HATCHERY AND GENETIC MANAGEMENT PLAN (HGMP)

DRAFT

Hatchery Program	Palmer Ponds Summer Steelhead Program
Species or Hatchery Stock	Summer Steelhead (*Oncorhynchus mykiss*) Green River (Skamania Hatchery stock)
Agency/Operator	WDFW
Watershed and Region	Green River Puget Sound
Date Submitted	August 4, 2005
Date Last Updated	August 1, 2005

SECTION 1. GENERAL PROGRAM DESCRIPTION

1.1) Name of hatchery or program.

Palmer Ponds Summer Steelhead Program

1.2) Species and population (or stock) under propagation, and ESA status.

Green River (Skamania Hatchery stock) Steelhead (*Oncorhynchus mykiss*) - not listed

1.3) Responsible organization and individuals

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Other agencies, Tribes, co-operators, or organizations involved, including contractors, and extent of involvement in the program:

The Muckleshoot Indians share co-management authority of steelhead stocks in the Green River system.

1.4) Funding source, staffing level, and annual hatchery program operational costs.

Operational Information	Number
Annual operating cost (dollars)	$49,536
The above information for annual operating cost applies cumulatively to the Palmer Ponds Fish Programs. Funding source is Wildlife Fund – State.	

1.5) Location(s) of hatchery and associated facilities.

Palmer Ponds: Unnamed stream (09.0147) at RM 0.2, tributary to the Green River (09.0001) at RM 56.1.

Soos Creek Hatchery: Big Soos Creek (09.0072) at RM 1, tributary to the Green River (09.0001) at RM 33.5.

Icy Creek Pond: Icy Creek, tributary to the Green River (09.0001) at RM 48.3

1.6) Type of program.

Isolated harvest

1.7) Purpose (Goal) of program.

The goal of this program is to release 80,000 summer steelhead into the Green River watershed to provide adult fish for sport and tribal harvest opportunity.

1.8) Justification for the program.

This program will be operated to provide fish for harvest while minimizing adverse effects on listed fish. This will be accomplished in the following manner:

1. Hatchery fish will be released as smolts at a time to minimize or eliminate adverse interactions with listed fish.

2. Fish will be acclimated before release.

3. Hatchery fish will be propagated using appropriate fish culture methods and consistent with the Co-Managers' Disease Policy, spawning and genetic guidelines and state and federal water quality standards.

4. Juvenile fish produced in excess to production goals will be dealt with appropriately such as by being planted in a lake without an outlet.

To minimize impacts on listed fish by WDFW facilities operation and the Palmer Pond steelhead program, the following Risk Aversions are included in this HGMP:

Table 1. Summary of risk aversion measures for the Palmer Pond summer steelhead program.

Potential Hazard	HGMP Reference	Risk Aversion Measures
Water Withdrawal	4.2	For rearing at Palmer pond, usage of spring water is regulated through water right permit # S1-*20296. Usage of surface water at Soos Creek for incubation and rearing is regulated through water right permit # S1-21122. Usage of spring water for rearing at Icy Creek is regulated through water right permit # S1-00317.
Intake Screening	4.2	No listed salmonids exist in the water source for Palmer Ponds as well as at Icy Creek. Intake screens at the Soos Creek Hatchery are not in compliance with NOAA fish screening criteria
Effluent Discharge	4.2	For rearing at Palmer Ponds and Icy Creek, effluent discharge is regulated through NPDES permit #'s WAG 13-3002 and WAG 13-3013, respectively. For Soos Creek, effluent is regulated through NPDES permit # WAG 13-3014.
Broodstock Collection & Adult Passage	2.2.3, 7.9	Summer steelhead voluntarily enter an off-channel trap at Palmer Ponds during a time period between September and November. Chinook may enter the trap at Palmer, but it is not very likely due to the small size and declination of the outlet creek. Any listed fish that enter the trap will be returned to the river to spawn.
Disease Transmission	7.9	The program is operated consistent with the co-manager's Fish Health Policy (1998).
Predation & Competition	2.2.3, 10.11	Fish are released at a time, size, and life-history stage (smolts) to foster rapid migration to marine waters. Smolts are released in May to allow chinook to grow to a size that reduces the potential for predation. Release of 30,000 fish moved to Soos Creek resulting in a 40% reduction in the number of river miles in which the summer steelhead smolt releases may interact with chinook juveniles. Studies are/will be conducted in riverine, estuarine, and nearshore areas to evaluate the ecological risks posed by the release of steelhead smolts.

1.9) List of program "Performance Standards".

See section 1.10.

1.10) List of program "Performance Indicators", designated by "benefits" and "risks."

Benefits:

Benefits		
Performance Standard	**Performance Indicator**	**Monitoring & Evaluation**
Assure that hatchery operations support Puget Sound Salmon Management Plan (US v Washington), the Shared Strategy for Salmon Recovery, production and harvest objectives.	Contribute to a meaningful harvest for sport, tribal and commercial fisheries. Achieve a 10-year average of 920 adults harvested and a 1.86% smolt-to-adult survival that includes harvest plus escapement.	Survival and contribution to fisheries will be estimated for each brood year released. Work with co-managers to manage adult fish returning in excess of broodstock needs.
Maintain outreach to enhance public understanding, participation and support of WDFW hatchery programs.	Provide information about agency programs to internal and external audiences. For example, local schools and special interest groups tour the facility to better understand hatchery operations. Off station efforts may include festivals, classroom participation, stream adoptions and fairs.	Evaluate use and/or exposure of program materials and exhibits as they help support goals of the information and education program. Record on-station organized education and outreach events.
Program contributes to fulfilling tribal trust responsibility mandates and treaty rights.	Follow pertinent laws, agreements, policies and executive and judicial orders on consultation and coordination with Native American tribal governments.	Participate in annual coordination meetings between the co-managers to identify and report on issues of interest, coordinate management, and review programs (FBD process).
Implement measures for broodstock management to maintain integrity and genetic diversity. Maintain effective population size	A minimum of 80 adults are collected throughout the spawning run in proportion to timing, age, and sex composition of return.	Annual run timing, age, and sex composition and return timing data are collected. Adhere to HSRG (2004) and WDFW spawning guidelines (WDFW 1983)
Region-wide, groups are marked in a manner consistent with information needs and protocols to estimate impacts to natural and hatchery-origin fish.	Use mass mark for maintaining a segregated population and for selective fisheries.	Returning fish are sampled throughout their return for length, sex, mass marks and, if available, coded-wire tags.

Maximize survival at all life stages using disease control and disease prevention techniques. Prevent introduction, spread or amplification of fish pathogens. Follow Co-Managers Fish Disease Policy (1998).	Necropsies of fish to assess health, nutritional status and culture conditions.	WDFW Fish Health Section inspect adult broodstock yearly for pathogens and monitor juvenile fish on a monthly basis to assess health and detect potential disease problems. As necessary, WDFW's Fish Health Section recommends remedial or preventative measures to prevent or treat disease, with administration of therapeutic and prophylactic treatments as deemed necessary. A fish health database will be maintained to identify trends in fish health and disease and implement fish health management plans based on findings.
	Release and/or transfer exams for pathogens and parasites.	1 to 6 weeks prior to transfer or release, fish are examined in accordance with the Co-Managers Fish Health Policy.
	Inspection of adult broodstock for pathogens and parasites.	At spawning, lots of 60 adult broodstock are examined for pathogens.
	Inspection of off-station fish/eggs prior to transfer to hatchery for pathogens and parasites.	Control of specific fish pathogens through eggs/fish movements is conducted in accordance to Co-managers Fish Health Disease Policy.

Risks:

Risks		
Performance Standard	**Performance Indicator**	**Monitoring & Evaluation**
Minimize impacts and/or interactions to ESA listed fish	Hatchery operations comply with all state and federal regulations. Hatchery juveniles are raised to smolt-size (5.0 fish/lb) and released from the hatchery at a time that fosters rapid migration downstream. Mass mark production fish to identify them from naturally produced fish (except CWT only groups)	As identified in the HGMP: Monitor size, number, date of release and mass mark quality. Additional WDFW projects: straying (if coded-wire tagged), NOR/HOR ratio on the spawning grounds, fish health documented.
Artificial production facilities are operated in compliance with all applicable fish health guidelines, facility operation standards and protocols including IHOT, Co-managers Fish Health Policy and drug usage mandates from the Federal Food and Drug Administration	Hatchery goal is to prevent the introduction, amplification or spread of fish pathogens that might negatively affect the health of both hatchery and naturally reproducing stocks and to produce healthy smolts that will contribute to the goals of this facility.	Pathologists from WDFW's Fish Health Section monitor program monthly. Exams performed at each life stage may include tests for virus, bacteria, parasites and/or pathological changes, as needed
Ensure hatchery operations comply with state and federal water quality and quantity standards through proper environmental monitoring	NPDES permit compliance WDFW water right permit compliance	Flow and discharge reported in monthly NPDES reports.
Water withdrawals and in stream water diversion structures for hatchery facility will not affect spawning behavior of natural populations or impact juveniles.	Hatchery intake structures meet state and federal guidelines where located in fish bearing streams.	Barrier and intake structure compliance assessed and needed fixes are prioritized.
Hatchery operations comply with ESA responsibilities	WDFW completes an HGMP and is issued a federal and state permit when applicable.	Identified in HGMP and Biological Opinion for hatchery operations.
Harvest of hatchery-produced fish minimizes impact to wild populations	Harvest is regulated to meet appropriate biological assessment criteria. Mass mark juvenile hatchery fish prior to release to enable state agencies to implement selective fisheries.	Agencies and tribes to provide up to date information monitor harvests.

1.11) Expected size of program.

1.11.1) Proposed annual broodstock collection level (maximum number of adult fish).

80 adults.

1.11.2) Proposed annual fish release levels (maximum number) by life stage and location.

Life Stage	Release Location	Annual Release Level
Eyed Eggs		
Unfed Fry		
Fry		
Fingerling		
Yearling	Palmer Ponds (Green River; 09.0001) *Soos Creek (09.0072) Icy Creek (09.)	30,000 30,000 20,000

* Releases from Soos Creek Hatchery began in May of 2002 and from Icy Creek in May of 1999.

1.12) Current program performance, including estimated smolt-to-adult survival rates, adult production levels, and escapement levels. Indicate the source of these data.

Recent 12-year average, range, and goal: (Source is WDFW Fish Management data)

Smolt-to-adult survival: Average 1.86%; Range .36% to 7.84%. Goal 3%
Adult production level: Average 947; Range 189 to 1830. Goal 3000
Hatchery escapement: Approximately 50 in year 2000. Goal 80.
Natural escapement: Approximately 3% of annual adult return. Goal <5%.

1.13) Date program started (years in operation), or is expected to start.

1970

1.14) Expected duration of program.

Ongoing

1.15) Watersheds targeted by program.

Duwamish/Green River (09.0001)

1.16) Indicate alternative actions considered for attaining program goals, and reasons why those actions are not being proposed.

Program goals supporting tribal and sport fisheries cannot be attained without hatchery augmentation. The Palmer Pond summer steelhead program produces smolts for planting in the Green River watershed. The majority of the smolts are released in the upper watershed that is at the upper end of the sport fishery so that they are highly susceptible to harvest.

Steelhead management and hatchery production are currently undergoing extensive co-manager review through the development of a science “white” paper. Expectation is that effort will address many of the issues and recommendations raised by the Hatchery Scientific Review Group (HSRG 2003).

SECTION 2. PROGRAM EFFECTS ON ESA-LISTED SALMONID POPULATIONS.

2.1) List all ESA permits or authorizations in hand for the hatchery program.

During 2004-05, WDFW is writing HGMP's to cover all stock/programs produced at the Palmer Pond complex for authorization under the 4(d) rule of the ESA.

2.2) Provide descriptions, status, and projected take actions and levels for ESA-listed natural populations in the target area.

2.2.1) Description of ESA-listed salmonid population(s) affected by the program.

- **Identify the ESA-listed population(s) that will be directly affected by the program.**

None.

- Identify the ESA-listed population(s) that may be incidentally affected by the program.

Duwamish/Green River/Summer-Fall Chinook

Most naturally-spawned Green River chinook migrate to salt water after spending only a few months in freshwater. Arrival of both hatchery and naturally produced smolts in the estuary peaks in May, and after a few weeks, most begin moving to nearshore feeding grounds in Puget Sound and the Pacific Ocean. Sexually mature fish begin arriving back at the river mouth as early as July. The upstream migration peaks in late August to mid-September. Spawning begins in early September, peaks in early October, and is generally complete by early November.

Adults spawn in the mainstem Green River from about river mile 25.4 in Kent to the City of Tacoma diversion dam at river mile 61. Approximately 70% of natural spawning occurs upriver from the mouth of Soos Creek (river mile 33.7). Tributary spawning occurs in the lower 4 miles of both Soos and Newaukum creeks. Natural spawners in Newaukum Creek are genetically similar to Green River Hatchery fish (Marshall et al. 1995) and are now considered the same genetic population.

2.2.2) <u>Status of ESA-listed salmonid population(s) affected by the program.</u>

- Describe the status of the listed natural population(s) relative to "critical" and "viable" population thresholds (*see definitions in "Attachment 1").*

Preliminary critical and viable population thresholds under ESA have been determined by the Co-manager's (Puget Sound) Technical Review Team (PSTRT) to be at 1,800 and 5,800, respectively (PSTRT 2003). NOAA Fisheries thresholds are 835 and 5,523, respectively. The SaSI report (draft 2002) determined this population (Duwamish/Green Summer/Fall Chinook) to be "healthy".

- Provide the most recent 12 year (e.g. 1988-present) progeny-to-parent ratios, survival data by life-stage, or other measures of productivity for the listed population. Indicate the source of these data.

On average (return years 1987-98), each Green River natural spawner (an aggregate of natural-origin and F1 hatchery-origin adults) produces 2.33 adults returning to Washington waters (WDFW Chinook Run-reconstruction Tables). Productivity for the natural-origin population only is unknown at this time. The high annual proportion of F1 hatchery-origin fish escaping to spawn naturally confounds the ability to determine the productivity of the natural proportion.

- Provide the most recent 12 year (e.g. 1988-1999) annual spawning abundance estimates, or any other abundance information. Indicate the source of these data.

Escapements have exceeded the 5,800 fish goal in 9 of the past 12 years (1988-99), with a range of 2,476 to 13,173. The 12-year average escapement is 8,080. (WDFW RR Tables)

- Provide the most recent 12 year (e.g. 1988-1999) estimates of annual proportions of direct hatchery-origin and listed natural-origin fish on natural spawning grounds, if known.

The proportion of Soos Creek hatchery-origin adults observed in mainstem Green River natural spawning areas averaged 33.4% of the total escapement in 7 years between 1989 and 1997 (WDFW coded-wire tag data). Small sample sizes (<4%) in 5 of these years, and the limited area sampled (RM 33.8 to 41.4 only), make these data less than reliable when applied to the entire river. For 2002 and 2003, the estimate of hatchery-origin contribution in the mainstem was 20 and 55 percent, respectively. For Newaukum Creek, the estimates for those two years were 35 and 59 percent, respectively

The ratio of Soos Creek hatchery-origin adults to Newaukum Creek natural spawners averaged 23.3% in 9 years between 1989 and 1997 (WDFW coded-wire tag data). Sample rates averaged 30% per year.

2.2.3) Describe hatchery activities, including associated monitoring and evaluation and research programs, that may lead to the take of listed fish in the target area, and provide estimated annual levels of take.

- Describe hatchery activities that may lead to the take of listed salmonid populations in the target area, including how, where, and when the takes may occur, the risk potential for their occurrence, and the likely effects of the take.

Broodstock Collection
Trapping of adult summer steelhead occurs at Palmer Ponds and Soos Creek between September and November. Chinook may enter the trap at Palmer, but it is not very likely due to the small size and declination of the outlet creek. Any listed fish that enter the trap will be returned to the river to spawn. There may be a potential for listed chinook to be impacted at Soos Creek due to steelhead collection, but care will be taken to return any non-marked fish back to the river unharmed.

Disease Effects
Pathogens are not unique to hatcheries. Hatchery-origin fish may have an increased risk of carrying fish disease pathogens because higher rearing densities of fish in the hatchery may stress fish and lower immune responses. Under certain conditions, hatchery effluent has the potential to transport fish pathogens out of the hatchery, where natural fish may be exposed. These impacts are addressed by rearing the steelhead at lower densities, within widely recognized guidelines (Piper et al 1982), continuing well-developed monitoring, diagnostic, and treatment programs already in place (Co-manager's Fish Health Policy 1998).

Predation/Competition
The program described in this HGMP interacts with the biotic and abiotic components of the freshwater, estuarine, and marine salmonid ecosystem through a complex web of short and long-term processes. The complexity of this web means that secondary or tertiary interactions (both positive and negative) with listed species could occur in multiple time periods, and that evaluation of the net effect can be difficult.

WDFW is not aware of any studies that have directly evaluated the ecological effects of this program to listed salmon. We therefore provide in this section a brief summary of empirical information and theoretical analyses of two types of ecological interactions that may relevant to the Palmer Pond program: 1) predation; and 2) competition. Recent reviews by Fresh (1997) and Flagg et al. (2000) can be consulted for additional information. NMFS (2002) also provides an extensive review of these potential hazards, and their application to ESA permitting evaluations of artificial production programs. This general information is applied to the specific hatchery operational practices proposed in the Palmer Pond summer steelhead HGMP to describe the plan's potential effects through predation and competition on listed salmon in the Green River watershed and within Puget Sound nearshore marine areas.

Predation – Freshwater Environment

Coho and steelhead released from hatchery programs may prey upon listed species of salmonids, but the magnitude of predation will depend upon the characteristic of the listed population of salmonids, the habitat in which the population occurs, and the characteristics of the hatchery program (e.g., release time, release location, number released, and size of fish released). The site-specific nature of predation, and the limited number of empirical studies that have been conducted, make it difficult to predict the predation effects of any specific hatchery program. WDFW is unaware of any studies that have empirically estimated the predation risks to listed species posed by the Palmer Ponds steelhead program.

In the absence of site-specific empirical information, the identification of risk factors can be a useful tool for reviewing hatchery programs while monitoring and research programs are developed and implemented. Risk factors for evaluating the potential for significant predation include the following:

<u>Environmental Characteristics.</u> Water clarity and temperature, channel size and configuration, and river flow are among the environmental characteristics that can influence the likelihood that predation will occur (see SWIG (1984) for a review). The SIWG (1984) concluded that the potential for predation is greatest in small streams with flow and turbidity conditions conducive to high visibility.

<u>Relative Body Size.</u> The potential for predation is limited by the relative body size of fish released from the program and the size of prey. Generally, salmonid predators are thought to prey on fish approximately 1/3 or less their length (USFWS 1994), although coho salmon have been observed to consume juvenile chinook salmon of up to 46% of their total length (Pearsons et al. 1998). The lengths of juvenile migrant chinook salmon originating from natural production have been monitored in numerous watersheds throughout Puget Sound, including the Skagit River, Stilliguamish River, Bear Creek, Cedar River, Green River, Puyallup River, and Dungeness River. The average size of migrant chinook salmon is typically 40mm or less in February and March, but increases in the period from April through June as emergence is completed and growth commences (Table 2). Assuming that the prey item can be no greater than 1/3 the length of the predator, Table 2 can be used to determine the length of predator required to consume a chinook salmon of average length in each time period. The increasing length of natural origin juvenile chinook salmon from March through June indicates that delaying the release hatchery smolts of a fixed size will reduce the risks associated with predation.

Table 2. Average length by statistical week of natural origin juvenile chinook salmon migrants captured in traps in Puget Sound watersheds. The minimum predator length corresponding to the average length of chinook salmon migrants, assuming that the prey can be no greater than 1/3 the length of the predator, are provided in the final row of the table. (NS: not sampled.)

Watershed	Statistical Week										
	16	17	18	19	20	21	22	23	24	25	26
Skagit [1] 1997-2001	43.2	48.3	50.6	51.7	56.1	59.0	58.0	60.3	61.7	66.5	68.0
Stillaguamish [2] 2001-2002	51.4	53.5	55.7	57.8	60.0	62.1	64.2	66.4	68.5	70.6	72.8
Cedar [3] 1998-2000	54.9	64.2	66.5	70.2	75.3	77.5	80.7	85.5	89.7	99.0	113
Green [4] 2000	52.1	57.2	59.6	63.1	68.1	69.5	NS	79.0	82.4	79.4	76.3
Puyallup [5] 2002	NS	NS	NS	66.2	62.0	70.3	73.7	72.7	78.7	80.0	82.3
Dungeness [6] 1996-1997	NS	NS	NS	NS	NS	NS	NS	NS	77.9	78.8	81.8
All Systems Average Length	50.4	55.8	58.1	61.8	64.3	67.7	69.2	72.8	76.5	79.0	82.4
Minimum Predator Length	153	169	176	187	195	205	210	221	232	239	250

Sources:

[1] Data are from Seiler et al. (1998); Seiler et al. (1999); Seiler et al. (2000); Seiler et al. (2001), and Seiler et al. (2002).
[2] Data are from regression models presented in Griffith et al. (2001) and Griffith et al. (2003).
[3] Data are from Seiler et al. (2003).
[4] Data are from Seiler et al. (2002).
[5] Data are from Samarin and Sebastian (2002).
[6] Data are from Marlowe et al. (2001).

Date of Release. The release date of juvenile fish for the program can influence the likelihood that listed species are encountered or are of a size that is small enough to be consumed. The most extensive studies of the migration timing of naturally produced juvenile chinook salmon in the Puget Sound ESU have been conducted in the Skagit River, Bear Creek, Cedar River, and the Green River. Although distinct differences are evident in the timing of migration between watersheds, several general patterns are beginning to emerge:

1) Emigration occurs over a prolonged period, beginning soon after enough emergence (typically January) and continuing at least until July;
2) Two broad peaks in migration are often present during the January through July time period; an early season peak (typically in March) comprised of relatively small chinook salmon (40-45mm), and a second peak in mid-May to June comprised of larger chinook salmon;
3) On average, over 80% of the juvenile chinook have migrated past the trapping locations after statistical week 23 (usually occurring in the first week of June).

Table 3. Average cumulative proportion of the total number of natural origin juvenile chinook salmon migrants estimated to have migrated past traps in Puget Sound watersheds.

Watershed	Statistical Week										
	16	17	18	19	20	21	22	23	24	25	26
Skagit [1] 1997-2001	0.61	0.64	0.68	0.73	0.76	0.78	0.83	0.86	0.90	0.92	0.94
Bear [2] 1999-2000	0.26	0.27	0.28	0.32	0.41	0.52	0.73	0.84	0.92	0.96	0.97
Cedar [2] 1999-2000	0.76	0.76	.0.76	0.77	0.79	0.80	0.82	0.84	0.87	0.88	0.90
Green [3] 2000	0.63	0.63	0.64	0.69	0.77	0.79	0.84	0.86	0.88	0.98	1.00
All Systems Average	0.56	0.58	0.59	0.63	0.68	0.72	0.80	0.85	0.89	0.94	0.95

Sources:

[1] Data are from Seiler et al. (1998); Seiler et al. (1999); Seiler et al. (2000); Seiler et al. (2001), and Seiler et al. (2002).
[2] Data are from Seiler et al. (2003).
[3] Data are from Seiler et al. (2002).

Release Location and Release Type. The likelihood of predation may also be affected by the location and type of release. Other factors being equal, the risk of predation may increase with the length of time the fish released from the artificial production program are commingled with the listed species. In the freshwater environment, this is likely to be affected by distribution of the listed species in the watershed, the location of the release, and the speed at which fish released from the program migrate from the watershed.

Coho salmon and steelhead released from western Washington artificial production programs as smolts have typically been found to migrate rapidly downstream. Data from Seiler et al. (1997; 2000) indicate that coho smolts released from the Marblemount Hatchery on the Skagit River migrate approximately 11.2 river miles per day. Steelhead smolts released on-station may travel even more rapidly – migration rates of approximately 20 river miles per day have been observed in the Cowlitz River (Harza 1998). However, trucking fish to off-station release sites, particularly release sites located outside of the watershed in which the fish have been reared may slow migrations speeds (Table 4).

Table 4. Summary of travel speeds for steelhead smolts for several types of release strategies.

Location	Release Type	Migration Speed (River miles per day)	Source
Cowlitz River	Smolts, on-station	21.3	Harza (1998)
Kalama River	Trucked from facility located within watershed in which fish were released.	4.4	Hulett (pers. comm.)
Bingham Creek	Trucked from facility located outside of watershed in which fish were released.	0.6	Seiler et al. (1997)
Stevens Creek	Trucked from facility located outside of watershed in which fish were released.	0.5	Seiler et al. (1997)
Snow Creek	Trucked from facility located outside of watershed in which fish were released.	0.4	Seiler et al. (1997)

<u>Number Released.</u> Increasing the number of fish released from an artificial production program may increase the risk of predation, although competition between predators for prey may eventually limit the total consumption (Peterman and Gatto 1978).

Predation – Marine Environment

NMFS (2002) reviewed existing information on the risks of predation in the marine environment posed by artificial production programs and concluded:

> "1) Predation by hatchery fish on natural-origin smolts or sub-adults is less likely to occur than predation on fry. Coho and chinook salmon, after entering the marine environment, generally prey upon fish one-half their length or less and consume, on average, fish prey that is less than one-fifth of their length (Brodeur 1991). During early marine life, predation on natural origin chinook, coho, and steelhead will likely be highest in situations where large, yearling-sized hatchery fish encounter sub-yearling fish or fry (SIWG 1984)."
>
> "2) However, extensive stomach content analysis of coho salmon smolts collected through several studies in marine waters of Puget Sound, Washington does not substantiate any indication of significant predation upon juvenile salmonids (Simenstad and Kinney 1978)."
>
> "3) Likely reasons for apparent low predation rates on salmon juveniles, including chinook, by larger chinook and other marine predators are described by Cardwell and Fresh (1979). These reasons included: 1) due to rapid growth, fry are better able to elude predators and are accessible to a smaller proportion of predators due to size alone; 2) because fry have dispersed, they are present in low densities relative to other fish and invertebrate prey; and 3) there has either been learning or selection for some predator avoidance."

Competition

Studies conducted in other areas to assess hatchery fish competitive effects on natural-origin fish indicate that this program is likely to pose a minimal risk of competition:

1) As discussed above, coho salmon and steelhead released from hatchery programs as smolts typically migrate rapidly downstream. The SIWG (1984) concluded that "migrant fish will likely be present for too short a period to compete with resident salmonids."

2) NMFS (2002) noted that "..where interspecific populations have evolved sympatrically, chinook salmon and steelhead have evolved slight differences in habitat use patterns that minimize their interactions with coho salmon (Nilsson 1967; Lister and Genoe 1970; Taylor 1991; Murdoch and Kamphaus 2002). Along with the habitat differences exhibited by coho and steelhead, they also show differences in foraging behavior. Peterson (1966) and Johnston (1967) reported that juvenile coho are surface oriented and feed primarily on drifting and flying insects, while steelhead are bottom oriented and feed largely on benthic invertebrates."

3) Flagg et al. (2000) concluded, "By definition, hatchery and wild salmonids will not compete unless they require the same limiting resource. Thus, the modern enhancement strategy of releasing salmon and steelhead trout as smolts markedly reduces the potential for hatchery and wild fish to compete for resources in the freshwater rearing environment. Miller (1953), Hochachka (1961), and Reimers (1963), among others, have noted that this potential for competition is further reduced by the fact that many hatchery salmonids have developed different habitat and dietary behavior than wild salmonids." Flagg et al (2000) also stated "It is unclear whether or not hatchery and wild chinook salmon utilize similar or different resources in the estuarine environment."

4) Fresh (1997) noted "Few studies have clearly established the role of competition and predation in anadromous population declines, especially in marine habitats. A major reason for the uncertainty in the available data is the complexity and dynamic nature of competition and predation; a small change in one variable (e.g., prey size) significantly changes outcomes of competition and predation. In addition, large data gaps exist in our understanding of these interactions. For instance, evaluating the impact of introduced fishes is impossible because we do not know which nonnative fishes occur in many salmon-producing watersheds. Most available information is circumstantial. While such information can identify where inter- or intra specific relationships may occur, it does not test mechanisms explaining why observed relations exist. Thus, competition and predation are usually one of several plausible hypotheses explaining observed results."

Potential Palmer Pond Summer Steelhead HGMP Predation and Competition Effects on Listed Salmon

The proposed annual production goal for the Palmer Pond summer steelhead program is the release on-station of up to 30,000 actively migrating steelhead smolts in May at an average size of 5 fpp (approximately 206 mm fl) at RM 56.1, RM 33.5 (30,000) on the mainstem Green River, and 20,000 from Icy Creek at RM 48.3. Steelhead smolts released at these river mile locations may encounter rearing and emigrating juvenile chinook salmon that are either wild or hatchery-origin fish. Trapping studies on the Green River have shown that natural-origin juvenile chinook salmon emigrate downstream in the Green River as sub-yearling fish from February through late June. Emigration timing appears to be bimodal, with peak juvenile fish abundances observed at RM 34.5 in late February-early March and May.

Environmental Characteristics: The Green River is a relatively large river that tends to carry sufficient flows, and be quite turbid during the spring hatchery steelhead release and juvenile chinook emigration months due to rainfall-induced run-off. The river has flow volume characteristics that foster downstream dispersal of emigrating chinook salmon and hatchery steelhead after they are released.

Relative Body Size: Steelhead yearlings released through the Palmer Pond program average 206 mm fl (CV around average size is 10%). Juvenile chinook salmon emigrating in the Green River during the month of May when the steelhead are released averaged 63 mm (s.d. = 7.78, range 50 to 84 mm) in the first week of May, and 79 mm (s.d. = 10.10, range 49 to 104 mm) during the last week of May (2000 data from Seiler et al., 2002). Food resource competition risks to listed chinook juveniles are not likely to be substantial, because the larger steelhead are likely to select different food resources. Assuming the "1/3 size rule", chinook salmon smaller than 68 mm may be susceptible to predation by the average size hatchery steelhead released through the program. Comparing sizes of chinook the first two weeks of May to the last two weeks indicates it would be advantages to release the steelhead close to the end of May to reduce potential predation of listed chinook by the hatchery steelhead. No fall chinook were noted in 903 migrant hatchery steelhead that were examined in the Green River in the spring of 2004 (Cameron Sharpe et al., WDFW 2004).

Date of Release: Hatchery steelhead yearlings are released through the program in May. Data collected in the Green River indicates that 69% of the annual juvenile chinook salmon emigration has occurred by the first week in May, and 84% has occurred by the last week in May. The Palmer Pond summer steelhead smolts are released after the majority of juvenile chinook salmon have emigrated seaward. Hatchery fish releases delayed until later in May will encounter a decreased proportion of the total emigrating chinook salmon population. Competition and predation opportunities would be reduced with less overlap in migration, and co-occurrence in freshwater areas, between the two groups.

Release Location and Release Type: Steelhead released through the Palmer Pond program in May likely encounter rearing and emigrating juvenile chinook salmon in the mainstem river from the release point to the river mouth. The duration of interaction between the two species may be limited. The steelhead are released as actively migrating smolts, which are likely to disperse seaward after release. WDFW data indicates that steelhead smolts released from the Palmer Pond program emigrate quite rapidly downstream; reaching a trapping location located 23 miles downstream at RM 34.5 within days of release (data from Seiler et al., 2004).

Release Number: Juvenile out-migrant trappings data collected by WDFW (Seiler 2004) suggests that a substantial proportion of the smolts released upstream of the trapping location at RM 34.5 perish during emigration, and never reach downstream river areas. The actual number of steelhead that may be of concern regarding predation and competition may therefore be substantially less than the number reportedly released. Steelhead emigrating quickly downstream (the majority of surviving fish) are therefore unlikely to pose significant predation risks to juvenile chinook.

Based on a review of general information applied to the proposed program, the steelhead are unlikely to pose significant predation and competition risks to listed chinook juveniles. Monitoring and evaluation actions, and potential adaptive management measures that will be implemented to determine, and then (as appropriate) respond to, ecological effects of the program on listed chinook salmon are described in HGMP section 11.0.

- Provide information regarding past takes associated with the hatchery program, (if known) including numbers taken, and observed injury or mortality levels for listed fish.

Unknown

- Provide projected annual take levels for listed fish by life stage (juvenile and adult) quantified (to the extent feasible) by the type of take resulting from the hatchery program (e.g. capture, handling, tagging, injury, or lethal take).

See "take" table.

- Indicate contingency plans for addressing situations where take levels within a given year have exceeded, or are projected to exceed, take levels described in this plan for the program.

For listed chinook, if significant numbers are observed impacted by this program operation, then staff would inform the WDFW District Biologist who along with the Hatchery Complex Manager would determine an appropriate plan and consult with NOAA fisheries, if needed.

SECTION 3. RELATIONSHIP OF PROGRAM TO OTHER MANAGEMENT OBJECTIVES

3.1) Describe alignment of the hatchery program with any ESU-wide hatchery plan (e.g. *Hood Canal Summer Chum Conservation Initiative*) or other regionally accepted policies (e.g. the NPPC *Annual Production Review* Report and Recommendations - NPPC document 99-15). Explain any proposed deviations from the plan or policies.

The Palmer Pond summer steelhead program HGMP is included as one of 46 WDFW-managed plans under the co-managers' non-chinook Resource Management Plan (RMP) for Puget Sound region non-chinook salmon hatcheries. This HGMP is in alignment with the RMP, which serves as the overarching comprehensive plan for state and tribal non-chinook salmon hatchery operations in the region.

As affirmed in the co-manager’s non-chinook RMP, WDFW hatchery programs in Puget Sound must adhere to a number of guidelines, policies and permit requirements in order to operate. These constraints are designed to limit adverse effects on cultured fish, wild fish and the environment that might result from hatchery practices. Following is a list of guidelines, policies and permit requirements that govern WDFW hatchery operations:

Genetic Manual and Guidelines for Pacific Salmon Hatcheries in Washington. These guidelines define practices that promote maintenance of genetic variability in propagated salmon (Hershberger and Iwamoto 1981).

Hatchery Reform- Principles and Recommendations of the Hatchery Scientific Review Group. This report provides a detailed description of the HSRG’s scientific framework, tools and resources developed for evaluating hatchery programs, the processes used to apply these tools, and the resulting principles, system-wide recommendations, and program-specific recommendations to reform (HSRG 2004).

Spawning Guidelines for Washington Department of Fisheries Hatcheries. Assembled to complement the above genetics manual, these guidelines define spawning criteria to be use to maintain genetic variability within the hatchery populations (Seidel 1983).

Stock Transfer Guidelines. This document provides guidance in determining allowable stocks for release for each hatchery. It is designed to foster development of locally adapted broodstock and to minimize changes in stock characteristics brought on by transfer of non-local salmonids (WDFW 1991).

WDFW Steelhead Rearing Guidelines. Details rearing guidelines and parameters statewide (July 31, 2001).

Fish Health Policy of the Co-managers of Washington State. This policy designates zones limiting the spread of fish pathogens between watersheds, thereby further limiting the transfer of eggs and fish in Puget Sound that are not indigenous to the regions (WDFW, NWIFC 1998).

National pollutant Discharge Elimination System Permit Requirements This permit sets forth allowable discharge criteria for hatchery effluent and defines acceptable practices for hatchery operations to ensure that the quality of receiving waters and ecosystems associated with those waters are not impaired.

In 1999, several PS and coastal stocks were listed as threatened under the federal Endangered Species Act (ESA). State, tribal and federal managers need to ensure that their hatcheries do not present a risk to listed species. Through this Hatchery Reform Project, the managers have sought to go beyond merely complying with ESA directives. The new approach is to reform hatchery programs to provide benefits to wild salmon recovery and sustainable fisheries. Hatchery management decisions will be based on system-wide, scientific recommendations, providing an important model that can be replicated in other areas.

In addition, the Legislature, in 1999, created the Salmon Recovery Funding Board (SRFB) and the Shared Strategy for Salmon Recovery. Both are collaborative efforts to protect and restore salmon runs across Puget Sound. They bring together the experience and viewpoints of citizens, major state and federal natural resource agencies, local governments, non-government organizations and Puget Sound Tribes. The SRFB provides grant funds to protect or restore salmon habitat and assist related activities that produce sustainable and measurable benefits for fish and their habitat. The Shared Strategy process helps identify what is needed in each watershed to recover salmon habitat through a watershed recovery plan (see section 3.4 for more details).

3.2) List all existing cooperative agreements, memoranda of understanding, memoranda of agreement, or other management plans or court orders under which program operates.

This hatchery, as well as other WDFW hatcheries, operates under *U.S. v Washington* that provides the legal framework for coordinating these programs, defining artificial production objectives, and maintaining treaty-fishing rights through the court-ordered Puget Sound Salmon Management Plan (1985). This co-management process requires that both the State of Washington and the relevant Puget Sound Tribe(s) develop program goals and objectives and agree on the function, purpose and release strategies of all hatchery programs. The Future Brood Document is a detailed listing of annual production goals. This is reviewed and updated each spring and finalized in July. The Current Brood Document reflects actual production relative to the annual production goals. It is developed in the spring after eggs are collected.

3.3) Relationship to harvest objectives.

3.3.1) Describe fisheries benefiting from the program, and indicate harvest levels and rates for program-origin fish for the last twelve years (1988-99), if available.

Returning summer steelhead adults provide for tribal subsistence and sport fisheries from June through December each year. Harvest rate is estimated at 97%.

Green (Duwamish) River Summer-run Steelhead WDFW District 12, 12410 138th St Ct E, Puyallup 98374, (253) 840-4563 1May-30Apr													**Smolt**
Return	**Sport Harvest** (1May-31Oct)			**Tribal Harvest** (1May-31Oct)			**Escapement**			**Total Runsize**			~May Release
Year	Hatchery	Wild	H&W Total	Hatchery	Wild	H&W Total	Hatchery	Wild	H&W Total	Hatchery	Wild	H&W Total	Return N+2
1992	861	74	935			16							79,600
1993	533	27	560			9							83,700
1994	1,026	92	1,118			140							81,300
1995	608	49	657			42							83,600
1996	1,207	69	1,276			45							100,100
1997	573	81	654			84							36,000
1998	408	53	461			136							86,300
1999	115	17	132			89							67,300
2000	240	12	252			62							65,300
2001	576	35	611			157							39,600
2002	317	49	366			180							101,100
2003	199	17	216										59,833

Source: B. Gill, WDFW steelhead historical database

3.4) Relationship to habitat protection and recovery strategies.

The Legislature, in 1999, created the Salmon Recovery Funding Board (SRFB) and, as indicated earlier, the Shared Strategy for Salmon Recovery. Both are collaborative efforts to protect and restore salmon runs across Puget Sound. They bring together the experience and viewpoints of citizens, major state and federal natural resource agencies, local governments, non-government organizations and Puget Sound Tribes. The SRFB provides grant funds to protect or restore salmon habitat and assist related activities that produce sustainable and measurable benefits for fish and their habitat. The Shared Strategy process helps identify what is needed in each watershed to recover salmon habitat through a watershed recovery plan.

Shared Strategy

The Shared Strategy is based on the conviction that:
1) People in Puget Sound have the creativity, knowledge, and motivation to find lasting solutions to complex ecological, economic, and cultural challenges;
2) Watershed groups that represent diverse communities are essential to the success of salmon recovery;
3) Effective stewardship occurs only when all levels of government coordinate their efforts;
4) The health and vitality of Puget Sound depends on timely planning for ecosystem health and strong local and regional economies; and
5) The health of salmon are an indicator of the health of our region salmon recovery will benefit both human and natural communities.

The 5-Step Shared Strategy

1) Identify what should be in a recovery plan and assess how current efforts can support the plan.

2) Set recovery targets and ranges for each watershed.

3) Identify actions needed at the watershed level to meet targets.

4) Determine if identified actions add up to recovery. If not, identify needed adjustments.

5) Finalize the plan and actions and commitment necessary for successful implementation.

Salmon Recovery Funding Board

Composed of five citizens appointed by the Governor and five state agency directors, the Board provides grant funds to protect or restore salmon habitat and assist related activities. It works closely with local watershed groups known as lead entities (see below). SRFB has helped finance over 500 projects. The Board supports salmon recovery by funding habitat protection and restoration projects. It also supports related programs and activities that produce sustainable and measurable benefits for fish and their habitat.

Lead Entities

Lead entities are voluntary organizations under contract with the Washington State Department of Fish and Wildlife (WDFW). Lead entities define their geographic scope and are encouraged to largely match watershed boundaries. Lead entities are essential in ensuring the best projects are proposed to the Board for funding in its annual grant process.

All lead entities have a set of technical experts that assist in development of strategies, and identification and prioritization of projects. The lead entity citizen committee is responsible under state law for developing the final prioritized project list and submitting it to the SRFB for funding consideration. Lead entity technical experts and citizen committees perform important unique and complementary roles. Local technical experts are often the most knowledgeable about watershed, habitat and fish conditions. Their expertise is invaluable to ensure priorities and projects are based on ecological conditions and processes. They also can be the best judges of the technical merits and certainty of project technical success. Citizen committees are critical to ensure that priorities and projects have the necessary community support for success. They are often the best judges of current levels of community interests in salmon recovery and how to increase community support over time with the implementation of habitat projects. The complementary roles of both lead entity technical experts and citizen committees is essential to ensure the best projects are proposed for salmon recovery and that the projects will increase the technical and community support for an expanded and ever increasing effectiveness of lead entities at the local and regional level. (http://www.iac.wa.gov/srfb/leadentities.htm).

The Lead Entity for the Green River/Duwamish River watershed is King County (WRIA 9). Howard Hanson dam, an impassable barrier to fish migration, prevents natural production of salmonids into 106 lineal miles of stream habitat of the Upper Green River. The lower portion of the Green River basin is highly developed, channelized, diked and industrialized. These factors have degraded or eliminated habitat important for chinook and coho salmon, adversely affecting the survival and productivity of the natural population in the watershed. The co-managers' resource management plans for artificial production in Puget Sound are expected to be one component of a recovery plan for Puget Sound chinook under development through the Shared Strategy process. Several important analyses have been completed, including the identification of populations of Puget Sound chinook, but further development of the plan may result in an improved understanding of the habitat, harvest and hatchery actions required for recovery of Puget Sound chinook.

3.5) Ecological interactions.

(1) Salmonid and non-salmonid fishes or other species that could negatively impact the program.

Negative impacts by fishes and other species on the Palmer Pond summer steelhead program could occur directly through predation on program fish, or indirectly through food resource competition, genetic effects, or other ecological interactions. In particular, fishes and other species could negatively impact Palmer Pond summer steelhead survival rates through predation on newly released, emigrating juvenile fish in the freshwater and marine areas. Certain avian and mammalian species may also prey on juvenile steelhead while the fish are rearing at the hatchery sites, if these species are not excluded from the rearing areas. Species that could negatively impact juvenile steelhead through predation include the following:

- Northern pikeminnow
- Avian predators, including: mergansers, cormorants, belted kingfishers, great blue herons, and night herons
- Mammalian predators, including: mink, river otters, harbor seals, and sea lions

Rearing and migrating adult steelhead originating through the program may also serve as prey for large, mammalian predators in marine areas, nearshore marine areas in Puget Sound and in the Green River to the detriment of population abundance and the program's success in augmenting harvest. Species that may negatively impact program fish through predation may include:

- Orcas
- Sea lions
- Harbor seals
- River otters

(2) Salmonid and non-salmonid fishes or other species that could be negatively impacted by the program (focus is on listed and candidate salmonid species).

- Chinook

3) Salmonid and non-salmonid fishes or other species that could positively impact the program

Fish species that could positively impact the program may include chinook salmon and other salmonid species present in the Green River watershed through natural and hatchery production. Juvenile fish of these species may serve as prey items for the steelhead during their downstream migration in freshwater. Decaying carcasses of spawned adult fish may contribute nutrients that increase productivity in the watershed, providing food resources for the emigrating steelhead.

4) Salmonid and non-salmonid fishes or other species that could be positively impacted by the program.

The steelhead program could positively impact freshwater and marine fish species that prey on juvenile fish. Nutrients provided by decaying hatchery steelhead carcasses may also benefit fish in freshwater. These species include:

- Northern pikeminnow
- Chinook
- Steelhead
- Pacific staghorn sculpin
- Numerous marine pelagic fish species

WDFW is unaware of any studies in the watershed that have directly evaluated the beneficial effects of this program to listed salmon. Therefore, we provide in this section a summary of empirical information and theoretical analyses of one type of ecological interaction that may be relevant to this program: nutrient enhancement. Recent reviews by Stockner (2003) can be consulted for additional information. NOAA Fisheries also provides a general review of nutrient enhancement benefits that may result from hatchery programs. This general information is applied to the specific hatchery operational practices proposed in the Palmer Pond steelhead HGMP to describe the plan's potential nutrient enhancement effect on listed salmon in the Green River watershed and within the Puget Sound nearshore marine areas.

Nutrient Enhancement

Steelhead adults originating from this program that return to natural spawning areas in the Green River may provide a source of nutrients in the form of gametes and carcasses, stimulating stream productivity. Many watersheds in the Pacific Northwest appear to be nutrient-limited (Gregory et al. 1987; Kline et al. 1997) and salmonid carcasses can be an important source of marine derived nutrients (Levy 1997). Carcasses from returning adult salmon have been found to elevate stream productivity through several pathways, including: 1) the releases of nutrients from decaying carcasses has been observed to stimulate primary productivity (Wipfli et al. 1998); 2) the decaying carcasses have been found to enrich the food base of aquatic invertebrates (Mathisen et al. 1988); and 3) juvenile salmonids have been observed to feed directly on the carcasses (Bilby et al. 1996). Addition of nutrients has been observed to increase the production of salmonids (Slaney and Ward 1993; Slaney et al. 2003; Ward et al. 2003).

Assuming a steelhead smolt to adult survival rate of 1.86% (see section 1.12), the Palmer Ponds program may lead to the annual return of 1,488 adult steelhead. At an average size of 6 pounds and if half of these spawn and die in the watershed, it can be assumed that approximately 4,464 pounds of marine derived nutrients would be made available for use by other living organisms, including juvenile fish, in the Green River watershed.

SECTION 4. WATER SOURCE

4.1) Provide a quantitative and narrative description of the water source (spring, well, surface), water quality profile, and natural limitations to production attributable to the water source.

Soos Creek Hatchery is supplied by surface water from Soos Creek. Water is withdrawn via 4 pumps at the hatchery site. Pumps produce 13,500 gallons per minute (gpm). In addition, a small spring water supply (50 gpm) can be utilized in the incubation building.

The quality of the spring water at Icy Creek is excellent but varies with the season from a low of 2.2 cubic feet per second (cfs) in the late fall to 13 cfs in the late spring.

Palmer Ponds is a gravity fed spring water source that provides from 2 to 15 cubic feet per second (cfs) of water depending on the time of year. It is clean, cold, high quality water with yearly temperatures ranging from 46 to 52 degrees.

4.2) Indicate risk aversion measures that will be applied to minimize the likelihood for the take of listed natural fish as a result of hatchery water withdrawal, screening, or effluent discharge.

Soos Creek Hatchery is supplied by surface water from Soos Creek (water right permit # S1-21122). The hatchery water intake structure at Soos Creek Hatchery (the incubation and early rearing site for the Icy Creek Hatchery programs) is in compliance with NOAA Fisheries screening criteria (NMFS 1995, 1996). However, the intake does not meet the current NOAA criteria.

Soos Creek Hatchery complies with NPDES Permit # WAG 13-3014, which was issued by WDOE to ensure that effluent from the hatchery was not detrimental to downstream aquatic life. Monitoring at the hatchery water return location indicates that the hatchery effluent meets NPDES permit standards. Hatchery effluent is regularly monitored, in accordance with permit requirements, to determine continued compliance with discharge limits.

Due to its extremely steep stream gradient, no natural-origin salmonid population has used the watershed upstream of the Icy Creek Hatchery water intake. The hatchery is operated to ensure that hatchery effluent is not detrimental to downstream aquatic life by meeting or exceeding applicable NPDES Permit standards (# WAG13 - 3013). Usage of spring water is regulated under water right permit # S1-00317.

At Palmer Ponds, no fish are present above the water intakes. Usage of spring water is regulated through water right permit # S1-*20296 and effluent from Palmer Ponds is regulated through NPDES permit # WAG 13-3002.

SECTION 5. FACILITIES

5.1) Broodstock collection facilities (or methods).

Broodstock is collected in the outlet to the rearing pond at Palmer. There is a concrete raceway where the fish are captured. At Soos Creek, there is a weir with a V-trap ladder where steelhead enter into a large in-stream holding pond.

5.2) Fish transportation equipment (description of pen, tank truck, or container used).

Adults trapped at Palmer remain at Palmer. If broodstock are trapped at Soos Creek, they are hauled to holding ponds in various sized tanker trucks equipped with oxygen tanks, air stones and recirculation pumps.

5.3) Broodstock holding and spawning facilities.

After trapping, broodstock are held in 20-foot diameter round ponds at Palmer. Fish are spawned at pond side. At Soos Creek, fish will be held in the holding pond and spawned at pond side (see Soos Creek coho HGMP for detail).

5.4) Incubation facilities.

All eggs are incubated at Soos Creek Hatchery (see Soos Creek coho HGMP).

5.5) Rearing facilities.

Portion of the steelhead destined for Palmer Ponds are initially reared at Soos Creek Hatchery. They are transferred to Palmer between 80-100 fish per pound (fpp).

5.6) Acclimation/release facilities.

Fish are acclimated and released from Palmer Ponds and Soos Creek hatchery.

5.7) Describe operational difficulties or disasters that led to significant fish mortality.

None known.

5.8) Indicate available back-up systems, and risk aversion measures that will be applied, that minimize the likelihood for the take of listed natural fish that may result from equipment failure, water loss, flooding, disease transmission, or other events that could lead to injury or mortality.

The Soos Creek Hatchery is equipped with a backup generator and adequate fuel supply in the event of a power outage. Two persons are on rotating standby status year around in the event of a problem. An upgraded alarm system is designed to detect changes in flow and power status. The risk of disease transmission shall be limited by using effective theraputents, as prescribed and in a timely manner.

Palmer Ponds and Icy Creek are gravity-fed stations and have never sustained fish losses due to high water.

SECTION 6. BROODSTOCK ORIGIN AND IDENTITY

Describe the origin and identity of broodstock used in the program, its ESA-listing status, annual collection goals, and relationship to wild fish of the same species/population.

6.1) Source.

Steelhead adults returning to the Palmer Ponds and Soos Creek hatchery traps.

6.2) Supporting information.

6.2.1) History.

The Skamania summer steelhead stock was founded in 1963 from the North Fork Washougal River and has since been transplanted to various hatcheries throughout Washington and several other states. Selection for early spawning time was necessary to obtain one-year smolts. In recent years, eggs for the Green River program have come from the Reiter Ponds on the Skykomish River. This broodstock is largely Skamania origin, but has also included some Skykomish origin fish. Efforts to trap returning adults began at Keta Creek (Muckleshoot Tribe) and Palmer Ponds in 2000, with the goal of developing a local summer steelhead broodstock from the Skamania/Skykomish stock. Currently adults are trapped as Palmer Ponds and Soos Creek.

6.2.2) Annual size.

80 adults (40 males and 40 females), assuming fecundity of 3,000 eggs per female. Only adipose-fin clipped fish will be used for broodstock.

6.2.3) Past and proposed level of natural fish in broodstock.

All summer steelhead currently used for hatchery broodstock are of hatchery origin (adipose-fin clipped) with unknown levels of natural fish in the past.

6.2.4) Genetic or ecological differences.

Historically, the Green River did not contain wild summer steelhead. Since the start of the hatchery program, naturally produced summer steelhead have been present in small numbers in the Green River as a result of some limited spawning of un-harvested fish. No genotypic, phenotypic, or behavioral differences have been noted between these fish and the hatchery stock.

6.2.5) Reasons for choosing.

Skamania Hatchery broodstock, as was the case with winter steelhead, has been selected for its early arrival and spawn timing as compared to wild steelhead and in order to obtain one-year smolts.

6.3) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic or ecological effects to listed natural fish that may occur as a result of broodstock selection practices.

Natural-origin steelhead are not used in broodstock selection. Collection and selection of steelhead broodstock takes place between September and November. Chinook may enter the trap at Palmer, but it is not very likely due to the small size and declination of the outlet creek. Any listed fish that enter the trap will be returned to the river to spawn. There may be a potential for listed chinook to be impacted at Soos Creek due to steelhead collection, but care will be taken to return any non-marked chinook back to the stream.

SECTION 7. BROODSTOCK COLLECTION

7.1) Life-history stage to be collected (adults, eggs, or juveniles).

Adults

7.2) Collection or sampling design.

Summer steelhead are trapped at Palmer Ponds and Soos Creek between September and November with traps associated with those tributaries or rearing ponds.

7.3) Identity.

All steelhead used for broodstock are of hatchery origin and 100% identified with an adipose-fin clip.

7.4) Proposed number to be collected:

7.4.1) Program goal (assuming 1:1 sex ratio for adults):

80. The year 2000 was the first year that summer run steelhead were trapped and used for broodstock on the Green River system.

7.4.2) Broodstock collection levels for the last twelve years (e.g. 1988-99), or for most recent years available:

Year	Adults			Eggs	Juveniles
	Females	Males	Jacks		
1995					
1996					
1997					
1998					
1999					
2000	4	3		13,000	
2001	25	17		90,000	
2002	45	43	2	183,400	
2003	9	10		29,700	
2004	8	2 (6 live spawned)		28,900	

Data source: Palmer ponds hatchery records

7.5) Disposition of hatchery-origin fish collected in surplus of broodstock needs.

Surplus fish can be recycled for additional sport fishing opportunity if not needed for broodstock.

7.6) Fish transportation and holding methods.

Adults are transported in various sized tanker trucks equipped with oxygen tanks, air stones and recirculation pumps.

7.7) Describe fish health maintenance and sanitation procedures applied.

Standard fish health protocols, as defined in the Co-manager Fish Health Policy (1998) are adhered to.

7.8) Disposition of carcasses.

Spawned carcasses are utilized for nutrient enhancement or disposed of.

7.9) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic or ecological effects to listed natural fish resulting from the broodstock collection program.

Trapping of adult summer steelhead occurs at Palmer Ponds and Soos Creek Hatchery between September and November. Chinook may enter the trap at Palmer, but it is not very likely due to the small size and declination of the outlet creek. Any listed fish that enter the trap will be returned to the river to spawn. There may be a potential for listed chinook to be impacted at Soos Creek due to steelhead collection, but care will be taken to return any non-marked chinook back to the stream.

SECTION 8. MATING

Describe fish mating procedures that will be used, including those applied to meet performance indicators identified previously.

8.1) Selection method.

Females are chosen based on ripeness. The pond is sorted once a week from the third week in January until spawning is complete.

8.2) Males.

Spawning is based on a 1:1 ratio with the use of a backup male to insure fertilization. Jacks are used, if available, up to 1% of broodstock total.

8.3) Fertilization.

Matings are 1:1 with the use of a backup male. Eggs are water hardened and disinfected in a 100 parts per million-iodophor solution.

8.4) Cryopreserved gametes.

NA

8.5) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic or ecological effects to listed natural fish resulting from the mating scheme.

No listed fish are a part of the mating scheme. Only adipose-fin clipped steelhead (hatchery-origin) are part of the mating scheme.

SECTION 9. INCUBATION AND REARING -

Specify any management *goals* (e.g. "egg to smolt survival") that the hatchery is currently operating under for the hatchery stock in the appropriate sections below. Provide data on the success of meeting the desired hatchery goals.

9.1) Incubation:

9.1.1) Number of eggs taken and survival rates to eye-up and/or ponding.

2000 was the first year of broodstock collection. 80,000 eggs were collected and 85% survival to eye-up was achieved. In past years, 120,000 eggs were transferred to produce 80,000 smolts.

9.1.2) Cause for, and disposition of surplus egg takes.

Surplus fish could be planted into local lakes without an outlet to provide fishing opportunity, although this has not occurred at this facility.

9.1.3) Loading densities applied during incubation.

Steelhead eggs average 2,800 to the pound. Incubation occurs in shallow troughs receiving 8-10 gpm. Loadings are 20,000 per shallow trough. All eggs are incubated at Soos Creek Hatchery.

9.1.4) Incubation conditions.

Eggs are incubated at Soos Creek hatchery on surface water where temperatures are monitored daily (45-52 degrees) and incubation systems are checked daily by hatchery personnel.

9.1.5) Ponding.

Fish are initially fed in the shallow trough incubators where they are incubated. Fish are given feed at 95% button up. Fish are force ponded into larger intermediate or standard raceways when they are between 500-1000 fish per pound (fpp).

9.1.6) Fish health maintenance and monitoring.

Eggs receive daily formalin treatments until hatch out. Eggs are shocked and picked at 600 Temperature Units (TU's).

9.1.7) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish during incubation.

All eggs incubated are from hatchery-origin marked steelhead adults. All chinook are incubated separately from the steelhead.

9.2) <u>Rearing</u>:

9.2.1) Provide survival rate data (*average program performance*) by hatchery life stage (fry to fingerling; fingerling to smolt) for the most recent twelve years (1988-99), or for years dependable data are available..

Fry to smolt survival rates have ranged between 20.7 and 91.9%, with an average of 65.1%. Bird and otter predation have been the most significant contributors to loss. Bird netting has been installed and losses have decreased substantially.

9.2.2) Density and loading criteria (goals and actual levels).

Fish are reared in large earthen ponds at Palmer and rearing conditions do not fit into the same criteria as in raceways, space is not a limiting factor. While fish are reared at Soos Creek, loading goals conform to guidelines set out in Fish Hatchery Management (Piper et al.1982).

9.2.3) Fish rearing conditions

Palmer Ponds water supply is spring water ranging from 2-15 cfs, which is gravity fed. It is considered high quality and cold, with temperatures between 46 and 52 degrees. All ponds at Soos Creek receive ambient surface water from the creek. Incoming oxygen levels are saturated, but are not normally monitored. Due to heavy silt loads the ponds are vacuumed frequently (weekly or as-needed).

9.2.4) Indicate biweekly or monthly fish growth information (*average program performance*), including length, weight, and condition factor data collected during rearing, if available.

Not available.

9.2.5) Indicate monthly fish growth rate and energy reserve data (*average program performance*), if available.

Not available.

9.2.6) Indicate food type used, daily application schedule, feeding rate range (e.g. % B.W./day and lbs/gpm inflow), and estimates of total food conversion efficiency during rearing (*average program performance*).

Fish are fed a variety of dry pellet and starter mash formulations depending on life stage. Fish are fed on an aggressive schedule in order to produce a 1-year smolt between five and eight to the pound. Feed rates vary widely depending on time of the year and size of the fish.

9.2.7) Fish health monitoring, disease treatment, and sanitation procedures.

A WDFW Fish Health Specialist performs routine checks on fish health.

9.2.8) Smolt development indices (e.g. gill ATPase activity), if applicable.

Gill ATPase activity is not monitored. The migratory state of the release population is noticeable by fish behavior. Aggressive screen crowding, swarming against sloped pond sides, a silvery physical appearance and loose scales during feeding events are signs of smolt development. From past history, hatchery personnel will reduce feed regimes in early spring as fish show signs of smolting. Correspondingly, environmental cues including daylight increase, spike in the water temperature and spring freshets will also be part of the decision to release fish.

9.2.9) Indicate the use of "natural" rearing methods as applied in the program.

NA

9.2.10) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish under propagation.

Pathogens are not unique to hatcheries. Hatchery-origin fish may have an increased risk of carrying fish disease pathogens because higher rearing densities of fish in the hatchery may stress fish and lower immune responses. Under certain conditions, hatchery effluent has the potential to transport fish pathogens out of the hatchery, where natural fish may be exposed. These impacts are addressed by rearing the steelhead at lower densities, within widely recognized guidelines (Piper et al 1982), continuing well-developed monitoring, diagnostic, and treatment programs already in place (Co-manager's Fish Health Policy 1998).

SECTION 10. RELEASE

Describe fish release levels, and release practices applied through the hatchery program.

10.1) Proposed fish release levels.

Age Class	Maximum Number	Size (fpp)	Release Date	Location
Eggs				
Unfed Fry				
Fry				
Fingerling				
Yearling	30,000 *30,000 20,000	5** 5 5	May May May	Palmer Pond Soos Cr. Icy Cr.

*- Releases from Soos Creek Hatchery began in May of 2002.

** 5 fish per pound (fpp) – 206 mm fl

10.2) Specific location(s) of proposed release(s).

Stream, river, or watercourse: Green River

Release point: Palmer Ponds (Green River, 09.0001) at RM 56.1 and on Soos Creek at RM 1, tributary to the Green River at RM 33.5.

Major watershed: Duwamish/Green River

Basin or Region: Puget Sound

10.3) Actual numbers and sizes of fish released by age class through the program.

Release year	Eggs/ Unfed Fry	Avg size	Fry	Avg size	Fingerling	Avg size	Yearling	Avg size
1995							83,582	6
1996							100,125	6
1997							52,509	7
1998							61,396	9
1999							46,784	8
2000							65,273	7
2001							65,860	6
2002							27,437	5
2003							25,935	5.5
Average							67,933	7

Data source: Palmer ponds hatchery records (release numbers are for Palmer ponds only (WDFW)).

10.4) Actual dates of release and description of release protocols.

Typically steelhead smolts are released in early to mid May. Releases are volitional for the first several weeks, then forced at the end.

10.5) Fish transportation procedures, if applicable.

The smolts are released on site and therefore do not need any transportation.

10.6) Acclimation procedures.

All steelhead released at Palmer Ponds are acclimated on spring water over the entire rearing period. Prior to the release at Soos Creek, fish are acclimated on surface water.

10.7) Marks applied, and proportions of the total hatchery population marked, to identify hatchery adults.

All steelhead are 100% identified with an adipose-fin clip (mass mark).

10.8) Disposition plans for fish identified at the time of release as surplus to programmed or approved levels.

Surplus fish have not been an issue because of otter and bird predation.

10.9) Fish health certification procedures applied pre-release.

A routine fish health inspection by the Area WDFW Fish Health Specialist takes place prior to release.

10.10) Emergency release procedures in response to flooding or water system failure.

Depending upon circumstances, release fish with either the highest probability of surviving to adulthood or the fish with the highest probability of sustaining catastrophic loss if held at the hatchery.

10.11) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish resulting from fish releases.

To minimize the risk of residualization and impact upon natural-origin listed fish, hatchery yearlings are released in May as smolts and only in the Green River watershed (see section 2.2.3 for more details).

SECTION 11. MONITORING AND EVALUATION OF PERFORMANCE INDICATORS

11.1) Monitoring and evaluation of "Performance Indicators" presented in Section 1.10.

11.1.1) Describe plans and methods proposed to collect data necessary to respond to each "Performance Indicator" identified for the program.

The co-managers conduct numerous ongoing monitor programs, including catch, escapement, marking, tagging, and fish health testing. The focus of enhanced monitoring and evaluation programs will be on the risks posed by ecological interactions with listed species. WDFW is proceeding on four tracks:

1) An ongoing research program conducted by Duffy et al. (2002) is assessing the nearshore distribution, size structure, and trophic interactions of juvenile salmon, and potential predators and competitors, in northern and southern Puget Sound. Funding is provided through the federal Hatchery Scientific Review Group. Preliminary results by Duffy et al. (2005, HSRG Research Workshop) indicated that the dominant predator of salmonids in the nearshore and estuary environments is cutthroat trout. Chinook were found to prey largely on herring and sandlance. The biggest prey item for coho was marine plankton and pink and chum salmon.

2) A three-year study of the estuarine and early marine use of Sinclair Inlet by juvenile salmonids is nearing completion. The project has four objectives:

a) Assess the spatial and temporal use of littoral habitats by juvenile chinook throughout the time these fish are available in the inlet;
b) Assess the use of offshore (i.e., non-littoral) habitats by juvenile chinook;
c) Determine how long cohorts of juvenile chinook salmon are present in Sinclair inlet;
d) Examine the trophic ecology of juvenile chinook in Sinclair Inlet. This will consist of evaluating the diets of wild chinook salmon and some of their potential predators and competitors. Funding is provided by the USDD-Navy.

3) WDFW is developing the design for a research project to assess the risks of predation on listed species by coho salmon and steelhead released from artificial production programs. Questions that this project will address include:

a) How do trucking and the source of fish (within watershed or out of watershed) affect the migration rate of juvenile steelhead?
b) How many juvenile chinook salmon of natural origin do coho salmon and steelhead consume?
c) What is the rate of residualism of steelhead in Puget Sound Rivers?
Funding needs have not yet been quantified, but would likely be met through a combination of federal and state sources.

4) WDFW is assisting the Hatchery Scientific Review Group in the development of a template for a regional monitoring plan. The template will provide an integrated assessment of hatchery and wild populations.

11.1.2) Indicate whether funding, staffing, and other support logistics are available or committed to allow implementation of the monitoring and evaluation program.

See Section 11.1.1.

11.2) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish resulting from monitoring and evaluation activities.

Risk aversion measures will be developed in conjunction with the monitoring and evaluation plans.

SECTION 12. RESEARCH

12.1) Objective or purpose.

12.2) Cooperating and funding agencies.

12.3) Principle investigator or project supervisor and staff.

12.4) Status of stock, particularly the group affected by project, if different than the stock(s) described in Section 2.

12.5) Techniques: include capture methods, drugs, samples collected, tags applied.

12.6) Dates or time period in which research activity occurs.

12.7) Care and maintenance of live fish or eggs, holding duration, transport methods.

12.8) Expected type and effects of take and potential for injury or mortality.

12.9) Level of take of listed fish: number or range of fish handled, injured, or killed by sex, age, or size, if not already indicated in Section 2 and the attached "take table" (Table 1).

12.10) Alternative methods to achieve project objectives.

12.11) List species similar or related to the threatened species; provide number and causes of mortality related to this research project.

12.12) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse ecological effects, injury, or mortality to listed fish as a result of the proposed research activities.

SECTION 13. ATTACHMENTS AND CITATIONS

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SECTION 14. CERTIFICATION LANGUAGE AND SIGNATURE OF RESPONSIBLE PARTY

"I hereby certify that the foregoing information is complete, true and correct to the best of my knowledge and belief. I understand that the information provided in this HGMP is submitted for the purpose of receiving limits from take prohibitions specified under the Endangered Species Act of 1973 (16 U.S.C.1531-1543) and regulations promulgated thereafter for the proposed hatchery program, and that any false statement may subject me to the criminal penalties of 18 U.S.C. 1001, or penalties provided under the Endangered Species Act of 1973."

Name, Title, and Signature of Applicant:

Certified by_____________________________ Date:_____________

Take Table. Estimated listed salmonid take levels by hatchery activity.

Chinook

ESU/Population	Puget Sound Chinook *(Oncorhynchus tshawytscha)* Green River
Activity	Palmer Ponds Summer Steelhead Program
Location of hatchery activity	Soos Creek Hatchery, RM 1 Big Soos Creek (09.0072) Palmer rearing Pond, RM 0.2Unnamed stream (09.0147) Icy Creek Pond, Tributary to Green R. at RM 48.5
Dates of activity	December- May
Hatchery Program Operator	WDFW

Type of Take	Annual Take of Listed Fish by life Stage (number of fish)			
	Egg/Fry	Juvenile/Smolt	Adult	Carcass
Observe or harass (a)	-	-	-	-
Collect for transport (b)	-	-	-	-
Capture, handle, and release (c)	-	-	-	-
Capture, handle, tag/mark/tissue sample, and release (d)	-	-	-	-
Removal (e.g., broodstock (e)	-	-	-	-
Intentional lethal take (f)	-	-	-	-
Unintentional lethal take (g)	-	-	-	-
Other take (indirect, unintentional) (h)	-	Unknown	-	-

a. Contact with listed fish through stream surveys, carcass and mark recovery projects, or migrational delay at weirs.
b. Take associated with weir or trapping operations where listed fish are captured and transported for release.
c. Take associated with weir or trapping operations where listed fish are captured, handled and released upstream or downstream.
d. Take occurring due to tagging and/or bio-sampling of fish collected through trapping operations prior to upstream or downstream release, or through carcass recovery programs.
e. Listed fish removed from the wild and collected for use as broodstock.
f. Intentional mortality of listed fish, usually as a result of spawning as broodstock.
g. Unintentional mortality of listed fish, including loss of fish during transport or holding prior to spawning or prior to release into the wild, or, for integrated programs, mortalities during incubation and rearing.
h. Other takes not identified above as a category.