
Green River Hatchery Summer Steelhead	Y	L	L	L	L	M	H	M	M	M	H	H	H
Green River Sea-Run Cutthroat	N	M	M	M	M	M	M	M	M	M	H	H	H

Biological significance is determined by considering a number of specific factors relating to stock origin, biological attributes and population subdivisions, with the stock defined as being of either low, intermediate or high significance.

Population viability is determined by considering a number of specific factors such as age class structure, spawner escapement and proportion of hatchery-origin fish in natural spawning, with the stock's viability defined as being either critical, at risk or healthy. This rating refers to the stock's ability to sustain itself in the natural environment (except in the case of a segregated harvest program, in which case the ratings are low, medium and high and refer to the stock's ability to sustain itself in the culture environment).

⁷⁶ This table contains ratings for all the salmonid stocks in the sub-region, as provided by the managers. For a more detailed definition of these ratings, see HSRG Scientific Framework and Hatchery Review Program, Benefit/Risk Tool chapter.



The stock's spawning, freshwater, migration and estuarine **habitat** is rated as either inadequate (target stock is unproductive and the population will go extinct, even without terminal harvest), limiting (target stock is productive enough for the population to sustain itself at a low level terminal harvest) or healthy (productivity of the stock is high and the population is capable of growth and supporting significant terminal harvest).

Harvest opportunity is rated according to whether the goal is to provide no directed harvest opportunity, occasional opportunity, opportunity most years, or opportunity each year.

HATCHERIES

*Soos Creek Hatchery*⁷⁷

Soos Creek Hatchery is located on Big Soos Creek, a tributary to the Green River, on approximately 37 acres of land owned by WDFW. The hatchery site is a half-mile upstream from the Green River at river mile 33.5. The facility is located at 13030 Auburn-Black Diamond road, three miles southeast of Auburn. The hatchery is owned and operated by WDFW, and is financed through the State General Fund and the Puget Sound Recreational Enhancement Fund. This facility was originally named the White River Hatchery when constructed in 1901, later renamed the Green River Hatchery. The hatchery was completely rebuilt in 1907, 1926 and 1948. In 1995, the hatchery was renamed the Soos Creek Hatchery.

There are two residences, one located two miles from the hatchery and the other on the hatchery grounds. There is one hatchery building, a shop, large carport, storage building, small (5' x 4') storage shed and small, covered spawning area located inside the creek. There is one pump intake for rearing, one small gravity intake for domestic water and pathogen free incubation and rearing. The hatchery building has 160 shallow troughs for incubation and 56 deep troughs for hatching. There are three ¼ acre asphalt ponds, eight 10' x 80' raceways, eight 17.5' x 95' concrete raceways, and twelve 3' x 15' fiberglass intermediate raceways. The adult holding pond is located in Soos Creek. A temporary weir across the creek is used to trap and hold adults. Soos Creek Hatchery rears Green River fall chinook, Green River coho, Chambers Creek stock winter-run steelhead, Skamania stock summer-run steelhead and Green River wild winter-run steelhead.

*Icy Creek (Pautzke) Rearing Ponds*⁷⁸

The Icy Creek rearing ponds are located off the Enumclaw-Franklin Road, at river mile 48.5. The facility is owned and operated by WDFW. The program is financed through the Puget Sound Recreational Enhancement fund. The hatchery was established in 1977, originally as a spring chinook facility. The Icy Creek Pond is gravity fed from shallow springs. There are two earthen ponds, but only the approximately one-third acre lower pond is used. The upper pond is not used, as fish cannot be direct released and need to be hauled. The site is isolated and there are currently no surrounding housing developments. There are no on-site buildings. Icy Creek rears Green River fall chinook.

*Palmer Ponds*⁷⁹

Palmer Ponds is approximately 12 acres and is located at river mile 56 on the Green River in King County. The property is owned by WDFW and financed through Wildlife funds. There are two buildings, a residence and carport/storage building. There are two earthen ponds, one of one acre, and one of 0.4 acres. There are four 20' round ponds. The lower earthen pond drains into a migrant smolt

⁷⁷ Information provided by the Soos Creek Hatchery Crew, Brodie Antipa and Darrell Mills, WDFW, August 2002.

⁷⁸ *Ibid.*

⁷⁹ *Ibid.*



and adult trap. All ponds are gravity fed with spring water. Palmer Ponds rears Chambers Creek stock winter-run steelhead and Skamania stock summer-run steelhead.

Keta Creek Hatchery⁸⁰

Keta Creek Hatchery is located approximately eight miles southeast of Auburn, just off Green Valley Road. It is situated next to Crisp Creek, one mile upstream from the confluence of Crisp Creek and the Green River. The 28 acre hatchery site is held in federal trust for the Muckleshoot Tribe. The facility rears fall chinook, coho and chum and steelhead. Funding to culture all stocks comes from the Muckleshoot Tribe, Tacoma Public Utilities, and the Bureau of Indian Affairs. Keta Creek has one staff house, two storage/work shops, pollution abatement ponds, eight 4' x 40' concrete start tanks, four 10' x 100' x 4' rearing raceways, and an office building containing a lab and freezer. The hatchery building houses heath tray incubators, start tanks, a formalin room, and various pieces of water quality equipment.

Crisp Creek Hatchery⁸¹

The three acre Crisp Creek Rearing Ponds complex is adjacent to Keta Creek Hatchery. It is owned by WDFW, but operated by the Muckleshoot Tribe, in conjunction with operations at Keta Creek. Crisp Creek Ponds contain two one-quarter acre earthen ponds and five 5' x 40' x 4' rearing tanks. Funding to culture all stocks comes from the Muckleshoot Tribe, Tacoma Public Utilities, and the Bureau of Indian Affairs.

Seattle Aquarium⁸²

The Seattle Aquarium is located on the waterfront in downtown Seattle, on Elliott Bay. The Aquarium is operated by the City of Seattle as a public aquarium, for the purpose of public education and entertainment. It is a popular attraction in the busy waterfront hub of Seattle. As part of its emphasis on local and eastern Pacific Rim marine fish and wildlife species, the Aquarium has focused special attention on the life cycle of Pacific salmon. The Aquarium is equipped to trap, spawn, incubate, rear and release sufficient numbers of fish for educational purposes and is able to display all life stages to the viewing public. The facility rears both coho and chum and has done so for over 20 years, in cooperation with WDFW. Small numbers of returning chum and coho are trapped and spawned at the site for educational purposes. The remaining fish for the program come from the Minter Creek and Soos Creek hatcheries. The Aquarium is equipped with vertical incubators, small starting and rearing tanks and a large sea water tank, which has a viewing window that allows viewing from beneath.

SeaTac Occupational Skills Center⁸³

The SeaTac Occupational Skills Center (OCS) is located in the town of Burien, at Seahurst Beach. The OCS is a high school level, alternative education program administered through the Highline School District and is available to high school juniors and seniors from that district. Part of the OSC curriculum, Marine Technology, features a hands-on salmon, culture facility with a small scale hatchery program capable of the full hatchery cycle, from adult trapping to release. The facility specializes in rearing coho to fingerling and yearlings size, for planting into the unnamed watershed. The water supply is a small, steep, spring-fed creek that drains directly into Puget Sound. The creek is

⁸⁰ Information provided by Dennis Moore, Muckleshoot Tribe, October 2002.

⁸¹ *Ibid.*

⁸² Information provided by Darrell Mills, WDFW, August 2002.

⁸³ *Ibid.*



occasionally subject to storm run-off, which has caused mortality in the past. Soos Creek coho acts as a back-up source of fish for this educational program.

Des Moines Net Pen⁸⁴

The Des Moines Net Pen is located in the town of Des Moines, south of Seattle. The net pen project is a cooperative effort between WDFW and the Northwest Salmon and Steelhead Council, Des Moines Chapter. The project has been in operation for over 20 years and is financed through the Aquatic Lands Enhancement Account. The site was originally used to rear delayed-release chinook, but that program has been dropped due to concerns about adults straying into the watersheds of the region. The site currently rears only Soos Creek coho smolts.

Elliott Bay Net Pen⁸⁵

The Elliott Bay Net Pens are a cooperative effort between the Muckleshoot and Suquamish tribes, begun in 1994. Green River coho broodstock are spawned at the WDFW facility, incubated, reared for a short time, then transferred to the Crisp Creek Rearing Ponds operated by the Muckleshoot Tribe. Approximately 450,000 yearlings are shipped in March of each year to the two, 100,000 cubic foot ocean spar nets, located south of Terminal 88 in Elliott Bay. The coho are reared until June 15, then released into Elliott Bay.

⁸⁴ *Ibid.*

⁸⁵ Information provided by Suquamish Tribal Fisheries Department, November 2002.



Green River Fall Chinook

Washington Department of Fish and Wildlife and Muckleshoot Tribe

Stock Goals:	Current	Short-Term	Long-Term
<i>Biological Significance</i>	Medium	Medium	Medium
<i>Population Viability</i>	At Risk	At Risk	Healthy
<i>Habitat</i>	Limiting	Limiting	Limiting ⁸⁶
<i>Harvest Opportunity</i>	Each Year	Each Year	Each Year
Hatchery Program:			
<i>Purpose</i>	Harvest and Conservation		
<i>Type</i>	Integrated		

PROGRAM DESCRIPTION

The Green River fall chinook sub-yearling program began in 1901 with adults collected from the Green River. The yearling program began in 1983. Hatchery broodstock for both sub-yearling and yearling releases is randomly selected from adults trapped at Soos Creek Hatchery on the Green River. The hatchery stock has been self-sufficient for decades. The broodstock is considered to represent the native Green River stock, with little genetic influence from outside the region. Green River fall chinook belong to the South Puget Sound, Hood Canal and Snohomish Summer and Fall GDUs. 3.2 million fingerlings are released on-station at Soos Creek Hatchery. 300,000 fingerlings are transferred to Icy Creek Pond, approximately 15 miles upstream, for release as yearlings. There are no adult trapping facilities at Icy Creek. 600,000 eyed eggs are transferred to Keta Creek Hatchery for hatching, and then outplanted as fry above Howard Hanson Dam (river mile 64.5).

OPERATIONAL CONSIDERATIONS

- The proportion of natural-origin adults among fish spawned for broodstock averaged 42% per year 1990–99.
- Coded wire tag data show that the proportion of natural spawners comprised of Soos Creek Hatchery-origin adults within the mainstem Green River averaged 37.3% from 1989–99 (with a range of zero to 67%). The proportion of natural spawners comprised of Icy Creek Hatchery-origin adults averaged 18.7% (with a range of zero to 100%) during the same nine years. The overall proportion of natural spawners comprised of hatchery-origin adults has averaged 59.6% for the years 1989–2000 with “other” hatchery fish constituting 3.6% of natural spawners. These proportions should be interpreted with caution, because of small sample sizes and the restricted region of the mainstem river surveyed (eight miles between mouths of Soos and Icy creeks). In general, the proportion of natural spawners comprised of hatchery-origin adults in the Green River has exceeded 50%, approximately 50% of the time.

⁸⁶ *The HSRG understands that the co-managers are currently in the process of attempting to resolve the particularly difficult challenge of assessing long-term habitat status in this sub-region, taking into account intense development pressures and other potentially negative impacts, alongside potential habitat improvement projects. The HSRG believes its recommendations for this program are valid despite this uncertainty.*



- The proportion of natural spawners comprised of Soos and Icy creek hatchery-origin adults in Newaukum Creek averaged 28.8% (with a range of zero to 68%) and 17.9% (with a range of zero to 42.3%), respectively, for 11 years between 1989 and 1999.
- The annual natural escapement goal for fall chinook salmon in the Green River drainage is 5,800 adult spawners. The annual escapement goal for the Soos Creek Hatchery is 3,500 adults. Escapement to the hatchery has exceeded 9,000 adults every year since 1995, except for 2000, when escapement was approximately 6,000.
- Up to 3,500 adults are passed upstream of the adult trap for natural spawning in Soos Creek.
- Adults are spawned pairwise (one-to-one) for fingerling releases. For the Icy Creek yearling program, adults are spawned in gamete pools of three males and three females.

BENEFITS AND RISKS

A. Consistent with short-term and long-term goals?

This program is conferring significant harvest benefits. Harvest rates on this hatchery stock averaged 63% for brood years 1985–93 based on coded wire tag data, with approximately 65% of the harvest occurring in waters of Washington state. The program is likely to continue meeting harvest goals in a compromised habitat and appears to be providing a demographic benefit to the overall escapement and abundance of fall chinook in the Green River. This demographic benefit may be indirectly helping to maintain the biological significance of this stock in the Green River watershed. However, the large numbers of hatchery-origin adults spawning in the Green River is a significant concern, as they may be competing with natural-origin adults for spawning habitat. A decrease in habitat quality or quantity would also present a risk to meeting harvest and conservation goals.

B. Likelihood of attaining goals?

The long-term genetic consequences of the hatchery program on the fitness and productivity of the natural population in the Green River is unknown. The hatchery program may be affecting the long-term self-sustainability of the natural fall chinook stock, as may a decrease in habitat quality or quantity.

C. Consistent with goals for other stocks?

Predation risks on sub-yearling coho, chinook and chum may exist from yearling releases. There may be nutrient benefits from hatchery-origin carcasses in the Green River.

RECOMMENDATIONS

- Conduct a stomach content study of hatchery-origin yearling chinook from the Icy Creek Pond that are caught downstream in the Green River smolt trap or other sites in the lower river, to determine if these fish are preying on other salmonids. Use the results of this study to determine what, if any, changes should be made to the program.
- Modify the yearling program to allow collection of returning adults. This could be accomplished by constructing adult recapture facilities at Icy Creek and Newaukum Creek.
- Release all components of the program volitionally.
- Design and construct an adult holding and sorting pond that is not in the mainstem of Soos Creek at the Soos Creek Hatchery. This new facility should include bypass facilities for efficiently passing adult fish upstream, and a weir for diverting upstream migrating fish into the holding pond.
- Continue to evaluate semi-natural rearing methods to increase survival and reduce potential domestication.



- Manage this program to allow natural origin fish to drive adaptation, to the extent possible in this highly-urbanized watershed. In order to do this, the goal should be for natural fish to constitute an average of at least two-thirds of the naturally spawning population.
- Determine the natural spawning escapement and its composition (hatchery- and naturally-origin), and the number and composition of the resulting recruitment.
- Select broodstock for the yearling releases to represent the entire run timing. Use BKD control strategies consistent with this selection process.
- Continue to incorporate natural-origin spawners in the hatchery broodstock consistent with HSRG guidelines.

COMMENTS

- Returning adults from the yearling release (YR) are, on average, older than returning adults from the sub-yearling release (SR) based on CWT returns, 1987-1993. Age 2: YR, 1.83%; SR, 4.76%. Age 3: YR, 10.74%; SR, 30.03%. Age 4: YR, 67.43%; SR, 57.76%. Age 5: YR, 17.79%; SR, 4.12%). These data contrast with data for other fall chinook programs in Puget Sound.
- This broodstock appears to be highly integrated genetically with natural-origin adults returning to the Green River.
- Currently, approximately one-third of the hatchery broodstock is derived from natural spawners. This is consistent with a highly-integrated program. No discernable evidence of genetic divergence has been identified.
- The co-managers recognize that the current average of 60% hatchery-origin natural spawners in the Green River is a concern. This needs to be addressed by the co-managers in the context of developing long-term habitat and stock management goals.
- A monitoring and evaluation program and research are necessary to ensure continued success of the program and to evaluate the program's effects on the fitness of the natural population over time. There is uncertainty as to whether the high proportion of hatchery-origin adults among natural spawners compromises the fitness of the natural population in the Green River.

MANAGERS RESPONSE

WDFW generally supports the recommendations of the HSRG, but notes that:

- The target proportion of natural origin fish in the hatchery broodstock and in natural spawning areas is a complex topic that will require additional analyses and discussion; and
- Additional funding will be required to upgrade the facilities as recommended.

WDFW has taken the following actions consistent with the HSRG recommendations:

- Implemented collection and evaluation of the stomach contents of smolts captured at the Green River smolt trap;
- Will test trap and collection facilities in 2003 for adults returning to Icy and Newaukum creeks (subject to approval from NOAA Fisheries); and
- Conducted a three year study of the magnitude and composition of natural spawning escapement in the Green River.



Green River Coho

Washington Department of Fish and Wildlife, Muckleshoot Tribe, Suquamish Tribe

Stock Goals:	Current	Short-Term	Long-Term
<i>Biological Significance</i>	Medium	Medium	Medium
<i>Population Viability</i>	At Risk	At Risk	Healthy
<i>Habitat</i>	Inadequate	Inadequate	Inadequate ⁸⁷
<i>Harvest Opportunity</i>	Each Year	Each Year	Each Year
Hatchery Program:			
<i>Purpose</i>	Harvest and Conservation		
<i>Type</i>	Integrated		

PROGRAM DESCRIPTION

The Green River coho program began in 1901 with native adults collected from the Green River. Additional stocks were occasionally imported in the early days of the hatchery operation, but their contribution is not believed to be significant. The program has been maintained by adult returns to the hatchery for many decades. The program produces 800,000 yearlings (600,000 on-station at Soos Creek Hatchery, 200,000 on-station at Crisp Creek Hatchery) and 800,000 fry (500,000 fry outplanted above Howard Hanson dam, above river mile 64.5, from Keta Creek Hatchery, 300,000 fry outplanted into the lower river tributaries from Soos Creek) released into the Green River. Adult collection, incubation and early rearing for all releases are at Soos Creek. 400,000 yearling smolts are released from the Elliott Bay Net Pens. Adult collection, spawning, incubation and early rearing occur at Soos Creek. Intermediate rearing prior to salt-water transfer takes place at Crisp Creek.

OPERATIONAL CONSIDERATIONS

- The managers plan to collect brood from all temporal segments of the run returning to Soos Creek, but often are not able to collect late-returning broodstock.
- Fish are released from the hatchery earlier than the ideal release time because of programming constraints.
- Control of predatory birds at the hatchery is difficult without adequate netting.
- Pollution abatement at the hatchery site is not adequate.
- Fish for the Elliott Bay Net Pen release site are vaccinated at Crisp Creek before being introduced into the pens.
- Fish for the Elliott Bay Net Pen release site are not mass marked, but 10–12.5% have historically had coded wire tags.

⁸⁷ The HSRG understands that the co-managers are currently in the process of attempting to resolve the particularly difficult challenge of assessing long-term habitat status in this sub-region, taking into account intense development pressures and other potentially negative impacts, alongside potential habitat improvement projects. The HSRG believes its recommendations for this program are valid despite this uncertainty.



BENEFITS AND RISKS

A. Consistent with short-term and long-term goals?

The program is consistent with harvest goals, having provided substantial annual harvest over many years. The interaction—mixed parentage—of hatchery and wild-spawning coho in the Green River is consistent with mid- and long-term goals for this stock of medium biological significance. It is also consistent with conservation goals, in that the hatchery provides demographic support for coho spawning in the urbanized habitat of the Green River, although the risk of lost fitness through domestication is important.

B. Likelihood of attaining goals?

The program is likely to continue to support the integrated goals of conservation and harvest. Habitat is unlikely to improve, and the integrated stock may be increasingly domesticated.

C. Consistent with goals for other stocks?

Green River chum fry, and natural chinook and coho fry, are at risk of predation by coho smolts produced from the program. Adults returning to the Elliott Bay Net Pen site stray to, and interbreed with, other coho stocks at an unknown rate (substantial numbers of coded wire tagged adults are recovered at other hatcheries, including those inside the Ballard Locks and on the Kitsap Peninsula), potentially reducing the population fitness (the local-adaptedness) of those stocks.

RECOMMENDATIONS

- Release fish later, when they are fully smolted and outmigration will occur rapidly. There are a number of options available for adjusting the program and/or the facilities to achieve this result
- Ensure sufficient gene flow from the naturally-spawning segment of the population by incorporating known natural-origin recruits in the hatchery broodstock. If there has been no divergence, this should be at the rate of at least 10–20% per year on average.
- Mark all releases, including smolts released from net pens.
- Evaluate straying (and gene flow where possible) from different segments of the stock (on-site releases, upstream releases, lower river tributary releases, net pen releases, natural spawning).
- Do not increase the size of Elliott Bay Net Pen releases until the effects of straying have been evaluated; releases should then be sized at an appropriate level.

COMMENTS

- Mass marking will allow the managers to determine over time whether genetic divergence from the natural stock has occurred.

MANAGERS RESPONSE

WDFW generally supports the recommendations of the HSRG, but notes the following:

- The target proportion of natural origin fish in the hatchery broodstock and in natural spawning areas is a complex topic that will require additional analyses and discussion.
- Delaying the release of smolts from Soos Creek Hatchery requires balancing the risk that fish held to a later date in the creek ponds will be lost in flood events. WDFW is evaluating short- and long-term solutions, including the development of incubation and early rearing facilities at Icy Creek and Palmer Ponds.
- Additional funding will be required to evaluate the magnitude of straying.



Aquarium Hatchery Coho

Seattle Aquarium and Washington Department of Fish and Wildlife

Stock Goals:	Current	Short-Term	Long-Term
<i>Biological Significance</i>	Medium	Medium	Medium
<i>Population Viability</i> ⁸⁸	Medium	Medium	Medium
<i>Habitat</i>	Inadequate	Inadequate	Inadequate
<i>Harvest Opportunity</i>	Each Year	Each Year	Each Year
Hatchery Program:			
<i>Purpose</i>	Education and Harvest		
<i>Type</i>	Segregated		

PROGRAM DESCRIPTION

The Aquarium coho program began in the late 1970s with fingerlings from Minter Creek Hatchery in the South Sound region. More recently, it has been maintained with fish from the Green River. 12,500 fingerlings and 25,000 yearlings are released on-station into Elliott Bay. Adult collection, spawning, incubation and early rearing for fingerling releases occur on-station. Adult collection, spawning, incubation and early rearing for yearlings releases occur at Soos Creek Hatchery.

OPERATIONAL CONSIDERATIONS

- None.

BENEFITS AND RISKS

A. Consistent with short-term and long-term goals?

The direct release of sub-yearling coho into Elliot Bay most likely results in little survival or adult returns and is therefore inconsistent with harvest goals.

B. Likelihood of attaining goals?

The educational benefits from this program are high. Harvest benefits are unknown.

C. Consistent with goals for other stocks?

Yes.

RECOMMENDATIONS

- Focus on the educational goal of this program, rather than harvest benefits.

⁸⁸ In the case of a segregated harvest program, population viability ratings are low, medium and high and refer to the stock's ability to sustain itself in the culture environment.



COMMENTS

- The contribution of yearling releases to harvest, and their potential straying, could be evaluated.

MANAGERS RESPONSE

WDFW supports the recommendations of the HSRG.



Burien Coho

Northwest Salmon and Steelhead Council, SeaTac Occupational Skills Center, and Washington Department of Fish and Wildlife

Stock Goals:	Current	Short-Term	Long-Term
<i>Biological Significance</i>	Low	Low	Low
<i>Population Viability</i>	Critical	Critical	Critical
<i>Habitat</i>	Inadequate	Inadequate	Inadequate
<i>Harvest Opportunity</i>	Each Year	Each Year	Each Year
Hatchery Program:			
<i>Purpose</i>	Education and Harvest		
<i>Type</i>	Integrated		

PROGRAM DESCRIPTION

The Burien coho program began in 1985 with eggs of Green River origin. This program is now maintained by returns to a small hatchery operated by the SeaTac Occupational Skills Center (OSC) as part of the Marine Technology curriculum. The OCS is an alternative educational program at the high school level. Additional eyed eggs from Soos Creek Hatchery are brought in, as needed, to meet release goals. 120,000 fry are scatter planted (33,000 to Miller Creek, 54,000 to Des Moines Creek, and 33,000 to Walker Creek). 15,000 fry and 10,000 yearlings are released from the OCS facility, which is on a small, spring-fed creek. Early rearing for yearling release also occurs at Soos Creek.

OPERATIONAL CONSIDERATIONS

- This is a cooperative program with the Northwest Salmon and Steelhead Council.
- The program has changed recently from releasing fed fry to releasing unfed fry, to reduce potential competition with natural-origin juveniles.
- Approximately one-half of the fry are released upstream of anadromous fish barriers.

BENEFITS AND RISKS

A. Consistent with short-term and long-term goals?

Educational benefits relate primarily to the value of habitat for sustaining salmon populations.

B. Likelihood of attaining goals?

Harvest benefits are unknown.

C. Consistent with goals for other stocks?

Competition risks exist with natural-origin juveniles, because of the number of fry released.

RECOMMENDATIONS

- Determine the status of natural populations in Des Moines, Miller, and Walker creeks.



- Resize the program, adjusting the number of fry released to reflect the status of the natural populations and watershed capacities.

COMMENTS

- None.

MANAGERS RESPONSE

WDFW supports the recommendations of the HSRG.



Des Moines Net Pen Coho

Northwest Salmon and Steelhead Council and Washington Department of Fish and Wildlife

Stock Goals:	Current	Short-Term	Long-Term
<i>Biological Significance</i>	Low	Low	Low
<i>Population Viability⁸⁹</i>	High	High	High
<i>Habitat</i>	Limiting	Limiting	Limiting
<i>Harvest Opportunity</i>	Each Year	Each Year	Each Year
Hatchery Program:			
<i>Purpose</i>	Harvest		
<i>Type</i>	Segregated		

PROGRAM DESCRIPTION

The Des Moines net pen coho program began in 1988 with fish of Green River origin. Juvenile fish from Soos Creek Hatchery currently maintain this program. 25,000 yearlings are released into Puget Sound from Des Moines marine net pens. Adult collection, spawning, incubation and initial rearing are at Soos Creek.

OPERATIONAL CONSIDERATIONS

- This is a cooperative program with the Northwest Salmon and Steelhead Council.

BENEFITS AND RISKS

A. Consistent with short-term and long-term goals?

Yes.

B. Likelihood of attaining goals?

Unknown.

A. Consistent with goals for other stocks?

Yes.

RECOMMENDATIONS

- Continue to mark released fish.
- Monitor and evaluate contribution to harvest and straying periodically.

⁸⁹ In the case of a segregated harvest program, population viability ratings are low, medium and high and refer to the stock's ability to sustain itself in the culture environment.



COMMENTS

- None.

MANAGERS RESPONSE

WDFW supports the recommendations of the HSRG, but notes that additional funding will be required for coded-wire tagging and assessment of straying.



Vashon Coho

Vashon Sportsmen and Washington Department of Fish and Wildlife

Stock Goals:	Current	Short-Term	Long-Term
<i>Biological Significance</i>	Low	Low	Low
<i>Population Viability</i> ⁹⁰	Low	Low	Low
<i>Habitat</i>	Inadequate	Inadequate	Inadequate
<i>Harvest Opportunity</i>	Each Year	Each Year	Each Year
Hatchery Program:			
<i>Purpose</i>	Education and Harvest		
<i>Type</i>	Segregated		

PROGRAM DESCRIPTION

30,000 fry are outplanted from Soos Creek Hatchery (15,000 into Judd Creek and 15,000 into Shinglemill Creek). Adult collection, spawning, incubation and early rearing occur at Soos Creek.

OPERATIONAL CONSIDERATIONS

- This is a cooperative program with the Vashon Sportsmen's Club.

BENEFITS AND RISKS

A. Consistent with short-term and long-term goals?

Under the premise that the recipient streams have no native stocks and little or no natural production potential (low biological significance and viability now and in the future), this program is generally consistent with short- and long-term goals for the stock.

B. Likelihood of attaining goals?

Education goals can be met. The project contributes to greater public awareness of the importance of habitat to salmon. Harvest benefits are unknown.

C. Consistent with goals for other stocks?

No goals have been identified for other stocks in these streams. Ecological interactions with resident species are unknown.

RECOMMENDATIONS

- Periodically evaluate program benefits (contribution to harvest and natural spawning).

⁹⁰ In the case of a segregated harvest program, population viability ratings are low, medium and high and refer to the stock's ability to sustain itself in the culture environment.



COMMENTS

- The potential for future natural production in small streams like these should be reviewed periodically to determine if habitat status and viability of the naturally spawning stock warrant upgrading.

MANAGERS RESPONSE

WDFW supports the recommendations of the HSRG, but notes that additional funding will be required for coded-wire tagging and assessment of straying.



Aquarium Hatchery Chum

Seattle Aquarium and Washington Department of Fish and Wildlife

Stock Goals:	Current	Short-Term	Long-Term
<i>Biological Significance</i>	Low	Low	Low
<i>Population Viability</i> ⁹¹	Medium	Medium	Medium
<i>Habitat</i>	Inadequate	Inadequate	Inadequate
<i>Harvest Opportunity</i>	Most Years	Most Years	Most Years
Hatchery Program:			
<i>Purpose</i>	Education and Harvest		
<i>Type</i>	Segregated		

PROGRAM DESCRIPTION

The Aquarium chum program began in the 1980s with eggs from Finch Creek and fry from Minter Creek Hatchery in the South Sound region. Beginning in 1990, the stock changed to John's Creek, via Minter Creek. This program collects some eggs from adults returning to the Aquarium, but is also maintained by annual introductions from Minter Creek as needed. This stock belongs to the Central/South Puget Sound Fall GDU. 40,000 fry (400 fish per pound) and 60,000 fingerlings (100 fish per pound) are released on-station into Elliott Bay. A small number of returning adults (up to 15 pairs) are trapped and spawned at the Aquarium with incubation, rearing, and fry releases occurring on-station. Adult collection, spawning, and initial incubation to the eyed stage for the fingerling releases occur at Minter Creek.

OPERATIONAL CONSIDERATIONS

- None.

BENEFITS AND RISKS

A. Consistent with short-term and long-term goals?

This program is providing educational benefits. Harvest benefits are unknown.

B. Likelihood of attaining goals?

C. Consistent with goals for other stocks?

No appreciable risks appear to be associated with this program, although potential straying of returning adults into the Duwamish and Green rivers may occur.

⁹¹ In the case of a segregated harvest program, population viability ratings are low, medium and high and refer to the stock's ability to sustain itself in the culture environment.



RECOMMENDATIONS

- Use Green River instead of Minter Creek stock for this program. Obtain eyed eggs from the Keta Creek Hatchery.
- Consider doing all adult trapping, incubation, and pre-release rearing at one location (i.e., the Aquarium). This would increase the educational value of the program.

COMMENTS

- None.

MANAGERS RESPONSE

WDFW supports the recommendations of the HSRG.



Vashon Chum

10 Million Salmon and Washington Department of Fish and Wildlife

Stock Goals:	Current	Short-Term	Long-Term
<i>Biological Significance</i>	Low	Low	Low
<i>Population Viability</i> ⁹²	Low	Low	Low
<i>Habitat</i>	Inadequate	Inadequate	Limiting
<i>Harvest Opportunity</i>	Each Year	Each Year	Each Year
Hatchery Program:			
<i>Purpose</i>	Education and Harvest		
<i>Type</i>	Segregated		

PROGRAM DESCRIPTION

50,000 unfed fry released into Judd Creek from remote site incubators. Adult collection, spawning and eyeing occur at Minter Creek Hatchery in the South Sound region.

OPERATIONAL CONSIDERATIONS

- None.

BENEFITS AND RISKS

A. Consistent with short-term and long-term goals?

Under the premise that the recipient streams have no native stocks and little or no natural production potential (low biological significance and viability now and in the future), this program is generally consistent with short- and long-term goals for the stock.

B. Likelihood of attaining goals?

Education goals can be met. The project contributes to greater public awareness of the importance of habitat to salmon. Harvest benefits are unknown, but likely to be small.

C. Consistent with goals for other stocks?

No goals have been identified for other stocks in these streams. Ecological interactions are minimal.

RECOMMENDATIONS

- Periodically evaluate program benefits (contribution to harvest and natural spawning).

⁹² In the case of a segregated harvest program, population viability ratings are low, medium and high and refer to the stock's ability to sustain itself in the culture environment.



COMMENTS

- Natural production potential for chum may become viable in the long-term, with habitat improvements.

MANAGERS RESPONSE

WDFW generally supports the intent of the HSRG recommendation, but notes that evaluating the contribution to harvest could be prohibitively expensive for a program of this size.



Green River Chum

Muckleshoot Tribe

Stock Goals:	Current	Short-Term	Long-Term
<i>Biological Significance</i>	Low	Low	Medium
<i>Population Viability</i>	At Risk	At Risk	At Risk
<i>Habitat</i>	Inadequate	Inadequate	Inadequate
<i>Harvest Opportunity</i>	Most Years	Most Years	Most Years
Hatchery Program:			
<i>Purpose</i>	Harvest and Conservation		
<i>Type</i>	Integrated		

PROGRAM DESCRIPTION

This program began in 1975, with broodstock of Hood Canal origin (Finch Creek). The program began a transition to Central Sound-origin chum from Cowling Creek Hatchery broodstock in the early 1990s. This stock is one of three in the Central Puget Sound Fall Chum GDU. Two million fry are released on-station at Keta Creek Hatchery into Crisp Creek. Adult collection, spawning, incubation and rearing occur on-station. Harvest goals include incidental harvest by commercial fisheries and subsistence harvest by traditional users. Conservation goals include the introduction and supplementation of chum in the Duwamish and Green rivers.

OPERATIONAL CONSIDERATIONS

- None.

BENEFITS AND RISKS

A. Consistent with short-term and long-term goals?

The program is consistent with its goals. Cowling Creek is the appropriate broodstock. Some harvest benefit is being derived.

B. Likelihood of attaining goals?

Incidental harvest in the coho commercial fishery occurs each year; some subsistence harvest does occur but the number of fish harvested is not known. Attaining conservation goals would require habitat improvements and allowing for local adaptation of this stock.

C. Consistent with goals for other stocks?

Yes.

RECOMMENDATIONS

- Establish a program to mark all fry produced from the hatchery (e.g., otolith thermal marking).



- Document the harvest—both commercial and subsistence—of this stock for at least five years, differentiating between natural- and hatchery-origin fish in the harvest.
- Assess the abundance and distribution of natural spawning fish in the watershed for at least five years.
- Document the contribution to natural spawning of hatchery produced fish by estimating the proportion of marked fish in the naturally spawning segment of the stock in each of the five years.
- Incorporate an annual average of 10–20% naturally spawning fish in hatchery broodstock.
- Assess the importance of the hatchery program to the sustained harvest of the stock, and to the viability of the natural spawners in each of the five years.
- Collect and analyze tissue samples from returning hatchery adults to ensure that conversion to a Central Puget Sound stock is adequate. If the result of this genetic analysis is that the conversion is not adequate, use Cowling Creek broodstock as necessary to meet goals.

COMMENTS

- None.

MANAGERS RESPONSE

No response received at time of publication. Check Hatchery Reform Project web site for responses received after publication date: www.ltk.org/hatcheryreform.html.



Green River Winter Steelhead

Muckleshoot Tribe and Washington Department of Fish and Wildlife

Stock Goals:	Current	Short-Term	Long-Term
<i>Biological Significance</i>	Medium	Medium	Medium
<i>Population Viability</i>	At Risk	At Risk	At Risk
<i>Habitat</i>	Limiting	Limiting	Limiting ⁹³
<i>Harvest Opportunity</i>	Each Year	Each Year	Each Year
Hatchery Program:			
<i>Purpose</i>	Harvest and Conservation		
<i>Type</i>	Integrated		

PROGRAM DESCRIPTION

40,000–80,000 fingerlings are outplanted into the Green River or tributaries from Keta Creek Hatchery. Adults are collected by hook and line in-river, matured, spawned, incubated and reared at Keta Creek. If annual escapement objectives are met, fingerlings are adipose clipped and outplanted. If escapement objectives are not met, pre-smolts remain unmarked and are outplanted into areas with low natural spawning. Up to 33,000 adipose fin clipped and ventral marked yearlings are acclimated and released on-station at Crisp Creek Hatchery. Adults for the yearling component are collected by hook and line in-river, and matured and spawned at Keta Creek, then incubated and early reared at Soos Creek Hatchery.

OPERATIONAL CONSIDERATIONS

- This is a new program.
- Fingerlings may or may not be adipose fin clipped, depending upon meeting escapement objectives.

BENEFITS AND RISKS

A. Consistent with short-term and long-term goals?

The program could realize some minimal effect in regards to harvest, but quantification of results has not been possible due to it being a new program. Long-term quantification of results is also doubtful, due to small numbers and an inability to accurately assess adult returns. This program is not consistent with conservation goals as presently designed, because of the small genetic effective size of the broodstock and the potential for genetic swamping (the Ryman/Laikre effect). On the other hand, collecting more adults for broodstock could create demographic risks to the natural population.

⁹³ The HSRG understands that the co-managers are currently in the process of attempting to resolve the particularly difficult challenge of assessing long-term habitat status in this sub-region, taking into account intense development pressures and other potentially negative impacts, alongside potential habitat improvement projects. The HSRG believes its recommendations for this program are valid despite this uncertainty.



B. Likelihood of attaining goals?

Conservation goals cannot be attained, as described above. The likelihood of attaining harvest goals is constrained by the high mortality of the broodstock, the use of low-surviving fingerling releases, and the small size of the program.

C. Consistent with goals for other stocks?

Minimal negative interactions are to be expected, due to the small size of the program.

RECOMMENDATIONS

- Discontinue the current conservation program, since the benefits are unlikely to exceed the genetic and demographic risks it creates.
- Discontinue fingerling releases; follow HSRG steelhead release guidelines.
- Evaluate the program's contribution to harvest and continue only a harvest benefit is established and the conservation risk is addressed by selective removal of a significant proportion of returning hatchery-origin adults.
- If the program continues, follow HSRG Area-Wide Recommendations for steelhead (see other steelhead program reviews).

COMMENTS

- None.

MANAGERS RESPONSE

WDFW appreciates the HSRG recommendations on Wild Steelhead Management Zones, but notes:

- A "white paper" on this topic could increase our understanding of HSRG concerns and recommended remedies.
- As a companion to the HSRG white paper, WDFW proposes to conduct a series of workshops on steelhead during 2003 to discuss recent research, performance of the hatchery programs, and management options (including integrated and segregated programs).
- Implementation of any changes in the steelhead program will require consultation with the Fish and Wildlife Commission and the affected tribes. Modification of the program should not occur until these tasks are completed.



Green River Hatchery Winter Steelhead

Washington Department of Fish and Wildlife and Muckleshoot Tribe

Stock Goals:	Current	Short-Term	Long-Term
<i>Biological Significance</i>	Low	Low	Low
<i>Population Viability</i> ⁹⁴	Low	Medium	High
<i>Habitat</i>	Limiting	Limiting	Limiting ⁹⁵
<i>Harvest Opportunity</i>	Each Year	Each Year	Each Year
Hatchery Program:			
<i>Purpose</i>	Harvest		
<i>Type</i>	Segregated		

PROGRAM DESCRIPTION

The Green River hatchery winter steelhead program began in 1969–70 with transplants from the Chambers Creek Hatchery. Currently, this program is maintained by adult returns to Palmer Ponds, with supplemental fish coming from Tokul Creek Hatchery in the Stillaguamish/Snohomish region, if needed. 200,000 yearlings are released on-station (190,000 at Palmer Ponds, 10,000 at Flaming Geyser Ponds). Adult collection occurs at Palmer Ponds and Keta Creek Hatchery. All adults are transferred to Palmer Ponds for maturation. Incubation and early rearing occurs at Soos Creek Hatchery. Eggs may be transferred in from Tokul Creek (more than 50% on average for last four years) or Bogachiel Ponds, to make up for an escapement shortfall.

OPERATIONAL CONSIDERATIONS

- Fish are released at 4.5–6.5 per pound from late April to mid-May.
- All releases are adipose fin clipped.
- Single pair matings are used.
- Eyed eggs from Tokul Creek or Bogachiel River hatcheries are used, due to shortfalls of local broodstock.
- Flaming Geyser release ponds lack adult collection capability.

BENEFITS AND RISKS

A. Consistent with short-term and long-term goals?

The program is being operated in a manner consistent with its short- and long-term goals. It is

⁹⁴ In the case of a segregated harvest program, population viability ratings are low, medium and high and refer to the stock's ability to sustain itself in the culture environment.

⁹⁵ The HSRG understands that the co-managers are currently in the process of attempting to resolve the particularly difficult challenge of assessing long-term habitat status in this sub-region, taking into account intense development pressures and other potentially negative impacts, alongside potential habitat improvement projects. The HSRG believes its recommendations for this program are valid despite this uncertainty.



providing for valuable harvest opportunity. Interbreeding of the hatchery stock with the naturally spawning stock is minimized by the differences in spawn time.

B. Likelihood of attaining goals?

There is a strong likelihood that program goals will continue to be met, although recent trends in adult returns are a concern and probably related to poor ocean conditions.

C. Consistent with goals for other stocks?

There is the potential for genetic interaction with naturally spawning winter steelhead, but this is likely to be minimized for the reason stated A, above.

RECOMMENDATIONS

- Implement Area-Wide Recommendations regarding establishing a regional system of wild steelhead management zones, where streams are not planted with hatchery fish and are instead managed for native stocks. Fishing for steelhead in these zones would not be incompatible with this approach, but no hatchery-produced steelhead should be introduced. Such zones would reduce the risk of naturally spawning fish interbreeding with hatchery fish, and provide native stocks for future fisheries programs. To meet harvest goals, hatchery releases may be increased in those streams selected for hatchery production.
- Select both wild and hatchery streams based on stock status and a balance of large and small streams and habitat types.
- The HSRG encourages the use of locally-adapted stock (of Chambers Creek origin) for those streams. Decrease reliance on other facilities (such as Tokul Creek or Bogachiel hatcheries) to backfill shortages in locally adapting hatchery stock. Actions such as harvest restrictions should be implemented to achieve 100% local broodstock.
- Manage the hatchery stock to maintain its early spawn timing and reduce the likelihood of interaction with naturally spawning steelhead.
- Include adult collection capability wherever steelhead are released, to capture as many adults from the returning segregated population as possible. Discontinue releases where adults cannot be collected at return.
- Size the hatchery program in a manner that achieves harvest goals with minimal impact on wild populations.
- Release hatchery yearling steelhead smolts between May 1 and May 15, at target size of six fish to the pound, and a condition factor of less than 1.0.
- Conduct a workshop to implement this wild steelhead management zones concept.
- Implement monitoring and evaluation as a basic component, of both wild steelhead management zones and hatchery harvest streams.
- Discontinue releases at Flaming Geyser Ponds, due to lack of adult collection capabilities.
- Institute predator control methods at Palmer Ponds.
- Increase volitional release timing prior to forced release.

COMMENTS

- Establishment of wild steelhead management zones should reduce the chances of ecological and genetic interactions with hatchery steelhead and help to ensure the availability of founding stocks for hatchery purposes should the need for such stocks arise.



MANAGERS RESPONSE

WDFW appreciates the HSRG recommendations on Wild Steelhead Management Zones, but notes:

- A “white paper” on this topic could increase our understanding of HSRG concerns and recommended remedies.
- As a companion to the HSRG white paper, WDFW proposes to conduct a series of workshops on steelhead during 2003 to discuss recent research, performance of the hatchery programs, and management options (including integrated and segregated programs).
- Implementation of any changes in the steelhead program will require consultation with the Fish and Wildlife Commission and the affected tribes.
- WDFW requests additional clarification on the recommendations to discontinue releases at Flaming Geyser Ponds. Based on current survival and harvest rates, the potential of this program to adversely impact wild fish does not appear to be significant.



Green River Hatchery Summer Steelhead

Washington Department of Fish and Wildlife and Muckleshoot Tribe

Stock Goals:	Current	Short-Term	Long-Term
<i>Biological Significance</i>	Low	Low	Low
<i>Population Viability</i> ⁹⁶	Low	Medium	High
<i>Habitat</i>	Limiting	Limiting	Limiting ⁹⁷
<i>Harvest Opportunity</i>	Each Year	Each Year	Each Year
Hatchery Program:			
<i>Purpose</i>	Harvest		
<i>Type</i>	Segregated		

PROGRAM DESCRIPTION

The Green River hatchery summer steelhead program began in 1969–70 with transplants from the Chambers Creek Hatchery (Skamania origin, Lower Columbia River Basin). More recently, the program has been maintained with transplants from Reiter Ponds in the Stillaguamish/Snohomish region of Skamania River stock summer-run steelhead. Currently, this program is maintained by returns to Soos Creek Hatchery and Palmer Ponds, with Reiter as backup if needed. 100,000 yearlings are released on-station (46,000 at Palmer, 29,000 at Soos, 20,000 at Icy Creek, 5,000 at Flaming Geyser Ponds). Adult collection occurs at Palmer, Soos and Keta Creek Hatchery. All adults are transferred to Palmer for maturation. Incubation and early rearing occurs at Soos.

OPERATIONAL CONSIDERATIONS

- Fish released at 4.5–6.5 per pound from late April to mid-May.
- All releases are adipose fin clipped.
- Single pair matings are used.
- Eyed eggs may be transferred in from Reiter Ponds to make up for escapement shortfall (ranging from zero to 100% over last few years).
- Flaming Geyser and Icy Creek ponds do not have adult collection facilities.

BENEFITS AND RISKS

A. Consistent with short-term and long-term goals?

The program is being operated in a manner consistent with its short- and long-term goals. It is

⁹⁶ In the case of a segregated harvest program, population viability ratings are low, medium and high and refer to the stock's ability to sustain itself in the culture environment.

⁹⁷ The HSRG understands that the co-managers are currently in the process of attempting to resolve the particularly difficult challenge of assessing long-term habitat status in this sub-region, taking into account intense development pressures and other potentially negative impacts, alongside potential habitat improvement projects. The HSRG believes its recommendations for this program are valid despite this uncertainty.



providing valuable harvest opportunity. Interbreeding of the hatchery stock with the naturally spawning stock is minimized by the differences in spawn time.

B. Likelihood of attaining goals?

There is a strong likelihood that program goals will continue to be met, although recent trends in adult returns are a concern and probably related to poor ocean conditions.

C. Consistent with goals for other stocks?

There is the potential for genetic interaction with naturally spawning winter steelhead, but this is likely to be minimized for the reason stated in A, above. There is an introgression risk to winter steelhead, due to controlled river flows that may allow hatchery fish to spawn in the wild.

RECOMMENDATIONS

- Implement Area-Wide Recommendations regarding establishing a regional system of wild steelhead management zones, where streams are not planted with hatchery fish and are instead managed for native stocks. Fishing for steelhead in these zones would not be incompatible with this approach, but no hatchery-produced steelhead should be introduced. Such zones would reduce the risk of naturally spawning fish interbreeding with hatchery fish, and provide native stocks for future fisheries programs. To meet harvest goals, hatchery releases may be increased in those streams selected for hatchery production.
- Select both wild and hatchery streams based on stock status and a balance of large and small streams and habitat types.
- Use locally-adapted stock (of Skamania origin) for those streams. Decrease reliance on other facilities (such as Reiter Ponds) to backfill shortages in locally adapting hatchery stock. Actions such as harvest restrictions should be implemented to achieve 100% local broodstock.
- Manage the hatchery stock to maintain its early spawn timing and reduce the likelihood of interaction with naturally spawning steelhead.
- Include adult collection capability wherever steelhead are released, to capture as many adults from the returning segregated population as possible. Discontinue releases where adults cannot be collected at return.
- Size the hatchery program in a manner that achieves harvest goals with minimal impact on wild populations.
- Release hatchery yearling steelhead smolts between May 1 and May 15, at target size of six fish to the pound, and a condition factor of less than 1.0.
- Conduct a workshop to implement this wild steelhead management zones concept.
- Implement monitoring and evaluation as a basic component, of both wild steelhead management zones and hatchery harvest streams.
- Discontinue releases at Flaming Geyser and Icy Creek ponds, due to lack of adult collection capabilities.
- Institute predator control methods at Palmer Ponds.
- Increase volitional release timing prior to forced release.

COMMENTS

- Establishment of wild steelhead management zones should reduce the chances of ecological and genetic interactions with hatchery steelhead and help to ensure the availability of founding stocks for hatchery purposes should the need for such stocks arise.



MANAGERS RESPONSE

WDFW appreciates the HSRG recommendations on Wild Steelhead Management Zones, but notes:

- A “white paper” on this topic could increase our understanding of HSRG concerns and recommended remedies.
- As a companion to the HSRG white paper, WDFW proposes to conduct a series of workshops on steelhead during 2003 to discuss recent research, performance of the hatchery programs, and management options (including integrated and segregated programs).
- Implementation of any changes in the steelhead program will require consultation with the Fish and Wildlife Commission and the affected tribes.
- WDFW requests additional clarification on the recommendations to discontinue releases at Flaming Geyser Ponds. Based on current survival and harvest rates, the potential of this program to adversely impact wild fish does not appear to be significant.
- Consistent with the HSRG recommendation, WDFW will in 2003 test trap and collection facilities for adults returning to Icy Creek (subject to approval from NOAA Fisheries).
- WDFW notes that additional funding will be required to implement improved monitoring as recommended by the HSRG.



LAKE WASHINGTON

Overview

HABITAT⁹⁸

Out of the 692 square miles in Water Resource Inventory Area (WRIA) 8,607 are in the Cedar/Sammamish watershed, which contains two major river systems—the Cedar and the Sammamish—and three large lakes—Union, Washington and Sammamish. The remainder of the WRIA consists of numerous small watersheds that drain directly to Puget Sound between Elliott Bay and Mukilteo. Lake Washington is the second largest natural lake in the state, with about 80 miles of shoreline (including about 30 miles along the shore of Mercer Island) and a surface area of about 35.6 square miles. Arguably, Lake Washington has the most highly altered watershed on the West Coast. Despite such heavy alteration, it continues to support numerous salmon runs.

WRIA 8 is located predominantly within the borders of King County, but 15% of it extends northward into Snohomish County. To the west, it is bounded by Puget Sound, while to the east the headwaters of the Cedar River reach the crest of the Cascade Range near Stampede Pass). The northern and southern boundaries follow hilltops, ridges and plateaus that define the drainage's divides between the Snohomish/Snoqualmie (WRIA 7) and Green/Duwamish (WRIA 9) watersheds, respectively.

The Lake Washington watershed has been dramatically altered in the 150 years since the first Euro-American settlers arrived in the Seattle area. This started with heavy logging of old growth forest in the 19th Century. It expanded at the turn of the 20th Century, when Seattle tapped the Cedar River as its main source of water supply. A major alteration of the watershed occurred in the decade of 1910-20, when the Lake Washington Ship Canal and Hiram M. Chittenden Locks were completed. The ecological consequences of this last alteration were profound—the outlet of Lake Washington was redirected from its south end at the Black River. The new outlet, at the Locks and Salmon Bay, had almost no features of a natural estuary and presented migrating salmonids an abrupt transition from freshwater to saltwater (and saltwater to freshwater). The level of Lake Washington was dropped about nine feet, which drained wetlands along much of its shoreline and dramatically changed the confluences with its tributaries. In addition, cutthroat populations have flourished in this urbanized environment, resulting in significantly increased predation problems affecting anadromous species.

In a separate but related action in the same decade, the Cedar River was redirected from its normal connection with the Black River, which had fed the Duwamish, and was channelized to flow into Lake Washington, with the initial hope of creating a major freshwater industrial port at Renton. Lowering the water surface level of Lake Washington also lowered the water surface of Lake Sammamish and drained the vast wetland complex that had made up the Sammamish River Corridor between the two lakes. This provided the basis for a major expansion of farming in that corridor, which led to channelization of the Sammamish River in the early 1920s to nearly its present course. Thus, by the 1920s the general hydro-geography of the present watershed was established.

⁹⁸ *Salmon And Steelhead Habitat Limiting Factors Water Resource Inventory Area (WRIA) 8, Cedar/Sammamish Watersheds, Washington State Conservation Commission, September 2001.*



In the ensuing years, the most important cause of physical change to the watershed has been the expansion of urban and suburban development. In particular, this has altered the hydrology of the watershed; both through changes in land cover and through increased water withdrawals. Changes in land cover due to urbanization have been extensively shown to relate to degradations in salmon habitat, mostly due to changes in flows but also because of degraded riparian areas. The removal of forest cover for urban and suburban development dramatically increases the size and frequency of high flows from storm water in lowland creeks. It typically reduces low flows in the summer and early fall, because cleared land and impervious surfaces dramatically reduces groundwater recharge. As to increased water withdrawals, through the 1940s these were primarily from Seattle's Cedar River Watershed, but total withdrawals from the watershed have been relatively stable since then, as Seattle and the region have developed other supplies. Major groundwater withdrawals in the watershed since then have been from below the lower Cedar River, lower Issaquah Creek, lower Bear Creek and Rock Creek (a tributary to the Cedar River).

Following significant floods in the 1950s, countywide flood control efforts in the 1960s led to a dramatic expansion of levees on the Cedar River and local sponsorship of major dredging and levee construction on the Sammamish River by the Army Corps of Engineers. This in turn supported the greater development of the floodplains of both rivers. Meanwhile, expanding urbanization led to heavy residential development of the shorelines of Lake Washington and Lake Sammamish. Residential development has also expanded along the bluffs above Puget Sound and along parts of its shoreline. The marine nearshore of WRIA 8 was even more dramatically affected by the construction of a railroad line along most of its length early in the 20th Century. Bulkheads and other protections for the railroad line and developments have significantly curtailed natural, beach-forming ecological processes along the Puget Sound nearshore.

Land uses differ considerably across the watershed and there are few watersheds in the Puget Sound basin that match extremes evident in WRIA 8. In the upper Cedar River, land is devoted almost entirely to preservation of forests. A mix of residential, commercial forestry generally characterizes the smaller streams, and agricultural land uses. Residential, industrial, and commercial uses prevail in the lower reaches of virtually all the streams. The Puget Sound drainages are primarily residential in nature. Fundamental land use changes to the WRIA over the last 150 years include:

- 1840s and 1850s, European settlement begins
- 1880–1910, Logging across much of the watershed
- 1901, City of Seattle begins water diversions out of Cedar River
- 1916, Cedar River diverted into Lake Washington, Hiram M. Chittenden Locks finished, Lake Washington outlet changed to Salmon Bay
- 1945–present, Residential, commercial, and industrial uses replacing largely farmlands and forests in western half of WRIA



STOCK STATUS⁹⁹

Stocks	Hatchery Program?	Biological Significance (L=Low, M = Intermediate, H =High)			Population Viability (L=Critical, M = At Risk, H = Healthy)			Habitat (L = Inadequate, M = Limiting, H = Healthy)			Harvest Opportunity (0 = None, L = Occasional, M = Most years, H = Each year)		
		Goals			Goals			Goals			Goals		
		Now	Short-Term	Long-Term	Now	Short-Term	Long-Term	Now	Short-Term	Long-Term	Now	Short-Term	Long-Term
Cedar River Chinook	N	M	M	H	M	M	H	L	L	M	L	L	M
North Lake Washington Chinook	N	M	M	M	L	L	M	L	L	L/M	L	L	L
Portage Bay Hatchery Chinook	Y	L	L	L	M	M	M	L	L	L	L	L	L
Issaquah Hatchery Chinook	Y	M	M	M	H	H	H	L	L	L	H	H	H
Portage Bay Hatchery Coho	Y	L	L	L	M	M	M	L	L	L	H	H	H
Lake Washington Coho	Y	L	L	L	L	L	L	L	L	L	H	H	H
Edmonds Net Pen Coho	Y	L	L	L	H	H	H	M	M	M	H	H	H
Lake Washington Sockeye	Y	M	M	M	M	M	H	M	M	M	M	M	H
Pipers Creek Chum	Y	L	L	L	L	L	L	L	L	L	L	L	L
Lake Washington Winter Steelhead	Y	M	M	M	L	L	M	L	L	L	0	0	L

Biological significance is determined by considering a number of specific factors relating to stock origin, biological attributes and population subdivisions, with the stock defined as being of either low, intermediate or high significance.

Population viability is determined by considering a number of specific factors such as age class structure, spawner escapement and proportion of hatchery-origin fish in natural spawning, with the stock's viability defined as being either critical, at risk or healthy. This rating refers to the stock's ability to sustain itself in the natural environment (except in the case of a segregated harvest program, in which case the ratings are low, medium and high and refer to the stock's ability to sustain itself in the culture environment).

The stock's spawning, freshwater, migration and estuarine **habitat** is rated as either inadequate (target stock is unproductive and the population will go extinct, even without terminal harvest), limiting (target stock is productive enough for the population to sustain itself at a low level terminal harvest) or healthy (productivity of the stock is high and the population is capable of growth and supporting significant terminal harvest).

Harvest opportunity is rated according to whether the goal is to provide no directed harvest opportunity, occasional opportunity, opportunity most years, or opportunity each year.

HATCHERIES

Portage Bay Hatchery¹⁰⁰

The Portage Bay Hatchery is located at the University of Washington (UW) College of Fisheries on the shores of Portage Bay. The program has two major goals and missions: 1) support research programs by University of Washington faculty, research scientists, graduate students and other affiliated research organizations such as NMFS, US Geological Survey and WDFW; and 2) support educational activities for undergraduate and graduate students within the UW and also K-12 outreach opportunities for Puget Sound region schools. The hatchery is equipped to trap, spawn, incubate, rear and release sufficient numbers of fish for educational and research purposes as well as releasing sufficient numbers of smolts to assure broodstock self-sufficiency. Portage Bay hatchery uses three different water sources to rear fish. The primary source for the facility is surface water drawn from Portage Bay. A well water source and domestic (city water) source are also utilized, depending on time of year, fish life stage and research needs. In addition, the facility has a limited ability to warm surface water drawn from Portage Bay. Portage Bay Hatchery rears Portage Bay chinook and coho.

⁹⁹ This table contains ratings for all the salmonid stocks in the sub-region, as provided by the managers. For a more detailed definition of these ratings, see HSRG Scientific Framework and Hatchery Review Program, Benefit/Risk Tool chapter.

¹⁰⁰ Information provided by Darrell Mills, WDFW, August 2002.



Issaquah Creek Hatchery¹⁰¹

Issaquah Creek Hatchery is located on Issaquah Creek, approximately three miles upstream from its confluence with Lake Sammamish. Issaquah Hatchery is unique in that it is situated in the heart of an urban area, downtown Issaquah. The facility is operated by WDFW and financed through the State General Fund. Three phases of reconstruction have recently been completed. The facility has two residences, a shop, an incubation building consisting of a three vertical incubation rooms, shallow trough and intermediate rearing capabilities, office/storage, break room and two class study rooms. The facility also has an adult spawning shed, educational Watershed Science Center and two large adult viewing platforms, bridge and viewing windows. The incubation building is comprised of 54 full stack vertical incubators, shallow and intermediate troughs that can be supplied with creek, well and/or chilled well water. Outside ponds consist of two 20' x 90' x 4', eight 10' x 9'0 x 4', two 20' x 80' x 5', four 10' x 80' x 3.5' rearing ponds and two 10' x 90' x 5' adult holding ponds. The facility has an upper gravity and lower pump intake. The gravity intake predominantly supplies water to the north side of the facility and the pump intake drives water to the south side. Incubation water may be supplied with creek, well or chilled well water. The hatchery rears Issaquah Creek chinook, Issaquah Creek coho and Lake Washington steelhead, and handles Issaquah Creek chinook, Issaquah Creek coho, Issaquah Creek sockeye, Issaquah Creek cutthroat, Issaquah Creek rainbow and Lake Washington steelhead.

Cedar River Hatchery¹⁰²

The Cedar River Hatchery is located within the 650 square-mile City of Seattle Municipal Watershed at river mile 21.8 on the Cedar River. The facility is owned by the City of Seattle and operated by WDFW. The project is financed with Seattle Public Utilities mitigation funds. The Cedar River Project began in September 1991, with an egg take goal of approximately three million. After several upgrades and remodels, the hatchery currently has the total capacity of incubating 18 million fry. At the adult holding ponds (river mile 21.4) there are four circular ponds 13' x 3.5' and four fiberglass intermediates that are 16' x 3' and a small 10' x 10' storage shed. The hatchery has a permanent 20' x 20' fertilization and disinfection room. There are two covered areas that are used for incubation (banks A and B). Bank A contains 24 Kitoi Incubation boxes. Bank B contains 29 Kitoi Boxes. A cargo container has been converted into an incubation room that holds 20 half-stack, vertical flow incubators. There are two cargo containers used for storage of tools and supplies. A 20' travel trailer is used for an office and break room. A 26' travel trailer is used as a residence for stand-by personnel. Refrigerated water used for otolith marking is generated from a series of chillers. Cedar River Hatchery rears Cedar River sockeye and Lake Washington winter steelhead (incubation only).

Ballard Net Pen¹⁰³

The Ballard Net Pen is located at the Shilshole Bay Marina in Ballard, northwest Seattle. The project is a cooperative effort between WDFW and the Ballard Salmon Club. The project has been in operation for over 20 years and is financed through the Aquatic Lands Enhancement Account. The site was originally used to rear delayed-release chinook, but that program has been dropped due to concerns about adults straying into the watersheds of the region. The site currently rears only coho smolts. The stock reared is Soos Creek coho. The release site is within 0.5 miles of the entrance to the Ballard Locks.

¹⁰¹ Information provided by Larry Klube, WDFW, August 2002.

¹⁰² Information provided by Brodie Antipa, WDFW, August 2002.

¹⁰³ Information provided by Darrell Mills, WDFW, August 2002.



*Edmonds Net Pen*¹⁰⁴

The Edmonds Net Pen is located at the Laebugten Wharf in the City of Edmonds. The project is a cooperative effort between WDFW and the Northwest Salmon and Steelhead Council, Laebugten Chapter. The project has been in operation for over 20 years and is financed through the Aquatic Lands Enhancement Account. The site was originally used to rear delayed-release chinook, but that program has been dropped due to concerns about adults straying into the watersheds of the region. The site currently rears only coho smolts. The stock reared is Issaquah coho.

¹⁰⁴ *Ibid.*



Portage Bay Hatchery Chinook

University of Washington and Washington Department of Fish and Wildlife

Stock Goals:	Current	Short-Term	Long-Term
<i>Biological Significance</i>	Low	Low	Low
<i>Population Viability</i> ¹⁰⁵	Medium	Medium	Medium
<i>Habitat</i>	Inadequate	Inadequate	Inadequate
<i>Harvest Opportunity</i>	Occasional	Occasional	Occasional
Hatchery Program:			
<i>Purpose</i>	Research and Education		
<i>Type</i>	Segregated		

PROGRAM DESCRIPTION

The Portage Bay hatchery chinook program began in 1949 with Green River origin chinook. Other stocks in addition to Green River have likely been transferred here. Portage Bay adult returns maintain this program. Portage Bay hatchery chinook belong to the South Puget Sound, Hood Canal and Snohomish Summer and Fall GDUs. 180,000 fingerlings are released at 22 fish per pound on-station into Portage Bay in late May. Adult collection, spawning, incubation and rearing occur on-station. The source of this stock was 60,000 from Portage Bay and 120,000 from Grovers Creek. The two stocks are differentially marked. 60,000 eyed eggs are transferred to regional cooperatives.

OPERATIONAL CONSIDERATIONS

- None.

BENEFITS AND RISKS

A. Consistent with short-term and long-term goals?

The program is consistent with its educational goals.

B. Likelihood of attaining goals?

This program provides opportunities for University of Washington researchers, in addition to educational benefits for collegiate and public school programs. It provides a minor harvest opportunity.

C. Consistent with goals for other stocks?

The program is generally consistent with the goals for other Lake Washington stocks. There is a straying risk that should be evaluated. The large size at release may suggest a risk of predation on other stocks.

¹⁰⁵ In the case of a segregated harvest program, population viability ratings are low, medium and high and refer to the stock's ability to sustain itself in the culture environment.



RECOMMENDATIONS

- Conduct marking and evaluation more consistently, enough to evaluate straying.
- Use Issaquah chinook if the program changes broodstocks.
- Evaluate lake residualism and predation, due to large size at release.
- Improve pollution abatement at the facility to meet water quality standards.

COMMENTS

- None.

MANAGERS RESPONSE

WDFW supports the recommendations of the HSRG.



Issaquah Hatchery Chinook

Washington Department of Fish and Wildlife

Stock Goals:	Current	Short-Term	Long-Term
<i>Biological Significance</i>	Medium	Medium	Medium
<i>Population Viability</i> ¹⁰⁶	High	High	High
<i>Habitat</i>	Inadequate	Inadequate	Inadequate ¹⁰⁷
<i>Harvest Opportunity</i>	Each Year	Each Year	Each Year
Hatchery Program:			
<i>Purpose</i>	Harvest and Education		
<i>Type</i>	Segregated		

PROGRAM DESCRIPTION

The Issaquah Hatchery chinook program began in 1937 with Green River chinook. Issaquah last received eggs from Green River Hatchery in 1992. Adults trapped at the Issaquah Hatchery have maintained this program since that time. Issaquah hatchery chinook belong to the South Puget Sound, Hood Canal and Snohomish Summer and Fall GDUs. Two million fingerlings are released on-station into Issaquah Creek. Adult collection, spawning, incubation and rearing occur on-station. Adults are also passed above the rack to spawn in Issaquah Creek.

OPERATIONAL CONSIDERATIONS

- This facility has been under reconstruction for the past few years and is nearly complete.
- Fish are not coded wire tagged.
- Returns to the hatchery are currently surplus to hatchery broodstock needs because of a lack of a satisfactory level of harvest.
- The facility features a strong educational component for both salmon life history and watershed stewardship.
- This facility suffers significant egg and fry mortality due to silt in the incubators.

BENEFITS AND RISKS

A. Consistent with short-term and long-term goals?

The program is consistent with the goals for the stock.

¹⁰⁶ In the case of a segregated harvest program, population viability ratings are low, medium and high and refer to the stock's ability to sustain itself in the culture environment.

¹⁰⁷ The HSRG understands that the co-managers are currently in the process of attempting to resolve the particularly difficult challenge of assessing long-term habitat status in this sub-region, taking into account intense development pressures and other potentially negative impacts, alongside potential habitat improvement projects. The HSRG believes its recommendations for this program are valid despite this uncertainty.



B. Likelihood of attaining goals?

The program is providing for limited harvest. Educational goals are being met.

C. Consistent with goals for other stocks?

The program is generally consistent with the goals for other Lake Washington stocks. However, there is a potential risk of fish from this program straying into the Cedar River and other Lake Washington tributaries.

RECOMMENDATIONS

- Mark/tag fish to evaluate potential straying and contribution to harvest.
- Ensure all management and hatchery staff can accurately describe program goals, given the facility's educational function.
- Explore the opportunity to increase harvest. If harvest is not increased, adjust the program size accordingly.
- Consider the development of a larger hatchery carcasses nutrient enhancement program in tributaries.
- Upgrade the water incubation system to include the appropriate number of sand filters.

COMMENTS

- The lower Canadian fishing rate may be temporarily contributing to the excess return.

MANAGERS RESPONSE

WDFW supports the recommendations of the HSRG, , but notes that additional funding will be required to improve the facilities. Consistent with the HSRG recommendations, WDFW has initiated marking and tagging of this stock.



Portage Bay Hatchery Coho

University of Washington and Washington Department of Fish and Wildlife

Stock Goals:	Current	Short-Term	Long-Term
<i>Biological Significance</i>	Low	Low	Low
<i>Population Viability</i> ¹⁰⁸	Medium	Medium	Medium
<i>Habitat</i>	Inadequate	Inadequate	Inadequate
<i>Harvest Opportunity</i>	Each Year	Each Year	Each Year
Hatchery Program:			
<i>Purpose</i>	Research and Education		
<i>Type</i>	Segregated		

PROGRAM DESCRIPTION

The Portage Bay hatchery coho program began with fish from multiple sources (Soos Creek, Issaquah, and other hatcheries). The University of Washington maintains the program from returns to the Portage Bay facility. 90,000 zero-plus coho are released on-station into Portage Bay. Adult collection, spawning, incubation and rearing occur on-station. This is an unusual release of zero-age coho at 30 fish per pound in May. This program provides 27,000 eyed eggs to regional watershed groups for educational purposes.

OPERATIONAL CONSIDERATIONS

- Year-round rearing is generally not possible because of elevated lake water temperatures in July, August and early September.
- This program produces almost exclusively two year-old spawners, an artificially selected life history.

BENEFITS AND RISKS

A. Consistent with short-term and long-term goals?

The program provides opportunities for University of Washington researchers, in addition to educational benefits for collegiate and public school programs. The program provides a minor harvest opportunity.

B. Likelihood of attaining goals?

The program is providing research and educational opportunities.

C. Consistent with goals for other stocks?

The program is generally consistent with goals for other Lake Washington stocks. There are straying and predation risks.

¹⁰⁸ *In the case of a segregated harvest program, population viability ratings are low, medium and high and refer to the stock's ability to sustain itself in the culture environment.*



RECOMMENDATIONS

- Conduct tagging and evaluation more consistently, enough to evaluate straying and survival.
- Use Issaquah coho if the program changes broodstocks.

COMMENTS

- None.

MANAGERS RESPONSE

WDFW supports the recommendations of the HSRG.



Lake Washington Coho

Washington Department of Fish and Wildlife

Stock Goals:	Current	Short-Term	Long-Term
<i>Biological Significance</i>	Low	Low	Low
<i>Population Viability</i>	Critical	Critical	Critical
<i>Habitat</i>	Inadequate	Inadequate	Inadequate
<i>Harvest Opportunity</i>	Each Year	Each Year	Each Year
Hatchery Program:			
<i>Purpose</i>	Harvest and Education		
<i>Type</i>	Integrated		

PROGRAM DESCRIPTION

Since its inception in 1936, the Issaquah Hatchery coho program has relied on locally collected adults and fish transplants from Green River Hatchery. 450,000 yearlings are released on-station at Issaquah Creek Hatchery, with ~1.2 million eggs outplanted from schools and volunteer projects into the drainage. Adults are also passed above the rack, to spawn in Issaquah Creek. Adult collection, spawning, incubation and rearing occur at Issaquah. Adult returns have in the past been supplemented with Green River fish, though this has not occurred for 20 years. Adults are outplanted into Tibbets and Coal creeks. This could be expanded in the future. The Ballard Net Pen coho program is also maintained with fish from this program. The Ballard Net Pen is a cooperative program between WDFW and the Ballard Salmon Club, which began in 1988. 25,000 yearlings are released into Puget Sound (Shilshole Bay) from marine net pens. Adult collection, spawning, incubation and rearing prior to salt water transfer occur at Issaquah Creek.

OPERATIONAL CONSIDERATIONS

- This facility has been under reconstruction for the past few years and is nearly complete.
- These fish are not coded wire tagged
- This program features a strong educational component for both salmon life history and watershed stewardship.
- This facility suffers significant egg and fry mortality due to silt in the incubators.
- Fish are not released volitionally.

BENEFITS AND RISKS

A. Consistent with short-term and long-term goals?

The program is consistent with the goals for the stock. It provides both a harvest and an educational benefit. It does create a competition risk with natural coho. The Ballard net pen releases provide some harvest benefits, but those benefits have not been quantified.



B. Likelihood of attaining goals?

The program is providing for limited harvest. Educational goals are being met. The potential straying risks from the Ballard net pen releases are perceived to be minimal, because of the small size of these releases and the low biological significance of Lake Washington coho.

C. Consistent with goals for other stocks?

There is a predation risk to chinook, sockeye and kokanee that may be exacerbated by forced releases leading to slower outmigration. There is also a risk of genetic divergence from the natural spawning population, due to a lack of known natural-origin recruits in the hatchery broodstock. There could be a potential risk from the Ballard net pen releases associated with attracting predators that affect other Lake Washington stocks, because of the proximity of the release site to the Ballard Locks.

RECOMMENDATIONS

- Mark/tag fish to evaluate potential straying and contribution to harvest.
- Develop a plan to identify natural-origin recruits and incorporate them into hatchery broodstock.
- Incorporate all segments of the run into broodstock representatively.
- Continue evaluation of semi-natural rearing. Add some educational signage about this element of the program.
- Upgrade the water incubation system to include the appropriate number of sand filters.
- Implement a volitional release program to reduce the predation risk to chinook, sockeye and kokanee.
- Put excess adult coho into tributaries as an alternative to fry plants in underused areas, and for nutrient enhancement.
- Continue to mark all fish released from the Ballard net pens.

COMMENTS

- Temporal selection of late returning adults for cooperatives may create a risk to maintaining run timing.

MANAGERS RESPONSE

WDFW generally supports the recommendations of the HSRG, but notes that:

- Additional funding will be required for coded-wire-tagging and assessment of straying; and
- Additional funding will be required to improve the facilities.



Edmonds Net Pen Coho

Northwest Salmon and Steelhead Council and Washington Department of Fish and Wildlife

Stock Goals:	Current	Short-Term	Long-Term
<i>Biological Significance</i>	Low	Low	Low
<i>Population Viability</i> ¹⁰⁹	High	High	High
<i>Habitat</i>	Limiting	Limiting	Limiting
<i>Harvest Opportunity</i>	Each Year	Each Year	Each Year
Hatchery Program:			
<i>Purpose</i>	Harvest		
<i>Type</i>	Segregated		

PROGRAM DESCRIPTION

The Edmonds net pen coho program began in 1990 with fish transplanted from the Marblemount Hatchery. More recently, this program has been maintained with juvenile fish from the Issaquah Creek Hatchery. 25,000 yearlings are released into Puget Sound from marine net pens at the city of Edmonds. Adult collection, spawning, incubation and rearing prior to salt water transfer occur at Issaquah Creek.

OPERATIONAL CONSIDERATIONS

- These fish are adipose fin clip marked, but not coded wire tagged.

BENEFITS AND RISKS

A. Consistent with short-term and long-term goals?

The program provides some harvest benefits, but those benefits have not been quantified.

B. Likelihood of attaining goals?

The program is likely to continue providing some level of harvest.

C. Consistent with goals for other stocks?

A potential straying risk exists into the Snohomish River system.

RECOMMENDATIONS

- Continue to mark all released fish.
- Periodically monitor and evaluate the contribution of adult returns to harvest and straying.

¹⁰⁹ *In the case of a segregated harvest program, population viability ratings are low, medium and high and refer to the stock's ability to sustain itself in the culture environment.*



COMMENTS

- None.

MANAGERS RESPONSE

WDFW generally supports the recommendations of the HSRG, but notes that additional funding will be required for coded-wire-tagging and assessment of straying.



Lake Washington Sockeye

City of Seattle and Washington Department of Fish and Wildlife

Stock Goals:	Current	Short-Term	Long-Term
<i>Biological Significance</i>	Medium	Medium	Medium
<i>Population Viability</i>	At Risk	At Risk	Healthy
<i>Habitat</i>	Limiting	Limiting	Limiting ¹¹⁰
<i>Harvest Opportunity</i>	Most Years	Most Years	Each Year
Hatchery Program:			
<i>Purpose</i>	Harvest and Conservation		
<i>Type</i>	Integrated		

PROGRAM DESCRIPTION

This program started in 1991 with naturally spawning fish returning to the Cedar River. The program is now maintained with adults returning to the Cedar River but their origin (hatchery-enhanced or wild) is uncertain. The Lake Washington/Cedar River sockeye were introduced from the Baker River, Washington, beginning in 1935 and from Cultus Lake, Canada, in 1944, 1950 and 1954. The population has maintained itself, without further introductions, since 1955. This population is the only one in the Cedar River Sockeye GDU.

The purposes of the program are both conservation and harvest. The Cedar River Sockeye population is descended from sockeye transplanted into the Lake Washington basin after the outlet of the Lake was artificially changed early in the last century and has naturally colonized the Cedar River. It is the largest sockeye population in the Puget Sound/western Washington region and the primary source of harvestable sockeye in the Lake Washington recreational fishery. Harvest occurs most years. Harvest may be possible each year with the full development of the hatchery program.

The future hatchery program is specified in the recently-signed, 50-year Habitat Conservation Plan, a legal agreement between city, state and federal governments. The program will mitigate potential spawning habitat not available because of the reservoir and Landsberg Dam. The plan sets production levels, on a sliding scale, so as not to overwhelm natural production. The HSRG reviewed the program as it presently exists, recognizing that there are well-developed plans to increase production with a new facility. Where the HSRG had concerns with the present program, particular attention was paid to the plan, to see whether they were adequately treated.

From nine million to 17.2 million unfed fry are released at four sites (river mile 28.1 - hatchery, river mile 13.5, river mile 1.2, river mile 0.1). Adult collection is at a weir located at river mile 6.3 on the Cedar River. Spawning and incubation occur at the Cedar River Hatchery. The planned program will

¹¹⁰ The HSRG understands that the co-managers are currently in the process of attempting to resolve the particularly difficult challenge of assessing long-term habitat status in this sub-region, taking into account intense development pressures and other potentially negative impacts, alongside potential habitat improvement projects. The HSRG believes its recommendations for this program are valid despite this uncertainty.



expand the range of releases up to 34 million unfed fry. The program is designed to integrate the hatchery-spawned and naturally-spawning segments of the population such that they freely interbreed with one another and that domestication and other effects of hatchery culture are minimized. The hatchery broodstock is planned to include both hatchery-origin and natural-origin spawners and is designed so that hatchery-origin recruits will contribute to natural reproduction without detriment to the natural-origin segment of the population.

OPERATIONAL CONSIDERATIONS

- The operating plan of the hatchery would mix hatchery-origin and natural-origin recruits in the broodstock randomly with respect to proportion in the run. Egg takes are scaled to the size of the run, with the assumption of a significant post-release survival handicap associated with hatchery, so that the run is not more than about one-half hatchery-origin in years of abundance. Broodstock are not directly screened with respect to origin, but mass-marking enables post-season evaluation.
- The plan is designed to represent all temporal segments of the run in broodstock. However, the broodstock weir washes out early each year, and late-returning salmon have not been sampled proportionately.
- The hatchery plan is designed to emulate natural fry production that would occur in the river, releasing unfed fry into the river at a natural developmental stage. However, embryonic development is in spring water, which is warmer than intra-gravel water and fry complete development earlier than they would in nature.

BENEFITS AND RISKS

A. Consistent with short-term and long-term goals?

The program provides a demographic benefit, but the primary benefit is to harvest. This is a mitigation facility that is using conservation technology to achieve a harvest benefit.

B. Likelihood of attaining goals?

Given the current management structure, there is a high probability of this program providing additional fish for harvest. The present weir and incubation facilities limit the ability of the program to attain harvest goals.

C. Consistent with goals for other stocks?

There may be ecological risks (competition, predation, pathogens) to chinook and other sockeye stocks. There is evidence that the carrying capacity of the lake is not challenged by present natural and hatchery sockeye production. The hatchery plan makes this the subject of continuing monitoring and assessment.

RECOMMENDATIONS

- Given that the primary design criterion for the program is to emulate the natural life history of sockeye in the Cedar River/Lake Washington system, the hatchery managers should:
 - Take broodstock randomly from the run. The plan for the future hatchery accounts for this, but it remains to be seen whether the planned facility for collecting broodstock will be capable of sampling late-returning sockeye.
 - Adjust incubation temperature to a natural pattern. The HSRG notes that plans for the future entail chilling of incubation water to accomplish this purpose.
 - Carry out plans to monitor, evaluate and adapt the program. Change the program as its biological performance is better understood in the future.



- Continue to mark all fry, in keeping with this adaptive management plan.
- Carry out plans to monitor the production of fry in the lake (their abundance, growth and origin) and the production of smolts from the lake (their abundance, age, size and origin). Also, monitor the abundance, growth and survival of competitors and predators.

COMMENTS

- Dispose of carcasses aseptically. The marginal nitrification benefit from the hatchery carcasses will be small when added to the nitrification derived from naturally spawning carcasses. There can be no public question of whether the IHN-V virus is artificially increased in the system by carcass disposal if carcasses are not deposited in the River.
- Adaptive management is a hallmark of the proposed plan for the program and is based on considerable research. The program provides a research tool for understanding the fate of sockeye in the Lake Washington system by its ability to mark fry, mass mark the stock and differentially mark components of it through otolith thermal marks.
- In conjunction with the new hatchery, the managers should review the current harvest management policy and whether a fixed escapement goal of 350,000 sockeye is appropriate.

MANAGERS RESPONSE

WDFW supports the recommendations of the HSRG, but notes that funding will be required for marking, program evaluation, and to monitor the abundance, growth and survival of competitors and predators.



Pipers Creek Hatchery Chum

Carkeek Watershed Community Action Project, local tribes, Washington Department of Fish and Wildlife, Seattle Parks Department, and Seattle Public Utilities

Stock Goals:	Current	Short-Term	Long-Term
<i>Biological Significance</i>	Low	Low	Low
<i>Population Viability¹¹¹</i>	Low	Low	Low
<i>Habitat</i>	Inadequate	Inadequate	Inadequate
<i>Harvest Opportunity</i>	Occasional	Occasional	Occasional
Hatchery Program:			
<i>Purpose</i>	Education		
<i>Type</i>	Segregated		

PROGRAM DESCRIPTION

This program was started in 1980 with coho smolts from the University of Washington. In 1984, the program was eliminated and replaced with chum fry from Minter Creek Hatchery in the South Sound region. Adult returns to the hatchery and John's Creek fall chum (Minter Creek) currently maintain this program. This stock is one of five stocks in the Central/South Puget Sound Fall Chum GDU. 70,000 fry are released from an acclimation tank on Pipers Creek. Adult collection, spawning and incubation occur at Minter Creek.

OPERATIONAL CONSIDERATIONS

- None.

BENEFITS AND RISKS

A. Consistent with short-term and long-term goals?

This program provides educational benefit.

B. Likelihood of attaining goals?

The program's goals are being attained.

C. Consistent with goals for other stocks?

The program is consistent with goals for other stocks.

RECOMMENDATIONS

- Switch broodstock to Cowling Creek Hatchery chum.

¹¹¹ In the case of a segregated harvest program, population viability ratings are low, medium and high and refer to the stock's ability to sustain itself in the culture environment.



COMMENTS

- This is a good example of an educational program.

MANAGERS RESPONSE

WDFW supports the recommendations of the HSRG.



Lake Washington Winter Steelhead

Washington Department of Fish and Wildlife

Stock Goals:	Current	Short-Term	Long-Term
<i>Biological Significance</i>	Medium	Medium	Medium
<i>Population Viability</i>	Critical	Critical	At Risk
<i>Habitat</i>	Inadequate	Inadequate	Inadequate ¹¹²
<i>Harvest Opportunity</i>	None	None	Occasional
Hatchery Program:			
<i>Purpose</i>	Conservation		
<i>Type</i>	Integrated		

PROGRAM DESCRIPTION

Since its inception in 1997, the Lake Washington winter steelhead program has used natural fish returning to the Ballard Locks as broodstock. This is not an on-going program, because too few adults were captured in the last few years to maintain the program. This was an experimental program and juveniles produced from it were planted into north Lake Washington (Sammamish Basin) tributaries. Lake Washington hatchery winter steelhead belong to the South Puget Sound GDU. Up to 20,000 yearlings are intended to be released on-station at Issaquah Creek Hatchery. Adults are held and spawned and eggs are eyed at the Cedar River Hatchery. Hatching and rearing occur at Issaquah. Up to 30,000 fingerlings are also released into north tributaries, because of late arrivals and to test the results of different timing strategies.

OPERATIONAL CONSIDERATIONS

- 75 adults must return to Ballard Locks for the program to occur.
- Issaquah Creek Hatchery released fish at 9.5 per pound in May 2000.
- Juveniles appear to be residualizing in Lake Washington.
- The parasite *Ceratomyxa shasta* was recently observed in the Cedar River and Bear Creek and may be related to the decline of this stock.

BENEFITS AND RISKS

A. Consistent with short-term and long-term goals?

A conservation program is warranted with such low numbers of returning adults.

B. Likelihood of attaining goals?

The likelihood of attaining goals is highly doubtful with the present program design, coupled with

¹¹² The HSRG understands that the co-managers are currently in the process of attempting to resolve the particularly difficult challenge of assessing long-term habitat status in this sub-region, taking into account intense development pressures and other potentially negative impacts, alongside potential habitat improvement projects. The HSRG believes its recommendations for this program are valid despite this uncertainty.



unknown and potential problems associated with *Ceratomyxa*.

C. Consistent with goals for other stocks?

The program is probably too small to pose significant risks to other stocks.

RECOMMENDATIONS

- Discontinue using adults from the Ballard Locks until uncertainties associated with *Ceratomyxa* have been addressed. Address these uncertainties by:
 - Using susceptible sentinel fish to test locations within the Cedar River/Lake Washington Basin to locate sources of the parasite. PCR methodology (“DNA fingerprinting”) has been previously used to detect disease presence. The WDFW fish health lab now has PCR equipment (from Hatchery Reform Project funding).
 - Testing various wild stocks of salmonids found within the watershed for susceptibility to the disease.
 - Testing the Green River stock of hatchery and wild fish for susceptibility, as candidate stocks for introduction into Lake Washington.

COMMENTS

- Numbers of returning adults warrants strong intervention actions, but potential problems with *Ceratomyxa* need to be identified prior to deciding what options are available.

MANAGERS RESPONSE

WDFW supports the recommendations of the HSRG, but notes that funding will be required to implement the research and monitoring program.



FACILITY RECOMMENDATIONS

Assembled below are the Hatchery Scientific Review Group's recommendations that involve capital improvements at hatchery facilities in the Central Puget Sound region.

Puyallup River

DIRU CREEK HATCHERY

- Construct an acclimation and adult collection pond with adequate attraction to reduce straying of fish released from Diru Creek.
- Develop a covered spawning area.
- Develop a pollution abatement facility.

VOIGHTS CREEK HATCHERY

- Address the need for pollution abatement ponds and adult holding and collection facilities.
- Improve juvenile downstream passage at Electron Dam.
- Consider semi-natural rearing to increase survival and perhaps reduce domestication.
- Create a surface water pre-settling pond.
- Upgrade the pumps, intakes and pipeline.

East Kitsap

GROVERS CREEK HATCHERY

- Secure reliable, adequate incubation water at Grovers Creek, via redeveloping well water or other means.
- Develop a formalin treatment tank or pond at Grovers Creek.
- Develop incubation facilities at Grovers Creek or Gorst Creek, to eliminate transfer.

Green River

SOOS CREEK HATCHERY

- Design and construct an adult holding and sorting pond that is not in the mainstem of Soos Creek. This new facility should include bypass facilities for efficiently passing adult fish upstream, and a weir for diverting upstream migrating fish into the holding pond.
- Create elevated or moved raceways.
- Include bird netting.
- Include educational signage, etc.
- Upgraded the pollution abatement system.
- Develop a pre-settling pond for the intake.



ICY CREEK POND

- Develop adult collection capability. This could be accomplished by constructing adult recapture facilities at Icy Creek and Newaukum Creek.
- Institute predator control methods.

PALMER PONDS

- Institute predator control methods.

KETA CREEK HATCHERY

- Develop filtration facilities for incubation.
- Upgrade facility supply line, to improve water supply. security

CRISP CREEK HATCHERY

- Modify the yearling program to allow collection of returning adults.
- Improve predator controls and bird netting.
- Improve the supply and discharge system to eliminate tributary supply and to bypass draw-down effluent below stream intake.

Lake Washington

PORTAGE BAY HATCHERY

- Improve pollution abatement at the facility to meet water quality standards.

ISSAQUAH CREEK HATCHERY

- Upgrade the water incubation system to include the appropriate number of sand filters.
- Include a pre-settling pond with intake system.

CEDAR RIVER HATCHERY

- Include temperature control equipment.
- Develop a permanent adult trapping and holding facility to allow collection of a better representation of the total run timing, and ensure safety of the crew operating the trap.
- Rebuild the main water supply lines at the Cedar River adult ponds.
- Include a formalin system for every incubation vessel.
- Provide underground and insulated plumbing to the stand-by residence, fertilization shed and office trailer
- Include educational signage.