Services Review Draft (as modified by ACC on May06)

# Lewis River Hatchery and Supplementation Plan (FERC Project Nos. 935, 2071, 2111, 2213)

April 2006 (version 051106)

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# EXECUTIVE SUMMARY

This report describes the Hatchery and Supplementation Plan (H&S Plan) proposed by PacifiCorp Energy and Cowlitz County PUD for the Lewis River Hydroelectric Projects (FERC Nos. 935, 2071, 2111 and 2213). The H&S Plan is required under Section 8 of the Lewis River Hydroelectric Projects Settlement Agreement (Settlement Agreement) dated November 30, 2004.

The goals identified by the parties to the Settlement Agreement formed the basis for actions proposed in this plan. The Settlement Agreement states that the goals of the Hatchery and Supplementation Program are to support:

1. Self-sustaining, naturally producing, harvestable native anadromous salmonids species throughout their historical range in the North Fork Lewis River, and

2. The continued harvest of resident and native anadromous fish species.

The H&S Plan is designed to be consistent with the priority objective of recovering wild fish stocks in the basin to first viable and then harvestable levels. Therefore, when selecting between actions deference was given to those that provided the greatest benefit to the protection of wild fish populations.

Because the H&S Plan is to be updated every 5-years, this report focuses on the approach to be used for reintroducing anadromous fish into the area above Swift No. 1 Dam. Reintroduction efforts for Yale and Merwin are not scheduled until year 8 and 12 of the new license period, respectively.

As called for in the Settlement Agreement, the hatchery component of the H&S Plan incorporates the recommendations of the Hatchery Scientific Review Group (HSRG), and the Northwest Power and Conservation Council's (NPCC) Artificial Production Review and Evaluation (APRE) program. Both programs were mandated by Congress as a means to reform artificial production in the Pacific Northwest. The recommendations in these reports represent the regions current understanding of what constitutes best hatchery practices. The supplementation approach used in the plan was selected based on the results obtained as part of the Yakima River and Cowlitz River supplementation programs.

Other plans or documents relied on in the development of the H&S Plan include:

- Lewis River Fish Planning Document

- Miscellaneous Relicensing Studies

A summary of the major points, strategies and assumptions present in the plan are presented below:

## HATCHERY AND NATURAL PRODUCTION TARGETS

The combined actions proposed in the H&S Plan are designed to achieve the hatchery and natural production targets shown in Table ES-1. The values in the table are referred to as adult ocean recruits, which include escapement to the habitat plus the number of fish caught in ocean and freshwater fisheries. It should be noted that most representatives of the Lewis River Aquatic Coordination Committee (ACC) favor not including jacks in the ocean recruits calculation.

**Table ES-1. Hatchery targets and natural production adult threshold levels (adult ocean recruits) for spring Chinook, steelhead and coho.**

| | Spring Chinook | Steelhead | Coho | Total |
|---|---|---|---|---|
| Hatchery Targets | 12,800 | 13,200 | 60,000 | 86,000 |
| Natural Production Threshold | 2,977 | 3,070 | 13,953 | 20,000 |
| **Grand Total** | **15,777** | **16,270** | **73,953** | **106,000** |

As natural production for each species exceeds the threshold level identified in Table ES-1, hatchery production levels for that species would be reduced on a 1:1 (one wild fish for one hatchery fish) basis. For example, when natural spring Chinook adult returns equal 3,977 fish (1,000 fish over threshold), the hatchery production target for this same species would be reduced by 1,000 adults to 11,800. The decision to adjust hatchery production would be made by the ACC every 5-years based on the results of the ocean recruits analysis. However, as called for in the Settlement Agreement, hatchery production targets would not be reduced below the "Hatchery Target Floor" levels shown in Table ES-2.

**Table ES-2. Hatchery target floor levels for spring Chinook, steelhead and coho.**

| | Spring Chinook | Steelhead | Coho | Total |
|---|---|---|---|---|
| Hatchery Target Floor | 2,679 | 2,763 | 12,558 | 18,000 |

## HATCHERY JUVENILE PRODUCTION

As defined in the Settlement Agreement, the suggested number of hatchery juvenile fish to be released each year is shown in Table ES-3. However, as noted above, these numbers could be reduced if natural production exceeds threshold levels.

**Table ES-3. Hatchery juvenile production targets for spring Chinook, steelhead and coho.**

| Smolt Production | Spring Chinook | Steelhead | Coho | Total |
|---|---|---|---|---|
| Years 1-3 | 1.35 million | 275,000 | 1.8 million | 3.425 million |
| Years 4-5 | 1.35 million | 275,000 | 1.9 million | 3.525 million |
| Years 6-50 | 1.35 million | 275,000 | 2.0 million | 3.625 million |

The proposed number of juveniles to be released both upstream and downstream of Merwin Dam is shown in Table ES-4. The spring chinook juveniles released upstream of Merwin Dam would be used as part of the supplementation/reintroduction effort and to provide test specimens for evaluating juvenile collection facilities at Swift No. 1 Dam. Juveniles released downstream of Merwin Dam would provide adults for harvest, hatchery broodstock, and the fish needed for adult supplementation program. These numbers would be adjusted over time as more information is gathered regarding the effectiveness of both strategies.

**Table ES-4. The number of hatchery juveniles released by species upstream and downstream of Merwin Dam (initial planning targets).**

| Smolt Production | Spring Chinook | Steelhead | Coho | Total |
|---|---|---|---|---|
| Downstream | 1.25 million | 275,000 | 1.8 million | 3.275 million |
| Upstream | 100,000 | 50,000* | | 150,000 |
| **Total** | **1.35 million** | **325,000** | **1.8 million** | **3.425 million** |

* The 50,000 late winter steelhead juveniles would be of wild origin and initially released below Merwin Dam. The summer or winter steelhead production may need to be decreased by 50,000 smolts if hatchery facilities could not support the additional production.

For spring Chinook and Type S coho, existing hatchery broodstock will be used to produce juveniles needed for the supplementation program. For steelhead, wild late winter run fish collected at the Merwin Dam adult trapping facility or in lower river tributaries will provide the broodstock needed for the supplementation effort.

Initially, juveniles will be released at the sizes shown in Table ES-5. These sizes were selected because they are typical of wild smolts observed in other basins. Releasing fish at sizes and times that are more representative of wild populations is consistent with HSRG recommendations for hatchery programs attempting to reduce negative interactions with native fish populations as well as restoring natural production.

**Table ES-5. Release size (fish/per/pound) of juvenile spring Chinook, coho, and steelhead released both upstream and downstream of Merwin Dam.**

| Smolt Production | Spring Chinook | Steelhead | Coho |
|---|---|---|---|
| Upstream | 10-12 | No Releases | No Releases |
| Downstream | 10-12 | 5-8 | 14-16 |

Hatchery juveniles release size and timing may be altered once wild fish are captured at the Swift Dam juvenile collection facility starting in year 4.5 of the license. These wild fish would be used as the template for defining “a high quality smolt” for the basin.

## SUPPLEMENTATION PROGRAM

The H&S Plan provides an approach to reintroduce spring Chinook, steelhead, and Type S coho into stream reaches upstream of Merwin Dam. Both adult and juvenile supplementation strategies will be used as the tools to jump start fish production in the Upper Lewis River. The source of the supplementation fish will either be from the Lewis

River hatchery complex (spring Chinook and Type S coho) or native fish from the lower Lewis River basin (late winter steelhead).

For spring Chinook and Type S coho, adult fish in excess of hatchery broodstock needs will be transported and released in river reaches upstream of Swift Dam as part of the Upper Lewis River adult supplementation strategy. In addition, 100,000 juvenile spring Chinook will be transported to acclimation ponds in the upper basin as part of a juvenile supplementation effort. The 100,000 juvenile spring Chinook were selected based on the assumed rearing capacity of the two acclimation facilities to be built upstream of Swift No. 1 Dam. A Type S coho juvenile supplementation program is not proposed as data collected in both the Lewis River and Cowlitz River indicate that an adult supplementation program would be more successful at restoring coho production.

The number of juveniles released upstream of Swift No.1 Dam has been set conservatively until such time as more is known about the collection efficiency of the Swift Dam juvenile collection system.

Up to 50 wild late winter steelhead adults would be collected each year at Merwin Dam (or in tributaries of the North Fork Lewis River), live-spawned, and the juveniles (50,000) reared to 1+ smolts. These smolts would be uniquely marked, and released below Merwin Dam. Upon their return as adults, they would be transported and released above Swift Dam, thus constituting the adult supplementation program. In essence, the late winter steelhead hatchery program would be run as an Integrated type as defined by the HSRG. This new steelhead program would begin in year 1 of the reintroduction effort.

As spring Chinook, Type S coho, and steelhead populations become established in the upper basin, hatchery releases into this area would be reduced. This action would ensure that local adaptation for each species is driven by the natural not the hatchery environment. However, this action would not be considered for implementation until at least year 9 for Type S coho, and year 15 for spring Chinook and late winter steelhead.

All hatchery fish will be mass-marked to provide fishing opportunities while limiting exploitation rates on natural stocks. Spring Chinook juveniles used for supplementation would be uniquely marked to be distinguishable from those of the lower river spring Chinook hatchery harvest program. In addition, the marking of the supplementation smolts will allow researchers to estimate their survival to collection facilities, and distinguish them from naturally produced spring Chinook smolts originating from the Upper Lewis River basin.

## ARTIFICIAL PRODUCTION MANAGEMENT

The long-term objective (>15 years) for spring Chinook and coho (Type S) hatchery programs will be to operate these as an Integrated type as defined by the HSRG. The ratio of wild and hatchery origin fish used as broodstock, and released into the upper basin, would be tightly controlled. The primary goal of an Integrated hatchery program is to ensure that the natural environment and not the hatchery environment drive local adaptation.

Over the short-term (9 to 15-years) the existing spring Chinook and coho (Type S) hatchery programs would be run as Segregated programs. In other words, no wild fish would be used as hatchery broodstock. This approach results from the lack of local stocks adapted to stream conditions in the Upper Lewis River from which to integrate the existing program. After 3-5 generations of wild production, it is suggested that the hatchery programs be converted to Integrated consistent with HSRG guidelines.

The Type N coho program would continue to be run as a Segregated program at least until NOAA Fisheries completes their coho Biological Opinion (BiOp) for the Lower Columbia River. Future changes to both the Type S and Type N coho programs would be based on BiOp recommendations.

The late winter steelhead hatchery program would be operated as an Integrated type from the start. Wild late winter steelhead from the lower Lewis River would be used as the broodstock source.

All native spring Chinook, coho and steelhead stocks produced at the Lewis River Hatchery Complex would eventually be reared to produce high quality smolts. A quality hatchery smolt is defined as a fish that is similar in health status, physiology, morphology, and behavior to a naturally produced smolt originating upstream of Merwin Dam.

Non-native fish stocks (summer and winter steelhead) would be reared to produce a smolt that migrates rapidly from the basin and maximizes adult production and contribution to fisheries. This will be achieved by implementing volitional release strategies to the extent possible given the limitation of hatchery facilities, and releasing fish at sizes that result in high survival or reduced effects on native salmonids. If volitional release is determined infeasible, then gill ATPase and smolt condition data would be collected on a weekly basis in the spring to determine when smoltification has occurred, thus defining release time.

Hatchery Facilities

Hatchery rearing conditions will be modified through hatchery upgrades defined in Section and Schedule 8.7 of the Settlement Agreement. These upgrades will improve operational flexibility. Hatchery programming will be based on providing optimum rearing conditions for stocks regardless of current or historical rearing and release sites. Use of pond loading and agreed upon density and flow index guidelines, mating protocols that maximize genetic variability, and modification of hatchery structures to allow volitional migration to the extent possible will enable hatchery populations to develop the physiological, morphological, and behavioral traits important to long-term fitness. Hatchery production levels or rearing strategies will not exceed the current hatchery capacity limit to be defined as part of the hatchery remodel process.

Fish Marking

All hatchery spring Chinook, coho, winter and summer steelhead released below Merwin Dam will be marked by removing their adipose fin. The one exception being that the double-index group used for fish management would still possess this fin[1]. Juvenile fish captured at collection facilities at Swift No. 1 Dam (and eventually other projects) would be marked with a Coded-Wire-Tag (or other tag type) located in the cheek, nose or any other location recommended by the resource agencies. This would allow fish to be distinguished as to their collection location; Swift No. 1 Dam and Yale Dam. Note that when Merwin fish passage facilities are constructed, naturally produced fish would no longer need to be marked, as fish will be able to return to their natal stream by using passage facilities at each project.

Juvenile wild late winter steelhead released in the Lower Lewis River below Merwin Dam would be uniquely marked so they could be identified upon their return to the basin as adults. These fish would retain their adipose fin so that fishers would release them if captured in freshwater fisheries.

Harvest

Because harvest management is the responsibility of the resource agencies, the H&S Plan can only make recommendations as to best harvest policy for the basin. These recommendations include:

1. Anglers should be required to release any fish caught that possessed an intact adipose fin.

2. No targeted harvest would be allowed on spring Chinook, coho or steelhead released into the upper basin (above Merwin Dam) unless it can be assured that escapement goals are met for that species, and potential harvest (bycatch) impacts to resident bull trout populations are effectively managed. The H&S plan proposes the following minimum adult escapement goals for the Upper Lewis River basin:

    a. Spring Chinook - 2,000 (plus 65 for supplementation)

    b. Type S-Coho - 9,000

    c. Wild Winter Steelhead – 500

Monitoring and Evaluation

The H&S Plan calls for collecting the following information:

- Adult run-timing (life-history diversity)
- Adult and juvenile age structure (life-history diversity)

[1] As wild fish runs are established in the upper Lewis the need for a double-index group should diminish.

- Mark recovery (CWT, fin-clips etc.)
- Fecundity
- Adult transport survival
- Pre-spawning mortality (habitat quality, impacts of transportation)
- Adult distribution (including stray rate and location)
- Egg-to-smolt survival rates (habitat quality)
- Number of juveniles produced and collected at each passage facility (system capacity)
- Juvenile recruits per adult spawner (measures freshwater productivity)
- # of juveniles by species entering reservoirs.
- Fish passage survival rates by life-stage and facility (including reservoirs)
- Juvenile transport survival
- Juvenile migration timing
- Adult recruits per spawner (life-cycle productivity)
- Disease or general health information for both wild and hatchery populations
- Document ocean recruits for both wild and hatchery populations
- Impacts of resident trout stocking program on anadromous fish
- Stream habitat data both upstream and below Merwin Dam (mainstem Lewis River only).
- Smoltification data on any hatchery juveniles not allowed to migrate volitionally from rearing ponds or raceways.

Plan Updates

The H&S Plan would be updated every 5-years as called for in the Settlement Agreement. At each 5-year interval, an independent consultant would be hired to review the program and make recommendations to the ACC regarding possible changes.

## ADAPTIVE MANAGEMENT

The Adaptive Management Plan (AMP) presented in the H&S plan describes some of the key decision points, needed studies, and suggests possible directions the ACC may take in adjusting the fisheries program over time as new data become available. The AMP is

focused around identifying actions that would best meet the goals and objectives of the Settlement Agreement.

## EXPECTED OUTCOMES

The All-H Analyzer (AHA) model used in the development of the H&S Plan uses current habitat productivity/capacity, anticipated harvest rates, and proposed hatchery operations and supplementation strategies to estimate the average number of adult salmon and steelhead caught in fisheries, and returning to the spawning grounds or the hatchery complex (HSRG 2004). Table ES-6 summarizes the expected outcomes of each proposed program expressed as average annual adult ocean recruits (Catch + Escapement Methodology). The proposed resident rainbow trout and kokanee programs are expected to maintain the existing recreational fisheries in Swift Reservoir and Lake Merwin;

**Table ES-6. Expected outcomes of the Lewis Rive H&S Plan for all species of interest.**

| Program/Phase | Average Adult Ocean Recruits |
|---|---|
| **Spring Chinook** | |
| Supplementation Year | ~1,500 |
| Segregated Harvest Program | ~7,600 |
| Total | ~9,100 |
| | |
| **Coho** | |
| Type-S Supplementation Year | ~6,900 |
| Type-S Segregated Harvest Program | ~19,700 |
| Type-N Segregated Harvest Program | ~21,000 |
| Total | ~47,600 |
| | |
| **Steelhead** | |
| Late-winter Supplementation | ~1,400 |
| Winter Segregated Harvest Program | ~1,800 |
| Summer Segregated Harvest Program | ~4,000 |
| Total | ~7,200 |

however, the potential adverse effects of these programs on reintroduced salmon and steelhead are unknown. A monitoring program is proposed to investigate impacts of the rainbow trout program on juvenile anadromous fish. In addition, limited monitoring of anadromous fish impacts on resident bull trout populations is also proposed

The adult numbers presented in Table ES-6 were calculated based on the average smolt-to-adult survival rates presented in the Lewis River Fish Planning Document, EDT analysis, and those provided by WDFW as part of comments to the Draft H&S Plan. It is anticipated that due to both freshwater and ocean variability, adult production would vary upwards of 1,000 percent for some brood years. Adult production numbers would increase if the methodology used to calculate the Ocean recruits value for each species were based on Adult Equivalents, as recommended in this report (See section 4.2).

Finally, it should be noted that the data in Table ES-6 does not include fish production from Yale or Merwin. These programs will begin in years 8-12 from license issuance.

**Inconsistencies with Settlement Agreement**

The H&S Plan was structured to be consistent with the Settlement Agreement. However, although some actions and analyses proposed in the H&S Plan meet the intent of the Settlement Agreement, they may be considered inconsistent based on Settlement Agreement language. Examples include:

Definition of Ocean Recruits (Section 8.1 of Settlement Agreement): In the Settlement Agreement jacks should be accounted for in calculating ocean recruits. However, after discussion with members of the ACC, a decision was made to not include this life stage in either defining or calculating ocean recruits for each species in the H&S plan.

Juvenile Supplementation (Section 8.5 of Settlement Agreement): In the Settlement Agreement juvenile supplementation above Swift is an action for spring Chinook, steelhead, and coho. However within the H&S Plan, active juvenile supplementation is only proposed for spring Chinook and late winter steelhead. Coho supplementation will rely on surplus adults from the hatchery. Data collected on both the Lewis River and Cowlitz River show that adult coho releases produce a large number of juvenile offspring. Initial steelhead juvenile supplementation will not occur above Swift, but from Merwin hatchery below Merwin Dam. The steelhead program will use wild adults from the lower river as the broodstock. As offspring of these wild fish return to Merwin as adults, they will be transported upstream and released.

Timing of H&S Plan Implementation – ADD from SA 8.4.

Kim add the schedule from the white board here

# 1.0 INTRODUCTION

The Settlement Agreement for the Lewis River Hydroelectric Projects dated November 30, 2004 (Settlement Agreement) includes a comprehensive suite of salmon and steelhead protection, mitigation, and enhancement measures that PacifiCorp Energy and Cowlitz PUD have agreed to implement over the terms of the new project licenses (PacifiCorp and Cowlitz PUD 2004a). A central, significant feature of this agreement involves the reintroduction of spring Chinook (*Oncorhynchus tshawytscha*), winter steelhead (*O. mykiss*), and coho (*O. kisutch*) into their historical range above Merwin Dam by means of hatchery supplementation[2] and newly constructed fish passage facilities.

The salmon and steelhead supplementation program will follow a phased approach, where Spring Chinook, winter steelhead, and coho will first be reintroduced into habitat above Swift Dam (within 6 months of the 3rd anniversary of Merwin license issuance), and then introduced into the habitat located between Merwin and Swift dams (following the 13th and 17th anniversaries of the new licenses), unless otherwise directed by the U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) (Figure 1-1 and Figure 1-2).

To address hatchery operations and supplementation during the terms of the new licenses, Section 8 of the Settlement Agreement provides for a Hatchery and Supplementation Program. The primary goal of the Hatchery and Supplementation Program (Figure 1-3) is to use the existing Lewis River Hatchery Complex to support:

- Self-sustaining, naturally producing, harvestable native anadromous salmonid species throughout their historical range in the North Fork Lewis River basin, and
- The continued harvest of resident and native anadromous fish species.

To ensure the Hatchery and Supplementation Program is meeting its goals, PacifiCorp Energy and Cowlitz PUD are developing and will implement a Hatchery and Supplementation Plan (H&S Plan) to adaptively manage the program and guide its implementation. Specifically, the H&S Plan is designed to:

- Address the means by which PacifiCorp Energy and Cowlitz PUD will use the existing hatchery facilities to accomplish the goals and requirements of the Hatchery and Supplementation Program, including, without limitation, the ocean recruit targets identified in Table 1-1[3].

[2] Supplementation is defined as the use of artificial propagation to maintain or increase natural production while maintaining the long-term fitness of the target population, and keeping the ecological and genetic impacts to non-target populations within specified biological limits.
[3] Ocean recruits are defined as the total escapement (fish that naturally spawned above Merwin and hatchery fish) plus harvest (including ocean, Columbia River, and Lewis River harvest).

**Table 1-1. Hatchery and natural production adult threshold levels (adult ocean recruits) for spring Chinook, steelhead and coho.**

| | Spring Chinook | Steelhead | Coho | Total |
|---|---|---|---|---|
| Hatchery | 12,800 | 13,200 | 60,000 | 86,000 |
| Natural Production Threshold | 2,977 | 3,070 | 13,953 | 20,000 |
| **Grand Total** | **15,777** | **16,270** | **73,953** | **106,000** |

- Determine the methods to document the number of ocean recruits and to separately identify hatchery ocean recruits and ocean recruits from the natural spawning population, and identify the appropriate assessment time frame over which to measure hatchery adult ocean recruits and natural adult ocean recruits.

According to Section 8.3 of the Settlement Agreement, when the number of natural returning ocean recruits of any species exceeds the relevant natural production threshold for that species (see Table 1-1), PacifiCorp Energy and Cowlitz PUD would decrease the hatchery production targets on a one natural fish for one hatchery fish (1:1) basis. For example, when natural spring Chinook adult returns equal 3,977 fish (1,000 fish over threshold), the hatchery production target for this same species would be reduced by 1,000 adults to 11,800. The decision to adjust hatchery production would be considered by the ACC every 5-years based on the results of the ocean recruits analysis. However, the ACC does have the option of evaluating hatchery production each year with the submittal of the Annual Operating Report.

If hatchery production is reduced, it is anticipated that any adverse hatchery effects on natural stocks will decrease, thereby benefiting natural populations. PacifiCorp Energy and Cowlitz PUD would not decrease the hatchery targets below the hatchery target floor specified in Table 1-2.

**Table 1-2. Hatchery target floors identified in the Settlement Agreement.**

| | Spring Chinook | Steelhead | Coho | Total |
|---|---|---|---|---|
| Hatchery Target Floor | 2,679 | 2,763 | 12,558 | 18,000 |

The total number of hatchery juveniles that may be produced each year under the H&S Plan is shown in Table 1-3. Although, these numbers could be reduced if natural production exceeds threshold levels[4].

**Table 1-3. Hatchery juvenile production targets for spring Chinook, steelhead and coho.**

| Smolt Production | Spring Chinook | Steelhead[4] | Coho | Total |
|---|---|---|---|---|
| Years 1-3 | 1.35 million | 275,000 | 1.8 million | 3.425 million |
| Years 4-5 | 1.35 million | 275,000 | 1.9 million | 3.525 million |
| Years 6-50 | 1.35 million | 275,000 | 2.0 million | 3.625 million |

[4] The H&S Plan calls for adding 50,000 late winter steelhead juveniles to start the reintroduction effort.

## Settlement Agreement Measures Associated with Reintroduction Upstream of Swift No.1 Dam

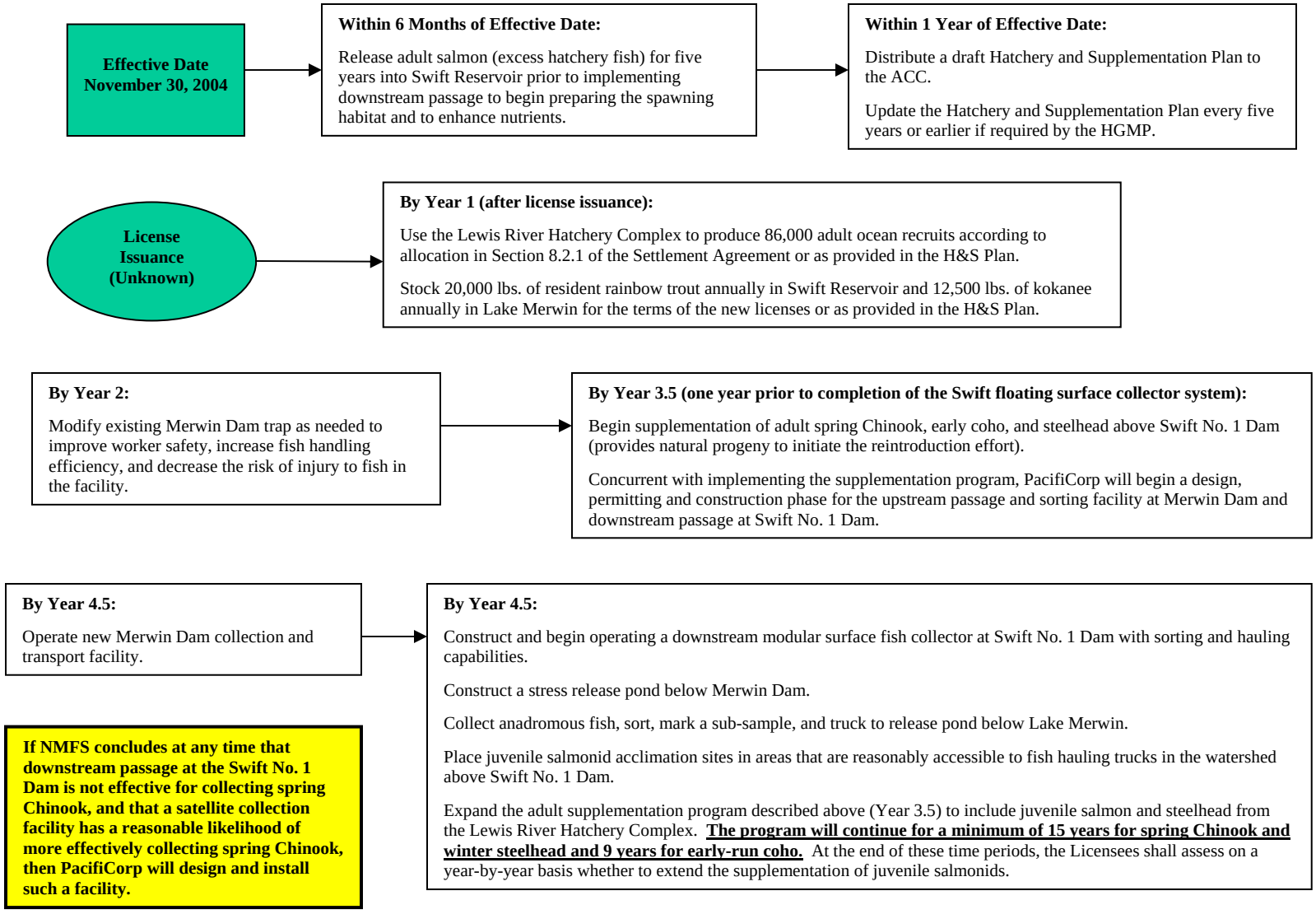


**Figure 1-1. Settlement Agreement flow chart for anadromous fish reintroduction upstream of Swift No. 1 Dam.**

# Settlement Agreement Measures Associated with Reintroduction Upstream of Yale and Merwin Dams

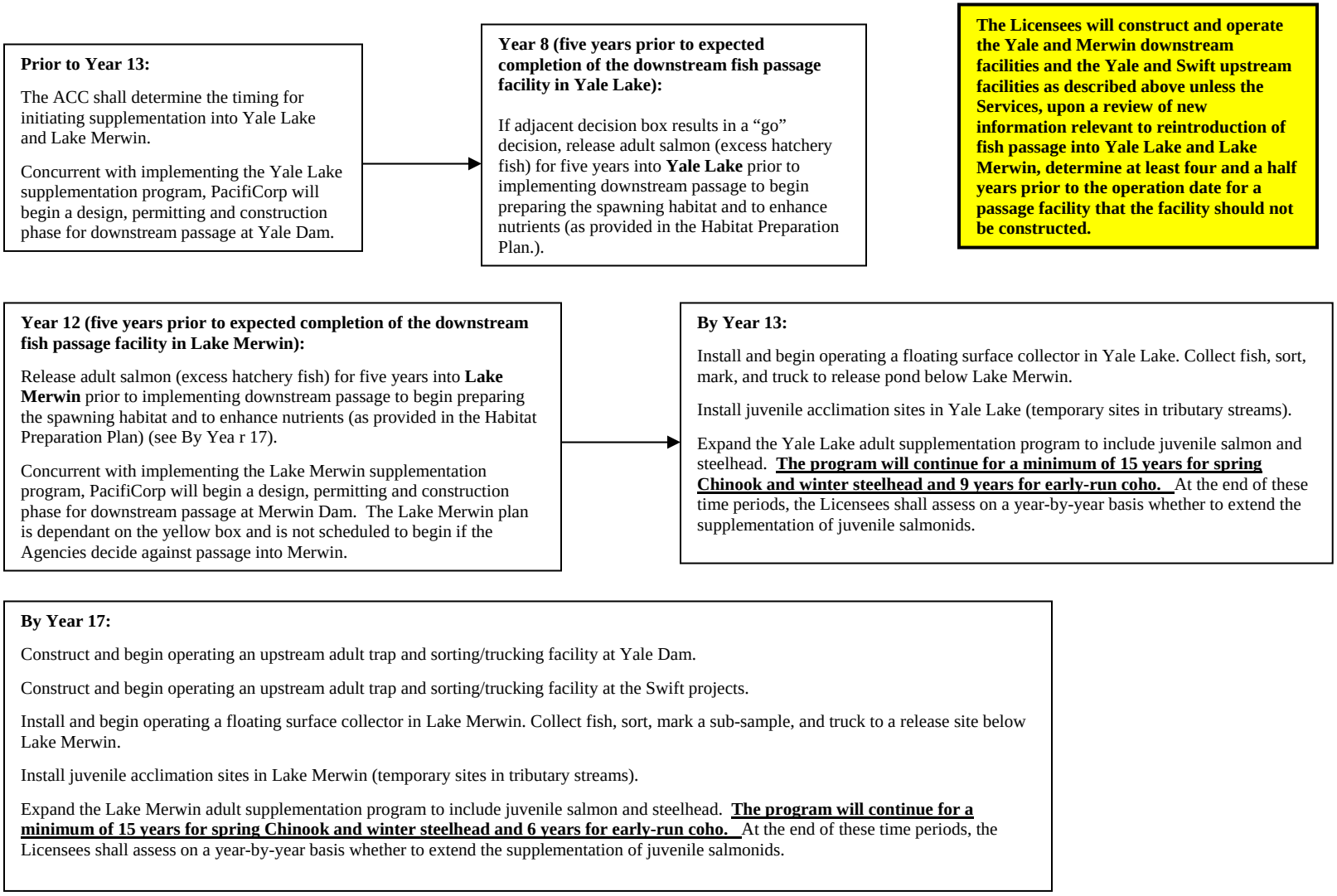


**Figure 1-2. Settlement Agreement flow chart for anadromous fish reintroduction above Yale and Merwin dams.**

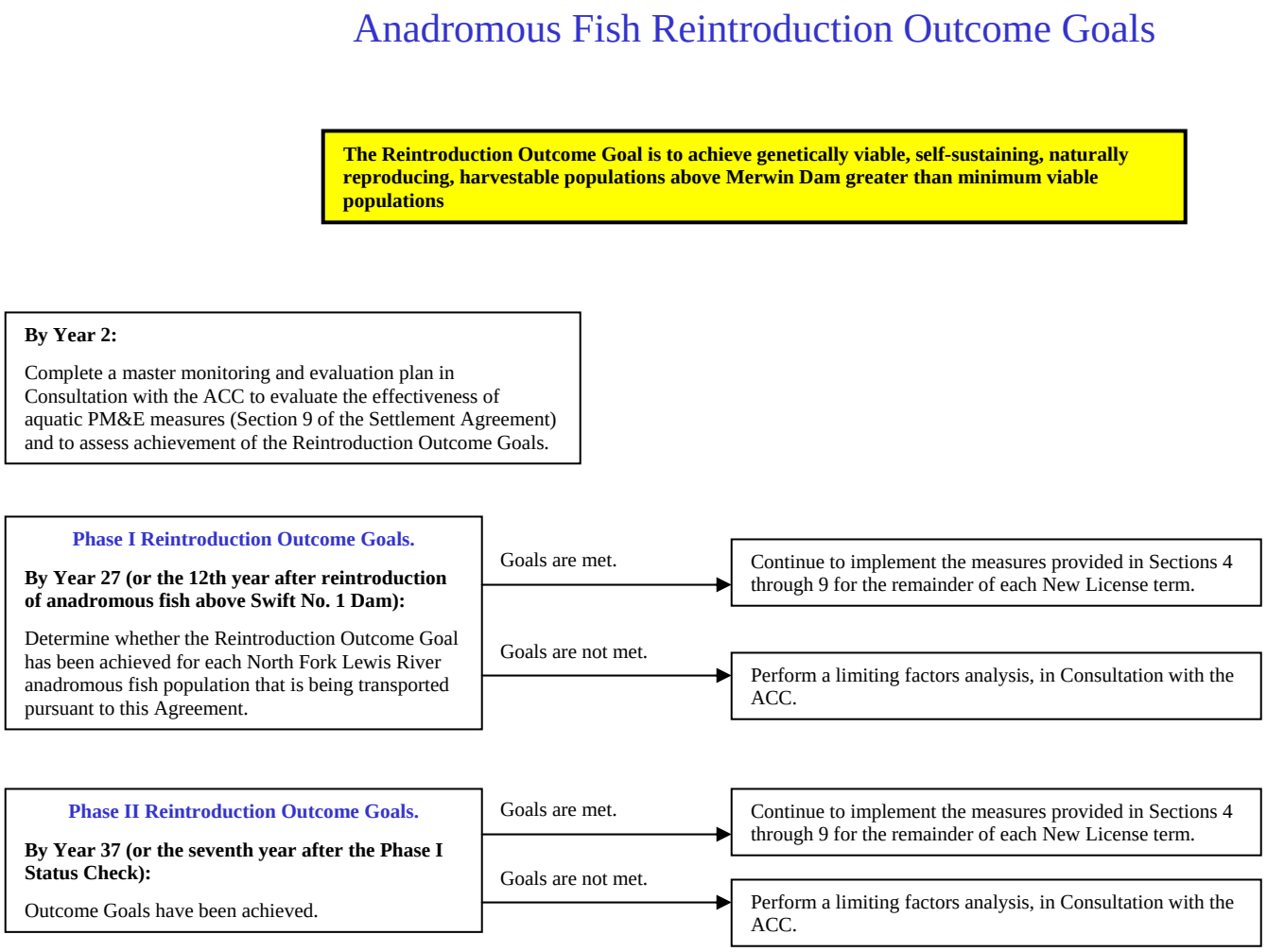


**Figure 1-3. Settlement Agreement anadromous fish reintroduction outcome goals.**

In addition to the above anadromous species, the Settlement Agreement calls for continued production and stocking of rainbow trout in Swift Reservoir, and resident kokanee in Lake Merwin. These fish will provide recreational opportunities for anglers and economic opportunities for local businesses.

This draft H&S Plan consists of six sections designed to address the requirements outlined in Section 8.2.2 of the Settlement Agreement. These include:

- Hatchery Programs and Operations
- Supplementation Program
- Monitoring and Evaluation (M&E)
- Adaptive Management
- Expected Outcomes
- Annual Operating Plan

It was developed using the concepts found in the following analyses and documents:

- Hatchery Reform: Principles and Recommendations of the Hatchery Scientific Review Group (HSRG 2004).
- Northwest Power and Conservation Council- Artificial Production Review and Evaluation Process (APRE) (http://www.apre.info/APRE/home.jsp)
- Monitoring and Evaluation of Supplementation Projects (ISAB 2005)
- Lewis River Fish Planning Document (Cramer and Associates 2004)

Lessons learned from the Yakima River and Cowlitz River supplementation and reintroduction programs were also used to help select effective approaches for the Lewis River.

Although the outcome goal of the Lewis River Hatchery and Supplementation Program has been defined in the Settlement Agreement (Figure 1-3), the metrics used to evaluate program success have yet to be developed. The identification of these metrics is the responsibility of NMFS and the USFWS. These two agencies (referred to as the "Services") will make this decision after consulting with the ACC, and taking into consideration the variability of the factors that may influence program success (i.e. ocean survival, fish passage success, freshwater variability etc.). According to the Settlement Agreement the Services decision process needs to be defined prior to the later of: (a) the 27th anniversary of the Issuance of the new license, or (b) the 12$^{th}$ year after reintroduction of anadromous fish above Swift No. 1 Dam.

Again, because the decision criteria are not yet available, the H&S Plan is designed to collect those types of data that may be used by the Services and ACC to determine program success. These data include:

- Ocean Recruits
- Smolt-to-adult survival rates (SAR)
- Juvenile-recruits-per-spawner (JRS)
- Adult-recruits-per spawner (ARS)
- Total juveniles entering reservoirs and collected at bypass facilities
- Adult returns to the spawning grounds

More detailed information on each of these factors can be found in the Monitoring and Evaluation (M&E) plan. A detailed description of existing hatchery facilities and operations in the Lewis River basin is presented in Appendix A of this report, and a complete copy of Section 8 of the Settlement Agreement is included in Appendix B.

Finally, the report presented below focuses on the methods and actions needed to reintroduce fish into stream reaches above Swift No.1 Dam, as the reintroduction of fish to Merwin and Yale does not begin until year 8 of the new license. A more detailed plan for Merwin and Yale will be developed as part of the H&S Plan update required in year 5. This approach will allow for the incorporation of new information regarding the success of the Swift adult and juvenile supplementation programs, fish passage collection efficiency, trap-and-haul mortality and harvest rates observed on wild populations.

# 2.0 HATCHERY PROGRAMS AND OPERATIONS

Hatchery programs and operations are discussed below under two headings, 1) Anadromous Fish, and 2) Resident Fish. Hatchery programs proposed for spring Chinook, coho, summer steelhead, winter steelhead and late winter steelhead are discussed in the Anadromous Fish section. The existing rainbow trout and kokanee hatchery programs are presented under Resident Fish.

## 2.1 ANADROMOUS FISH

### 2.1.1 Programs

The anadromous fish hatchery programs proposed were developed based on the recommendations put forth by two hatchery review processes:

- Northwest Power and Conservation Council- Artificial Production Review and Evaluation Process (APRE) (http://www.apre.info/APRE/home.jsp)

- Hatchery Reform: Principles and Recommendations of the Hatchery Scientific Review Group (HSRG 2004).

The APRE identified hatchery-operating procedures that maximize the benefits of artificial production while minimizing the risks to wild fish populations. The APRE was built upon the scientific principles and criteria put forth by the HSRG. The HSRG identified two primary purposes (or potential benefits) of artificial production, 1) help conserve naturally spawning populations, and 2) provide fish for harvest. To this end, the hatchery criteria put forth by the HSRG vary dependent on whether the hatchery is to operate as an Integrated or Segregated type program. The definitions for both types of programs are as follows:

- Segregated: A hatchery program is considered Segregated if the manager's intent is for the population to represent a distinct population that is reproductively isolated from naturally spawning populations. The principle intent of a Segregated program is to create a hatchery adapted population that can be used to meet harvest goals. Hatchery broodstock (and programs) are considered genetically segregated if the broodstock is maintained only with hatchery origin (HOR) adults. Therefore, gene flow from the natural origin population (NOR) to the hatchery broodstock is actively managed against in a Segregated program. In addition, hatchery origin adults are prevented from spawning in the wild to prevent gene flow from the less well-adapted hatchery population to the native or wild population.

- Integrated: A hatchery program is classified as Integrated if the manager's intent is for the natural environment to drive the adaptation and fitness of a composite population of fish that spawns both in the hatchery and the wild (i.e. natural environment). In an Integrated program, the proportion of natural origin broodstock in the hatchery and the proportion of hatchery fish on the spawning grounds determine the influence the hatchery and natural environments have on the composite population. The larger the ratio of wild fish to hatchery fish in either environment, the greater the influence wild fish genetics and adaptation will have on overall population genetics. The greater the difference

between the hatchery and natural stock components (e.g. run-timing), and the less natural the hatchery environment, the larger the ratio must be to reduce the effects of hatchery selection.

This H&S Plan calls for the development (over time) of up to eight hatchery programs (Table 2-1). The primary purpose of each program is to provide either fish for harvest (Segregated-Harvest), or to reintroduce anadromous fish to the upper river (Integrated-Conservation/Restoration).

**Table 2-1. Hatchery program types by species for the H&S Plan.**

| Program | Program Type | Primary Program Purpose |
|---|---|---|
| Lower River Spring Chinook | Segregated | Harvest |
| Lower River Type N Coho | Segregated | Harvest |
| Lower River Type S Coho | Segregated | Harvest |
| Lower River Summer Steelhead | Segregated | Harvest |
| Lower River Winter Steelhead | Segregated | Harvest |
| Upper River Spring Chinook | Integrated (long-term goal) | Conservation/Restoration |
| Upper River Type S Coho | Integrated (long-term goal) | Conservation/Restoration |
| Upper River Late Winter Steelhead | Integrated (long-term goal) | Conservation/Restoration |

The HSRG definitions fit well for those basins that have both wild and natural populations of the same species. The nomenclature doesn't fit as cleanly in the Lewis River because the wild fish populations in the Upper Lewis River basin have been extirpated. The exception is for the late winter steelhead program, which would have both a hatchery and wild fish stock component as wild steelhead are still found in the lower river.

The H&S Plan proposes to continue to operate most lower river hatchery programs as Segregated type, based on two assumptions:

1) The existing hatchery programs have had no systematic gene flow from the natural populations.

2) Natural spawning population genetics and fitness has been compromised by hatchery fish spawning in the wild.

In short, it is assumed that the hatchery environment, not the natural environment, has been driving fish fitness and genetics in the basin since anadromous fish were extirpated from the Upper Lewis River basin.

Comments received from some ACC members on the November 2005 Draft H&S Plan indicated that they would like to see the hatcheries run as Integrated programs as soon as feasible. The H&S Plan proposes to achieve this objective by following the HSRG methodology shown in Table 2-2 (Approach 2 or 3). Given the interactions that have likely occurred between Lewis River hatchery and wild fish in the past, the HSRG recommends that managers allow

**Table 2-2. HSRG guidelines for developing an Integrated hatchery program if natural production (and thus fitness) has been compromised by hatchery releases.**

**Scenario 3: Transition from an incompletely segregated program to an integrated program.** (Most common scenario).
Hatchery broodstock has had no systematic gene flow from the natural population
Natural spawning population has had significant influence from hatchery fish

| **Approach #1 - Not recommended because of low likelihood of attaining stock goals** | **Considerations** |
|---|---|
| • Incorporate a minimum of 10% NORs into hatchery broodstock each year.<br>• Ensure that gene flow from the natural population to the hatchery population is greater than gene flow from the hatchery to the natural population (pNOB > pHOS).<br>• Size program consistent with goals and the ability of the natural population to support hatchery broodstock requirements and gene flow limitations to the natural population.<br>• Restrict natural spawning by HORs. | **Likelihood of achieving natural adaptation:** Lowest likelihood of all options in attaining stock goals in the immediate future since NORs incorporated into hatchery broodstock may themselves have suffered loss of productivity as a result of past hatchery influence. Likelihood of reaching stock goals increases as additional NORs are incorporated into the hatchery population through time or as proportion of NORs in hatchery broodstock is increased.<br>Composite population is likely to have the lowest fitness in the natural environment of all the approaches.<br>**Cost:** Increase in cost incurred for broodstock collection appears similar for all approaches.<br>**Effect on Harvest:** Effect on harvest appears similar under all approaches other than Approach #2 in Scenarios 2 and 3. |

| **Approach #2 - Recommended approach if attaining harvest goal can be interrupted during transition to integrated program.** | **Considerations:** |
|---|---|
| • Take steps to reduce the number of hatchery fish in the natural population to less than five percent of the natural population. (Reduce hatchery program, selective harvest to limit strays, weir, other measures to control straying) .<br>• Allow a minimum of three to four generations to promote adaptation to the natural environment.<br>• Initiate a new hatchery program by collecting representative sample of natural fish.<br>• Collect a number of brood that allows for an effective population size of the composite population (natural plus hatchery) to be in excess of 500 fish.<br>• If a long-term goal of the hatchery program is to provide a conservation benefit, or if the natural spawning of hatchery-origin fish will be difficult to control, then the effective population size of the hatchery component should also be greater than 500 fish.<br>• Incorporate a minimum of 10% NORs into hatchery broodstock each year.<br>• Ensure that gene flow from the natural population to the hatchery population is greater than gene flow from the hatchery to the natural population (pNOB > pHOS).<br>• For stocks of moderate or high biological significance and viability (or goals to maintain or improve the biological significance and viability of the stock) pNOB/(pHOS+pNOB) should be greater than 0.70.<br>• Size program consistent with goals and the ability of the natural population to support hatchery broodstock requirements and gene flow limitations to the natural population.<br>• Terminate segregated harvest program. | **Likelihood of achieving natural adaptation:** Intermediate likelihood of attaining stock goals because of the uncertainly of adaptation to the natural environment after three to four generations. The likelihood of meeting stock goals increases with the amount of time allowed before initiating new program and lower contribution of hatchery fish in the natural population.<br><br>**Cost:** Increase in cost incurred for broodstock collection appears similar for all approaches.<br><br>**Effect on Harvest:** Highest likelihood of loss of contribution to harvest of all the approaches since the segregated program would likely be reduced to allow adaptation of the natural stock and the segregated program would be terminated to initiate a new integrated program. |

| **Scenario 3 (continued): Transition from an incompletely segregated program to an integrated program.** (Most common scenario).<br>Hatchery broodstock has had no systematic gene flow from the natural population<br>Natural spawning population has had significant influence from hatchery fish | |
|---|---|
| **Approach # 2 Plus Differential Marking - Recommended approach if attaining harvest goal cannot be interrupted during transition to integrated program** | **Considerations** |
| • Take steps to reduce the number of hatchery fish in the natural population to less than five percent of the natural population (reduce hatchery program, selectively harvest to limit strays, use a weir or other measures to control straying).<br>• Allow a minimum of three to four generations to promote adaptation to the natural environment.<br>• Initiate a new hatchery program by collecting representative sample of natural fish.<br>• Collect a number of brood that allows for an effective population size of the composite population (natural plus hatchery) in excess of 500 fish.<br>• If a long-term goal of the hatchery program is to provide a conservation benefit, or if the natural spawning of hatchery-origin fish will be difficult to control, then the effective population size of the hatchery component should also be greater than 500 fish.<br>• Differentially mark and release offspring of old/new broodstock. Preferentially use returns that represent the NOS broodstock. Phase out use of old broodstock as new broodstock returns.<br>• Incorporate a minimum of 10% NORs into hatchery broodstock each year once new broodstock returns.<br>• Ensure that gene flow from the natural to the hatchery population is greater than gene flow from the hatchery to the natural population (pNOB > pHOS).<br>• For stocks of moderate or high biological significance and viability (or goals to maintain or improve the biological significance and viability of the stock), pNOB/(pHOS+pNOB) should be greater than 0.70.<br>• Size program consistent with goals and the ability of the natural population to support hatchery broodstock requirements and gene flow limitations to the natural population. | **Likelihood of achieving natural adaptation:** Intermediate likelihood of attaining stock goals because of the uncertainly of adaptation to the natural environment after three to four generations. The likelihood of meeting stock goals increases with the amount of time allowed before initiating a new program and a lower contribution of hatchery fish in the natural population.<br><br>**Cost:** Increase in cost incurred for broodstock collection appears similar for all approaches. An additional cost for differentially marking the two hatchery broodstocks would be incurred. Cost in terms of operational complexity is higher than all other approaches except Approach #4, but should be no greater than rearing an additional species.<br><br>**Effect on Harvest:** Reduces loss of contribution to harvest during transition from the previous approach. |

three to four generations to establish a locally adapted population before integrating the hatchery programs. If reintroduction is successful, then it is likely that sufficient locally adapted spring chinook and Type S coho adults would be available for integration sometime between years 12-17 of the new license[5]. At that time, according to the HSRG guidelines, the ACC would need to chose between two integration approaches (#2 or #3), dependent on whether or not fish harvest goals can be interrupted (Table 2-2).

Given the fish population conditions assumed for the Lewis River, the HSRG does not recommend an approach where existing lower river origin unmarked natural fish are simply brought into the hatchery at a set rate (e.g. 10%). They rated this approach as having the lowest likelihood of achieving stock goals. As the Settlement Agreement requires that the H&S Plan be consistent with HSRG guidelines, the set rate approach for integration is not recommended.

[5] Type N coho will not be released above Merwin Dam. Late winter steelhead will be run as an Integrated program from the start, as wild adults are available for use as broodstock.

### 2.1.2 Hatchery Operations

Hatchery production and facilities will be operated consistent with HSRG and APRE guidelines for Segregated and Integrated programs. The key HSRG guidelines used for each type of program is presented in Table 2-3.

**Table 2-3. HSRG guidelines used for Segregated and Integrated hatchery programs.**

| Segregated (Harvest) | Integrated (Conservation) |
|---|---|
| Maintain an effective population $N_e$ of at least 500 fish. | Use mating protocols that maximize the effective population size ($N_e$) in the hatchery, including factorial mating, maintenance of the individual pedigrees, and cryopreserved gametes when necessary. |
| Avoid the use of broodstock from natural populations or other hatchery populations | Collect and spawn adults randomly with respect to time of return, time of spawning, size and other characteristics related to fitness. |
| Mark or tag all hatchery released fish, so that the proportions of natural and hatchery origin fish among natural spawners and in the broodstock can be monitored and controlled. | Rear in a hatchery environment and with operational protocols that ensure all portions of the population are treated equally and have the same opportunity to contribute to the release population. |
| Produce fish that have the physiological fitness to migrate rapidly to saltwater and to survive in that environment through growth regimes that promote smoltification. | Tag all hatchery-released fish to ensure correct identification for use in future broodstocks or in other monitoring programs. |
| Produce fish that have the morphological characteristics to meet harvest goals. | Use a hatchery environment that allows synchronization of adult maturation, incubation, and emergence, and out-migration with natural populations. |
| Produce fish that have the behavioral characteristics, such as adult run-timing to meet harvest goals. | Rear fish at reduced densities in enriched environments to improve cryptic coloration, territorial fidelity, and social behavior. |
| Avoid crowding and build-up of wastes and dead fish in fish holding units. | Release fish volitionally during the out-migration timing of the natural stock |
| Monitor fish health regularly and implement needed treatment immediately | Use a hatchery environment and operational protocols that maximize the survival of each individual including captive rearing. |
| Use prophylaxis by vaccination where feasible. | Use prophylaxis by vaccination where feasible, monitor the health of stocks regularly, and implement needed treatment immediately. |
| Use adequate diets that have been stored for only short periods. | Use adequate diets that have been stored for only short periods. |
| Use locally adapted stocks that are likely to develop reasonable resistance to pathogens likely to be present in the water supply. | Use locally adapted stocks that are likely to develop reasonable resistance to pathogens likely to be present in the water supply. |
| Avoid practices and situations likely to result in chronic stress (e.g. frequent fish handling etc.) | Avoid practices and situations likely to result in chronic stress (e.g. frequent fish handling etc.) |

A draft review of hatchery operations for the Lewis River have been entered into the APRE database (www.apre.info/APRE/VelocityController?VelocityAction=Login)[6]. Lewis River H&S Programs are identified with an H&S extension (PASSWORD = hatchery). These would be updated once the H&S Plan is approved. It should also be noted, that the APRE website is being upgraded and incorporated into the Co-managers "Manage For Success" (MFS) website over the next 6-months. Thus, these reports may not be available during some time frames.

### 2.1.3 Hatchery Production

The number of hatchery juveniles to be released as part of the harvest and supplementation programs is presented in Table 2-4.

**Table 2-4. Juvenile release numbers by species for the hatcheries and supplementation programs.**

| Smolt Production | Spring Chinook | Summer Steelhead | Winter Steelhead | Wild Late-Winter Steelhead | Type-N Coho | Type-S Coho |
|---|---|---|---|---|---|---|
| Hatchery | 1,250,000 | 175,000 | 100,000 | NA | 900,000 | 900,000 |
| Supplementation | 100,000 | NA | NA | 50,000 | NA | NA |
| **Total** | **1,350,000** | **175,000** | **100,000** | **50,000** | **900,000** | **900,000** |

Based on the conditions spelled out in the Settlement Agreement, hatchery coho production would increase to 1.9 million in years 4-5, and to 2.0 million in year 6 of the H&S Plan. For now it is assumed that the proportion of Type N and Type S coho released from the hatchery would remain constant as survival data presented in the Lewis River Fish Planning Document indicate that survival for both type is nearly equal (Cramer and Associates 2004).

Hatchery juveniles would be released at the following size ranges:

1. Coho- 14-16 fish per pound (fpp)
2. Spring Chinook- 10-12 fpp
3. Winter and Summer Steelhead 5-8 fpp

### 2.1.4 Broodstock Needs and Escapement Targets

The hatchery broodstock and adult escapement targets for the H&S Plan are presented in Table 2-5. The major change from current (2005) hatchery operations is the establishment of adult escapement targets for upper basin spring Chinook (2,065) Type-S coho (9,000) and late winter steelhead (550). These adults are needed for the supplementation program each year. To achieve these adult targets would require that WDFW establish a harvest policy in the Lower Lewis River that increases adult spring Chinook, late winter steelhead and coho returns to adult collection facilities.

**Table 2-5. Hatchery adult broodstock and adult escapement targets for the Lewis River*.**

| Smolt Production | Spring Chinook | Summer Steelhead | Winter Steelhead | Wild Late Winter Steelhead | Type-N Coho | Type-S Coho |
|---|---|---|---|---|---|---|
| Hatchery | 800 | 160 | 90 | NA | 800 | 800 |
| Supplementation | 2,065 | NA | | 500 | NA | 9,000 |
| **Total** | **2,800** | **160** | **50** | **500** | **800** | **9,800** |

*-Broodstock needed for the hatchery are approximate. These would be adjusted based on adult-to-smolt survival values achieved at the updated hatchery facilities.

Because harvest management is the responsibility of the resource agencies the H&S Plan can only make recommendations as to best harvest practices for the basin. These recommendations include:

1. Anglers should be required to release any fish caught that possessed an intact adipose fin (including fish that have an Adipose and RV or LV clip)

2. No directed harvest would be allowed on spring Chinook, coho or late winter steelhead unless it was certain that the escapement goals would be achieved for that species.

### 2.1.5 Hatchery Production Adjustment

The combined actions proposed in the H&S Plan are designed to achieve the hatchery and natural production targets shown in Table 2-6. The values in the table are referred to as adult Ocean Recruits, which include escapement plus the number of fish caught or available in ocean and freshwater fisheries. The methodologies that can be used for estimating Ocean Recruits are presented in the M&E section of this report.

**Table 2-6. Hatchery and natural production adult threshold levels (ocean recruits) for spring Chinook, steelhead and coho.**

| | Spring Chinook | Steelhead (Summer, Winter, Late Winter) | Coho (Type S and Type N) | Total |
|---|---|---|---|---|
| Hatchery | 12,800 | 13,200 | 60,000 | 86,000 |
| Natural Production Threshold | 2,977 | 3,070 | 13,953 | 20,000 |
| **Grand Total** | **15,777** | **16,270** | **73,953** | **106,000** |

As natural production upstream of Merwin Dam for each species exceeds its threshold level, hatchery production levels for that species would be reduced on a 1:1 basis. For example, when natural spring Chinook adult returns equal 3,977 fish (1,000 fish over threshold value of 2,977), the hatchery production target for this same species would be reduced by 1,000 adults to 11,800 (12,800-1,000 = 11,800). This would be accomplished by reducing the number of juveniles released from the hatchery each year for that species based on the average survival rate calculated over a 5-year period. The decision to adjust hatchery production to achieve threshold levels would be considered by the ACC every 5-years based

on the results of the Ocean Recruits analysis (See M&E)[7]. Note that hatchery targets may be increased back to initial levels if natural production were to decrease to below the threshold level.

However, as called for in the Settlement Agreement, hatchery production targets would not be reduced below the "Hatchery Target Floor" (HTF) levels shown in Table 2-7. In other words, no matter how many anadromous fish are produced above Merwin Dam, Lewis River hatcheries would continue to release sufficient juveniles to achieve the HTF.

**Table 2-7. Hatchery target floor levels for adult spring Chinook, steelhead and coho.**

| | Spring Chinook | Steelhead | Coho | Total |
|---|---|---|---|---|
| Hatchery Target Floor | 2,679 | 2,763 | 12,558 | 18,000 |

## 2.2 RESIDENT FISH

### 2.2.1 Kokanee

No changes are proposed for the existing kokanee program as the continued release of this species poses little risk to the success of the reintroduction effort being undertaken above Swift.

However, as anadromous fish are reintroduced into Merwin starting in year 12 of the license, the ACC should review the program and determine if it should be continued[8]. The decision to maintain the program would need to consider the importance of Lake Merwin as a rearing area for coho juveniles and management implications and cost of possibly handling large numbers of kokanee juveniles at the proposed Merwin juvenile collection facility. Ideally, all juveniles collected at the Merwin facility would be bypassed directly to the lower river with a minimum of handling. Unless managers allow kokanee to be released below Merwin Dam, then these fish would have to be sorted and released upstream of the dam.

### 2.2.2 Resident Trout

The 2006 resident trout program calls for the release of approximately 60,000 catchable rainbow trout (3 fpp) into Swift Reservoir. These fish provide sport-fishing opportunities for both local residents and visitors to the area.

The H&S Plan proposes that the rainbow trout program continue so long as the number of these fish entering juvenile collection facilities is manageable (i.e. they can be easily sorted without anesthetization and returned upstream). Data collected on a similar program at Mayfield Reservoir on the Cowlitz River show that rainbow trout released for similar purposes are captured in large numbers (3,000 to 7,000) at the Mayfield juvenile collection facility (Mark LaRiviere, Tacoma Power, pers. comm. 2005). The disposition of any stocked rainbow trout collected at Swift will need to be incorporated into the facility operation plan.

[7] The 5-year period was selected, as it is consistent with the independent review process established in the Settlement Agreement. The ACC will have the opportunity to evaluate hatchery production every year as part of their review of the Annual Hatchery operations plan.
[8] In year 12, anadromous fish may be released into Merwin, if agreed to by the ACC.

The Settlement Agreement also calls for the release of anadromous adults above Swift for five years prior to the implementation of downstream fish passage facilities. Off-spring of the adult plants are likely to residualize in large numbers is Swift Reservoir. These juveniles could exceed the carrying capacity of Swift Reservoir thereby depressing growth and survival of native fish communities. The M&E plan (see below) calls for the resident rainbow hatchery stocking program to be evaluated in terms of effects on reintroduced anadromous salmonids and the interaction between anadromous salmonids and resident fish species[9].

[9] Studies would be undertaken during this time frame as it is assumed that effects if any, would be the maximum likely to be observed, as juvenile fish cannot readily migrate from the system.

# 3.0 SUPPLEMENTATION PROGRAM

Supplementation was defined by the Regional Assessment of Supplementation Project (RASP 1992) as follows:

"Supplementation is the use of artificial propagation in an attempt to maintain or increase natural production, while maintaining the long-term fitness of the target population and keeping the ecological and genetic impacts on non-target populations within specified biological constraints."

Because anadromous fish have been extirpated from the Upper Lewis River basin, the supplementation program proposed is designed to re-establish self-sustaining populations of Type S coho, spring Chinook and late winter steelhead upstream of Merwin Dam.

Both adult and juvenile supplementation strategies would be employed to reintroduce spring Chinook to the Upper Lewis River basin. Juvenile spring Chinook (100,000) would be transported to acclimation facilities in the upper basin in February and then allowed to migrate volitionally from these facilities. Surplus hatchery adult spring Chinook would be released yearly upstream of Swift No.1 dam and released.

Adult supplementation would be emphasized for late winter steelhead and coho, as results of studies conducted on the Cowlitz River show good success with this type of an approach.

However, it should be noted that for steelhead, wild adults from the Lower Lewis River would be taken into the hatchery, spawned and the off-spring reared to, and released as, 1+ smolts below Merwin Dam[10]. Returning adults from these juvenile releases would then be collected at Merwin Dam, transported to the Upper Lewis River and released: thereby initiating the adult supplementation program. Wild adult steelhead collection would continue for 12-years to ensure that sufficient genetic diversity was obtained to prevent founder effects (i.e. starting with too little genetic resources)[11].

A more detailed description of the proposed supplementation program for each of the three species is presented by species below.

## 3.1 SPRING CHINOOK

### 3.1.1 Supplementation Strategy

The reintroduction strategy for spring Chinook will rely on two life stages: smolts and adults. A total of 100,000 smolts and a minimum of 2,000 hatchery adults (when available) will be released above Swift Reservoir to rebuild a natural spawning population[12]. The 2,000 adult minimum escapement target was selected based on EDT estimates of spawning capacity for

[10] The H&S plan considered rearing 2+ smolts for the late winter steelhead program, but this idea was rejected in favor of the 1+ smolt program. The logic being that the longer hatchery residence time would reduce the fitness of the population by selecting traits for traits that increase survival in the hatchery environment.
[11] Collecting 50 wild adults for 12 years meets/exceeds HSRG criteria for eliminating founder effects.
[12] The 2,000 release target is greater than the 1,200 recommended in the Lewis River Fish Planning Document (Table D-19)

habitat upstream of Swift No. 1 Dam, required passage survival and collection rates, and the average expected level of surplus hatchery adults (~3,200) available after ocean and freshwater fisheries (See Section 6).

The reintroduction strategy will be conducted as a 15-year[13] experiment that will continue throughout this period with no trigger points that would discontinue the program prior to its completion[14].

This supplementation program will initially use hatchery origin adults (HORs) for both the smolt and adult supplementation strategies. As adults return from the supplementation strategy, priority for introduction into the upper watershed will be given to:

1. Fish supplemented as adults. These fish are referred to as natural origin adults (NORs) as they have completed their entire life history in the wild (i.e. gravel-to-gravel).

2. Fish supplemented as juveniles: Fish that spent the majority of their freshwater life-history in a hatchery but were acclimated as smolts in the upper basin prior to release.

3. Hatchery origin adults.

After adults begin returning from the natural or supplemented releases, hatchery origin fish would only be used in the event that the number of fish produced above Swift are insufficient to meet the desired release numbers (See 3.1.5). Again, the H&S Plan calls for the continuation of the adult and juvenile supplementation program for at least 15-years without interruption. Priority for the use of natural-origin returns will be as follows:

1. For use as broodstock for juvenile supplementation program: Up to 65 adults.

2. Use for adult supplementation into the upper watershed: All NOR's above juvenile supplementation needs (65 adults).

At the completion of this initial supplementation period, both smolt and adult supplementation will be discontinued and the population will be monitored to determine if reintroduction goals have been achieved. This action is consistent with the Settlement Agreement that states the primary goal of the program is to establish self-sustaining, naturally producing, harvestable native anadromous salmonid populations. To determine sustainability will require the elimination of the supplementation program at some time in the future. However, any decision to terminate the program would be made in consultation with the ACC.

### 3.1.2 Broodstock Origin

Broodstock for the reintroduction efforts will initially come from returns to the Lewis River hatchery complex. This stock has been chosen since the original wild stock has been extirpated and the existing hatchery population, although originating from multiple out-of-

[13] The Settlement Agreement calls for supplementation to continue for 15-years.
[14] However, the ACC may stop or continue the program based on collected data.

basin stocks, has been self-sustaining in the Lewis River for approximately four (4) generations (WDFW, 2004a). This stock therefore represents the stock most likely to adapt to environmental conditions in the Lewis River. The hatchery stock will be used in the first generation of the supplementation efforts. Once adult fish return from smolt or adult releases, the supplementation program will preferentially use these returns for both juvenile and adult releases. Hatchery origin spring Chinook will only be used if the number of adults produced from above Swift is not sufficient to meet the broodstock needs for the juvenile program (approximately 65 adults) or the adult supplementation objective of 2,000 adults.

Although actual spring Chinook productivity and capacity of the upper watershed is currently estimated from modeling, the goal will be to reduce the use of hatchery-origin adults in the upper watershed over successive generations. The proposed approach is described in Table 3.1 below:

**Table 3.1 Priorities for use of hatchery and natural-origin broodstock (NOR's)**

| **Generation after Introduction** | **Broodstock Source, Number and Composition** |
|---|---|
| 1st Generation | 65 NOR's used preferentially for juvenile supplmentation program; additional adult NOR's to upper watershed; all excess adult HOR's to upper watershed; 2,000 minimum total adults |
| 2nd Generation | 65 NOR's used for juvenile supplementation program; additional adult NOR's to upper watershed; goal of 2:1 NOR's/HOR as adults, 2,000 minimum total adults |
| 3rd Generation | 65 NOR's used for juvenile program; additional NOR's as adults to upper watershed; goal of 3:1 NOR's/HOR as adults, 2,000 minimum total adults |
| 4th Generation | Only NOR's used for juvenile and adult supplementation, all NOR returns to the upper watershed (goal will be to eliminate juvenile supplementation program, and release of HOR adults)* |

* Assumption is consistent with the Lewis River Fish Planning Document which recognized that at some time supplementation will end (Appendix D, Table D-24).

The approach described above should only be used as a guide for adaptive management decisions by the ACC. The decisions for broodstock use, composition of broodstock, and continuation or suspension of the supplementation program should be based on monitoring of survival rates and productivity in the upper watershed as well as demographic and genetic risks to the supplemented population.

### 3.1.3 Broodstock Collection and Mating

Broodstock for both the smolt and adult supplementation strategies will be collected so that fish for these programs will represent the entire run timing of the returning population. The juveniles released in the program will represent the full range of return timing of the existing stock. In order to accomplish this, eggs for this program must be taken throughout the run, or fish transported to upriver acclimation ponds should be collected as a sub-sample from the entire spring Chinook population rearing at Lewis River facilities. Since adults released into the watershed will select their own mates, only the juvenile portion of the program requires mating protocols. Spawning protocols for the juvenile program should strive for selective neutrality and ensure that maximum genetic effective number of breeders represented in the population. The current protocol of single family pairing and incorporation of jacks into the spawning population should be sufficient to meet these needs when using the hatchery broodstock. Once returns from the upper watershed are used for broodstock, spawning protocols for the juvenile portion of the supplementation program should be modified to a 2 X 2 factorial mating approach to increase the genetic effective population size for this portion of the program.

### 3.1.4 Incubation and Rearing

Spring Chinook for this program will be incubated and reared at Speelyai Hatchery following the protocols described in the most recent WDFW spring Chinook HGMP (WDFW, 2004a). Rearing conditions at Speelyai Hatchery will be managed to provide optimal flow and density indexes given current and planned hatchery upgrades. Fish will be held at Speelyai Hatchery until the yearling stage when they will be transferred to upriver acclimation ponds following standard WDFW loading guidelines. If rearing conditions, particularly water temperature, in the acclimation ponds allow, feed rates will be reduced with the declining photoperiod in the fall at Speelyai Hatchery and increased at the acclimation ponds, as the photoperiod increases, to more closely represent natural growth patterns of spring Chinook. Yearling transfer will generally occur in February (Age 1+), approximately 6 weeks prior to release at an average size of 12 fish per pound. Rearing conditions in the acclimation ponds will also be managed to provide similar flow and density indices reached at Speelyai Hatchery.

### 3.1.5 Release Location and Numbers Released

Up to 100,000 smolts and a minimum of 2,000 adults (when available) will be released above Swift Reservoir. Juveniles will be released volitionally from the acclimation facilities between February 22nd and March 31st. The target release size will be approximately 8-12 fish per pound. A minimum of 2,000 adults will also be released near the head of the Swift Reservoir to spawn naturally in the upper Lewis River. This number of fish is based on the habitat capacity of 1,942 fish estimated by EDT for the Lewis River above Swift Reservoir considering both adult and juvenile passage survival once collection facilities are in place (99 percent and 80 percent respectively).

Although EDT may over or underestimate the habitat carrying capacity of the upper basin, the 2,000 adult release number can be met in most years. Currently, it appears that on average the number of surplus (not needed for hatchery broodstock) adult spring Chinook

returning to the Lewis River may average ~3,000 fish, under current harvest regimes (See section 6). Thus, the 2,000 adult supplementation target is likely to be met in the majority of years.

Natural origin returns (NOR) will not be incorporated into the broodstock for the existing spring Chinook Segregated harvest program for the duration of the re-introduction experiment. At the completion of the 15 years and evaluation of stock sustainability, a decision will be made whether or not to modify the current Segregated harvest program into an Integrated program.

## 3.2 COHO SALMON (TYPE S)

### 3.2.1 Supplementation Strategy

The reintroduction strategy for Type S coho salmon will rely on adult supplementation. The choice of this strategy is based on the availability of adult Type S coho from returns to the Lewis River Complex (averaging over 21,000 returns between 1996 and 2002) and relatively high natural productivity and capacity (over 4 recruits/spawner and capacity of nearly 9,000 adults) of the system above Swift Reservoir that is estimated using EDT. Adult supplementation alone, in this case, should provide both the abundant founding population and the mechanism to increase population fitness as described in the Lewis River Fish Planning Document (Cramer and Associates 2004).

Initially, 9,000 Type S Coho adults (when available) will be released above Swift Reservoir to rebuild a natural spawning population[15]. The 9,000 adult minimum escapement target was selected based on EDT estimates of spawning capacity for habitat upstream of Swift No. 1 Dam, required passage survival and collection rates, and the average expected level of surplus Type S coho hatchery adults (~14,500) available after ocean and freshwater fisheries (See Table 6-3)[16].

### 3.2.2 Broodstock Origin

Broodstock for the reintroduction efforts will initially come from returns of early Type S coho to the Lewis River hatchery complex[17]. This stock has been chosen since the native Lewis River coho provided the initial broodstock for the hatchery program and because historical information suggests that early coho were predominately upper Lewis River spawners (WDFW, 2004b). This stock therefore represents the stock most likely to adapt to environmental conditions in the Lewis River. The hatchery stock will be used only in the first generation of the supplementation efforts. Once adults return from upper basin adult releases, the supplementation program will preferentially use these returns for further introduction. Hatchery origin adult coho will only be used if the number of adults produced

[15] The 9,000 adult release target is greater than the 6,200 proposed in the Lewis River Fish Planning Document (Table D-19)
[16] In years when surplus exceeds 9,500 adults, the ACC will need to determine if harvest should be increased or release additional coho into the upper watershed. Note that the release number is greater than the 6,200 proposed in the Lewis River Fish Planning Document (Table D-19).
[17] Broodstock collection dates for Type S coho would be established by the WDFW.

from above Swift No. 1 Dam is not sufficient to meet the adult supplementation objective of 9,000 adults.

Although actual productivity and capacity of the upper watershed is currently unknown, the goal will be to reduce the use of hatchery-origin adults in the upper watershed over successive generations. The proposed approach is described in Table 3.2 below:

**Table 3-2. Priorities for use of Hatchery and Natural-Origin Type S coho broodstock**

| Generation after Introduction | Broodstock Source, Number and Composition |
|---|---|
| 1st Generation | NOR's used preferentially for adult supplemention; all adult NOR's returned to the upper watershed; excess HOR's as adults to upper watershed; 9,000 minimum total adults |
| 2nd Generation | NOR's used for preferentially for adult supplementation; all adult NOR's returned to the upper watershed; goal of 2:1 NOR's/HOR as adults, 9,000 minimum total adults |
| 3rd Generation | NOR's used preferentially for adult supplementation; all adult NOR's returned to the upper watershed; goal of 3:1 NOR's/HOR as adults, 9,000 minimum total adults |
| 4th Generation | Only NOR's used for adult supplementation, all adult NOR's returned to the upper watershed. No HOR's released.* |

* Assumption is consistent with the Lewis River Fish Planning Document which recognized that at some time supplementation will end (Appendix D, Table D-24).

The approach described above should only be used as a guide for adaptive management decisions by the ACC. The decisions for broodstock use, composition of broodstock, and continuation or suspension of the supplementation program should be based on monitoring of survival rates and productivity in the upper watershed as well as demographic and genetic risks to the supplemented population.

### 3.2.3 Hatchery Protocols

Since only adult supplementation will be used, broodstock collection, mating, rearing and release protocols will not be necessary.

### 3.2.4 Broodstock Collection

Adults for the supplementation program will be collected so that fish will represent the entire run timing of the returning population.

### 3.2.5 Release Location and Numbers Released

Initially, 9,000 hatchery origin adults will be released above Swift Reservoir to naturally distribute themselves and reproduce. Data collected on adult coho released in the Upper Lewis River basin indicate that hatchery adult coho distribute throughout the watershed and produce large numbers of juveniles (PacifiCorp and Cowlitz PUD. 2004b).

An adult release of 9,000 coho is based on the habitat capacity of 8,800 fish estimated by EDT for the Lewis River above Swift Reservoir considering both adult and juvenile passage survival once collection facilities are in place (99 percent and 80 percent respectively)[18]. As naturally produced adults from the supplementation program return, priority for introduction into the upper watershed will be given to fish that were produced in the upper watershed. All returning natural origin adults will be transported to the upper watershed to spawn naturally. Hatchery origin fish will only be used in the event that fish produced above Swift Reservoir are not sufficient to meet the 9,000 fish goal. At the completion of the 9-year period, adult supplementation with any hatchery origin fish will be discontinued, only natural origin returns will be allowed to spawn in the upper watershed, and the population will be monitored to determine if reintroduction goals for this species have been reached.

Natural origin returns will not be incorporated into the broodstock for the existing Type-S coho harvest program for the duration of the re-introduction experiment[19]. At the completion of the 9 years and evaluation of stock sustainability, a decision will be made whether or not to modify the current segregated harvest program for Type-S coho into an Integrated Harvest program.

## 3.3 STEELHEAD

### 3.3.1 Supplementation Strategy

The reintroduction strategy for steelhead will rely on two life stages: smolts and adults. Since relatively few wild steelhead adults are currently available, approximately 50 adults from that population will be collected at the Merwin Trap and reared to smolts within the hatchery complex to increase the number of adults from this stock available for adult supplementation above Swift Reservoir.

A total of 50,000 smolts produced from wild winter steelhead returning to the Merwin Trap (or other location if necessary) will be released from Merwin Hatchery as 1+ smolts. Upon

[18] The ACC raised concerns that EDT estimates of carrying capacity may be too low, and suggested more fish be released upstream of Swift. The EDT release exceeds the 6,200 recommended in the Lewis River Fish Planning Document.
[19] The plan uses the HSRG assumption that it will require 3-4 generations to build a truly wild stock that can be used for integrating into the hatchery environment. Until this occurs, the HSRG does not recommend the development of an Integrated program.

return, adults from this program will be transported above Swift Reservoir to build a natural spawning population in the upper watershed. Adults returning from the hatchery smolt releases will only be used for reintroduction. Broodstock for the program will be derived each year from the non-enhanced natural stock in order to improve the effective genetic effective population size of the reintroduced stock[20]. Supplementation will be conducted for 15-years, unless otherwise determined by ACC through adaptive management. Throughout this period there are no proposed trigger points that would discontinue the program prior to its completion. The 15-year period was selected as it is required in the Settlement Agreement (Section 8.5.1 of Settlement Agreement) with provision for continuation of supplementation.

### 3.3.2 Broodstock Origin

Broodstock for the reintroduction efforts will come from wild late winter steelhead returning annually to the Merwin Trap. Since these fish are thought to be from the native Lewis River steelhead stock, they are the obvious first choice for use in the supplementation program. However, WDFW and NMFS will need to provide direction on the acceptability of using ESA listed fish for the program.

As in the re-introduction programs for spring Chinook and coho, the goal of this program will be to reduce the reliance on supplemented adult fish as natural stocks increase in the upper watershed. A proposed approach is described in Table 3.3 below:

[20] All natural origin steelhead collected at Swift would be marked with a CWT (location to be determined by ACC). Late Winter supplemented steelhead juveniles released below Merwin would be marked by removing their Right Ventral fin (Adipose would remain to prevent harvest in fisheries) subject to approval of the ACC.

**Table 3-3. Priorities for use of hatchery and natural-origin late winter steelhead broodstock (NOR)**

| Generation after Introduction | Broodstock Source, Number and Composition |
|---|---|
| 1st Generation (3-4yrs) | All broodstock for juvenile releases obtained from wild adults (50 fish goal, actual number considers estimated wild fish run size); all adult returns from the juvenile program transferred to the upper watershed; 500 minimum total adults is the target but may not be met early in the program. |
| 2nd Generation (5-8yrs) | All broodstock for juvenile supplementation releases obtained from wild adults (not adult returns from supplemented juveniles); all adult returns from the juvenile supplementation; 500 minimum total adults is the escapement target. When adequate information is available, ACC needs to review juvenile release (or some portion) into upper basin. |
| 3rd Generation (9-12 yrs) | All broodstock for juvenile supplementation releases obtained from wild adults (not adult returns from supplemented juveniles); all adult returns from the juvenile supplementation; 500 minimum total adults is the escapement target |
| 4th Generation (12-15 yrs) | Juvenile supplementation program may be suspended per ACC review; all adults with intact adipose fins arriving at Merwin released above Swift No.1 Dam* |

*WDFW and NOAA will need to establish the adult handling policy to be followed once late winter steelhead production meets abundance targets. If NOR late winter steelhead from the upper basin are marked, agencies have the ability to sort out lower basin wild fish from upper basin steelhead.

The approach described above should only be used as a guide for adaptive management decisions by the ACC. The decisions for broodstock use, composition of broodstock, and continuation or suspension of the juvenile supplementation program should be based on monitoring of survival rates and productivity in the upper watershed as well as demographic and genetic risks to the supplemented population.

### 3.3.3 Broodstock Collection and Mating

Broodstock for the smolt release strategy will be collected so that fish for this program will represent the entire run timing of the returning population. Hatchery returns from this program will not be used as broodstock. Instead, 100 percent of the broodstock will be collected each year from the non-enhanced natural stock in order to improve the effective genetic effective population size of the reintroduced stock. Although only 50 to 150 fish annually return to this location (E. Kinne, WDFW, pers. comm. 2005), it should be possible to collect a sufficient number of broodstock throughout the duration of this program to prevent any significant genetic risks to the hatchery broodstock and reintroduced stock from founder effects and to prevent significant loss to the donor population from broodstock mining. Since adults released into the watershed will select their own mates, only the juvenile portion of the program requires mating protocols. Spawning protocols for the juvenile program should strive for selective neutrality and ensure that maximum genetic effective number of breeders represented in the population. Additionally, all broodstock will be "live-spawned" and returned to the lower river when spawning is complete to minimize impacts to this species. Given the relatively small size of donors used to establish the introduced stock, a 2 X 2 factorial mating protocol should be used to maximize the genetic effective population size in the smolt release program.

### 3.3.4 Incubation and Rearing

Steelhead for this program will be incubated and reared at Merwin Hatchery following the protocols described in the most recent WDFW winter steelhead HGMP (WDFW, 2004c). The goal of the program will be to produce a one-year smolt that will rapidly emigrate from the system. The target release size will be between 5 and 8 fish per pound with a condition factor of < 1.0 and fork lengths between 180 – 210 mm to approximate the size of naturally produced out-migrant smolts. These targets were chosen to prevent residualism in undersized juveniles and maximize survival for adult supplementation (WDFW 2004c). In order to reach these goals, incubation and/or early rearing water may need to be heated in order to allow multiple egg takes to be combined into a single rearing unit, and to reach the goals for release size.

### 3.3.5 Release Location and Numbers Released

A total of 50,000 smolts will be volitionally released starting in April, to coincide with smolt outmigration timing of wild juveniles. Currently, hatchery managers note that facilities are insufficient to allow for a true volitional release directly into receiving waters. Instead, fish will have to migrate from the raceways (or ponds) to a collection facility, and then transported and released into the Lewis River. The release location will need to be sited so that the recovery of returning adults is maximized. All returning adults from this program will be released near the head of the Swift Reservoir to spawn naturally in the upper Lewis River.

# 4.0 MONITORING & EVALUATION

The ISRP/ISAB (2005) developed recommendations for evaluating supplementation programs in the Pacific Northwest. In general, their evaluation program is designed to address the critical uncertainties regarding whether supplementation:

- Provides a demographic increase in natural production,
- Leads to decreased fitness of the natural population being supplemented
- Results in increased demographic, genetic, ecological and disease risks to native fish populations

Because native anadromous fish have been extirpated from the Upper Lewis River basin, the proposed supplementation program poses little risk to wild coho, spring Chinook or late winter steelhead stocks in this area. Therefore, monitoring is not needed to determine if supplementation decreases the fitness of the natural populations.

However, the program may pose ecological and disease risks to the native bull trout population. The large releases of both hatchery juveniles and adults may result in increased competition for both food and space that may reduce bull trout abundance. On the other hand, the expected increase in marine-derived nutrients resulting from the adult supplementation program, and increased prey base, may increase the food base resulting in greater bull trout abundance. Monitoring is needed to quantify possible impacts from supplementation activities on this species.

In addition to monitoring recommendations put forth by the ISAB/ISRP, the Settlement Agreement requires, or infers, that certain M&E activities take place, including:

- Supplementation juveniles must not be marked in the same manner as hatchery fish are for harvest.
- Documentation of ocean recruits for both the natural and hatchery components of the program.
- Ability to determine if hatchery fish are not a significant limiting factor to the establishment of self-sustaining, naturally producing, harvestable runs.
- Determine if the hatchery or supplementation programs pose unacceptable impacts on fishery management objectives such as the recovery of wild stocks in the basin.

The M&E program presented below is designed to address both ISAB/ISRP recommendations, and conditions and research needs established in the Settlement Agreement.

## 4.1 FISH MARKING

A fish marking program is needed to not only identify the origin (NOR or HOR) of adults returning to adult collection facilities, but also to determine if hatchery and supplementation goals are being achieved (See Ocean Recruits Methodology).

Currently, juvenile fish released from Lewis River hatchery facilities are marked to quantify overall survival rates, contribution to fisheries (ocean and freshwater), stray rate, and the proportion of hatchery fish that spawn naturally in the basin. Fish released from the hatchery are generally distinguished through a combination of marks:

- Adipose Clip: This mark is used to inform fishers and managers that the fish is of hatchery origin. These fish can be retained in selective fisheries. Almost all hatchery fish released in the Lewis River are marked in this manner: the exception is discussed below.

- Adipose Clip + CWT: A subset of the hatchery fish released is also marked with a CWT inserted into the nose. The CWT is used to determine overall survival rates of release groups, harvest rates, and stray rate into other basins etc.

- Adipose Present + CWT: This group is referred to as the Double-Index Group (DIG) and is used to estimate the impact mark selective fisheries have on natural populations (See Appendix D for more detail). In these fisheries, fish captured with adipose fins are released while adipose clipped fish are retained. The difference in survival between these groups quantifies harvest impacts to natural stocks.

These three marked groups will be retained as part of the H&S Plan as they are still necessary to determine hatchery performance. However, as wild production from the upper basin increases it is suggested that the DIG group be eliminated and replaced by marking the wild migrants.

A marking program will also be needed for managing the supplementation component of the H&S Plan. Fish will need to be marked so that upon their return to adult handling facilities they can be sorted, transported and released into one of two areas:

1. Upstream of Swift No.1 Dam (Swift)

2. Yale Dam to Swift No. 1 Dam (Yale)[21]

Once passage occurs at Merwin, all fish will be passed into Merwin where they sort themselves out as to whether they want to stay in a particular reservoir or move upstream.

As was the case with the hatchery releases, marking is needed to determine the success of the supplementation program for Yale and Swift.

[21] The ACC may have the option to release all fish into Yale if adult passage facilities are built and are effective at Swift.

The proposed marking scheme for hatchery, supplementation and natural origin fish is presented in Table 4-1. The marking program emphasizes the use of CWT's for spring Chinook and coho, and fin-clips for steelhead because few steelhead are captured in ocean fisheries.

**Table 4-1. Marking program for supplementation, hatchery, and natural origin spring Chinook, coho and steelhead.**

| | Fish Origin | Spring Chinook | Steelhead* | Coho |
|---|---|---|---|---|
| Lewis River Hatcheries | Hatchery | 1) AD Removed, 150,000 cwt (Nose)<br><br>2) AD present, 150,000 cwt (Nose) | 1) AD removed, 75,000 cwt (Nose)<br><br>2) AD present, 75,000 cwt (Nose) | 1) AD removed, 75,000 cwt (Nose)<br><br>2) AD present, 75,000 cwt (Nose) |
| Swift | Natural | AD Intact, Minimum of 50,000 cwt's (Right Cheek) | AD Intact, Minimum of 50,000 cwt's (Right Cheek) | AD Intact, Minimum of 50,000 cwt's (Right Cheek) |
| | Supplementation | AD Intact, 100% RV Clipped | AD Intact, 100% RV Clipped | AD Intact, 100% RV Clipped |
| Yale | Natural | AD Intact, Minimum of 50,000 cwt's (Left Cheek) | AD Intact, Minimum of 50,000 cwt's (Left Cheek) | AD Intact, Minimum of 50,000 cwt's (Left Cheek) |
| | Supplementation | AD Intact, 100% LV Clipped | AD Intact, 100% LV Clipped | AD Intact, 100% LV Clipped |
| Merwin | Natural | None | None | None |
| | Supplementation | None | None | None |

* CWT 's may be coded or blank dependent on harvest sampling program in net fisheries. In addition, the decision to use cwt's, or another tag type for upper basin wild production will be the responsibility of the resource agencies.

No marking program is proposed for Merwin origin fish as by the time fish production occurs in this area, adult passage facilities would have been built at Yale and Swift; thereby allowing the fish to self-sort.

## 4.2 OCEAN RECRUITS

According to the Settlement Agreement, the H&S Plan needs to be designed to achieve the numeric adult hatchery targets shown in Table 2-5. These targets are referred to as Ocean Recruits.

Ocean Recruits is defined in the Settlement Agreement as:

"… the total escapement (fish that naturally spawned above Merwin and hatchery fish) plus harvest (including ocean, Columbia River, and Lewis River Harvest)."

Jacks are not included or counted as part of the ocean recruits analysis(May 11, 2006 ACC Meeting).

There are three possible methodologies that could be used to calculate Ocean Recruits:

**Age 2 Recruits (Age2 Rec)**: Number of fish alive at the time of first recruitment into a fishery (typically at age 2). Represents the maximum number of fish available to be managed.

**Adult Equivalent Run (AER)**: The total number of fish that would have returned to the spawning grounds at all ages in the absence of fisheries. AER represents the maximum number of spawners if no harvest occurred. In other words, our best estimate of run-size absent human interference.

**Catch Plus Escapement (C+E)**: Total catch of all ages plus total escapement of all ages. This method is in reality the outcome of the harvest management activities affecting the species.

Because each methodology provides information that could be used to determine program success and improve management, it is recommended that each of the three analyses be completed for at least coho and chinook. Based on the Ocean Recruits definition provided above, it appears that program success should be based on the AER method as it defines total production absent fisheries. Calculations for each method are included in Appendix D.

However, because steelhead are not harvested in large numbers at young ages or in ocean fisheries, it appears that in reality the C+E and AER methods would produce very similar results. As the WDFW already reports both parameters on a yearly basis, it is recommended that only C+E be utilized for determining steelhead Ocean Recruits.

It should be noted that C+E, AER and Age2 Rec would also be calculated for Upper Lewis River origin fish as well as hatchery fish. As fish production increases in the Upper Lewis River basin, WDFW and the ACC should consider whether the Double Index group at the hatchery should be eliminated, as wild fish would provide data needed to estimate harvest impacts to wild Lewis River fish populations.

## 4.3 HATCHERY EFFECTS

### 4.3.1 Anadromous Fish Programs

The Settlement Agreement requires that the H&S Plan incorporate M&E protocols that can determine whether or not hatchery fish are a significant limiting factor to the establishment of self-sustaining, naturally producing, harvestable runs. It is difficult to quantify hatchery fish impacts on native fish populations. The term “significant” is also problematic since no numeric value has been assigned to the term. The task of defining this value should be determined by the ACC.

Regardless, because hatcheries will provide the fish needed for the reintroduction effort, whatever effects these fish may have on program success will have to be accepted, at least for upper basin fish populations. Long-term, the H&S Plan calls for eliminating all hatchery releases into the Upper Lewis River basin if data indicate that runs achieve the self-sustaining goal established in the Settlement Agreement.

The proportion hatchery fish contribute to the entire composite spawning population (natural and hatchery) in river reaches below Merwin Dam will be used as the indicator of the level of risk hatchery fish pose to natural populations in this area. Based on HSRG guidelines, hatchery fish from Segregated programs shall not make up more than 5 percent of the total natural spawning population. Spawning and carcass surveys would be used to document whether these criteria are being met each year[22]. Results of the surveys would be included in the Annual Operating Plan described in the Settlement Agreement.

Whether or not hatchery programs should be changed if the criteria were violated, would be made in consultation with the ACC. Options for reducing impacts could include the development of new hatchery release strategies, reduction or elimination of some hatchery programs, or the establishment of new criteria.

### 4.3.2 Resident Fish Programs

Resident trout plants in Swift reservoir would be evaluated to determine impacts on reintroduced anadromous fish. The study will be undertaken during the last two years of the 5-year period when anadromous adults are released above Swift to increase nutrients, and prepare stream habitat for anadromous fish reintroduction.

A sampling program will be established to capture the stocked trout and examine their stomach contents. Examining fish captured by local anglers and through bull trout netting activities would likely be the preferred sampling method as it is relatively low cost. Estimates would be made of the number of each species consumed by the rainbow trout. These data would be used to determine the predation impacts these fish are having on each species consumed.

In regard to anadromous fish, if the rainbow trout were consuming more than 3 percent of the total estimated number of juvenile anadromous fish of any species entering Swift Reservoir, it is recommended the rainbow trout program be altered or eliminated. The 3 percent value should be considered a placeholder until reviewed by the ACC. It is expected that the Services will provide a value as part of their review of the program.

### 4.3.3 Harvest Effects

The calculation of the Ocean Recruits value for each species is heavily dependent on the resource manager's ability to account for all marked fish. Therefore, intensive monitoring programs are needed to sample fish in all fisheries, adult collection facilities and on the spawning grounds.

Responsibility for setting and monitoring fisheries is the responsibility of the resource co-managers. Therefore, the H&S Plan assumes that the co-managers have in place a well-designed harvest-monitoring plan sufficient to develop accurate estimates of:

1. The number, age and sex of marked fish captured in fisheries and spawning in the wild.

[22] To be effective, egg-box plants or any other releases that do not allow identification of hatchery origin fish would need to be eliminated.

2. Survival rates for wild fish captured in fisheries and released (including drop-off rate).

3. Stray rates based on CWT's recovered in other basins.

All fish returning to adult collections facilities in the Lewis River are to be 100 percent mark-sampled to ensure that not only all tags are recovered but that adult fish are transported and released to the correct portion of the upper basin (Yale or Swift).

A key assumption in the H&S Plan is that the implementation of selective fisheries by the co-managers creates a harvest program that still allows for significant recreational and commercial harvest without jeopardizing the success of the reintroduction program. Therefore, for management purposes it is assumed that fishery impacts would be managed based on the data presented in WDFW's Fish Management and Evaluation Plans (www.nwr.noaa.gov/Salmon-Harvest-Hatcheries/Salmon-Fishery-Management/Fishery-Plans.cfm). WDFW is also responsible for conducting the monitoring required to document that performance criteria established in the plans are met.

### 4.3.4 Index Stocks

The Lewis River Fish Planning Document (Cramer and Associates 2004) makes a sound argument for using index stocks as a means to determine whether the success or failure of the Lewis River H&S Plan is a result of in-basin or out-of-basin factors. This information would feed into the Limiting Factors Analysis (LFA) called for in Year 27 of the license. The LFA would be used to develop a working hypothesis for why program goals were not met.

It is suggested that the Lower Columbia River spring Chinook, coho and late winter steelhead populations be used as the Index stocks for the proposed analysis. These populations were chosen because:

- All are located in the same geographic area (stream below Bonneville Dam)
- WDFW has a monitoring program tracking each population's status and performance

Additionally, special emphasis should be placed on tracking the success of the Cowlitz River reintroduction program. Similarities between the Cowlitz River and Lewis River programs are as follows:

- The species being reintroduced are the same (spring Chinook, coho and late winter steelhead),
- Both program are using similar methods to reintroduce these fish to stream reaches located upstream of 3-dams (adult and juvenile supplementation).
- Both utilize trap-and-haul systems to move fish to and from the spawning grounds, and
- Each has significant hatchery production facilities releasing large number of fish in the lower portion of the basin.

Data on total adult production, percent harvested in fisheries, escapement, stray rates, number of juveniles produced, fish passage survival, age structure (adults and juveniles) would be collected and summarized each year for each Index stock. This effort would mostly entail the gathering and summarizing of other reports produced by WDFW and Tacoma Power.

#### 4.3.5 Life-History Data and Performance

Basic life-history and performance data should be collected yearly for each species and type (hatchery and wild). The data collected should include:

- Adult run-timing (life-history diversity)
- Adult and juvenile age structure (life-history diversity)
- Adult composition on spawning grounds (% hatchery versus % wild)
- Mark recovery (CWT, fin-clips etc., using detectors and carcass surveys)
- Fecundity
- Adult transport survival
- Radio-Tracking of late winter steelhead adults after release above Swift reservoir.
- Adult distribution (including stray rate and location)
- Egg-to-smolt survival rates (habitat quality)
- Number of juveniles entering reservoir (needed for survival estimates)
- Number of juveniles produced and collected at each passage facility (system capacity)
- Juvenile recruits per adult spawner (measures freshwater productivity)
- Fish passage survival rates by life-stage, collection facility and reservoir
- Juvenile transport survival
- Juvenile migration timing
- Adult recruits per spawner (life-cycle productivity)
- Disease or general health information
- Habitat data both upstream and below Merwin Dam (mainstem Lewis River only).

Most of this data is being collected as part of fish management activities at the hatchery or in the lower Lewis River. The remainder would be collected as part of future fish passage facilities evaluations.

The data collected would be used to track program success over time and determine if conditions within or outside of the basin are negatively impacting the program.

The end product of the monitoring program would be the development of a Beverton-Holt production function for each species. The empirically derived estimate of this function would be compared yearly to the one developed as part of the EDT analysis. The point of this comparison is to confirm that the working hypothesis put forward by the models used for developing the H&S Plan (EDT and Salmon PopCycle models) is correct. Ideally, the model estimates of system productivity and capacity should compare favorably to the observed data. If not, then a new working hypothesis regarding how the ecosystem responds to supplementation should be developed and tested.

### 4.3.6 Hatchery Operations

Data to be collected at each hatchery facility should include for each species:

- Environmental rearing conditions in the environment by life stage
- Tracking consistency of programs with HSRG guidelines
- Disease presence and loss by life stage
- Survival by life stage
- Growth rate by month from fry ponding to release as smolts
- Number of fish tagged, tag type and purpose (experimental, production, other?)
- Smoltification data on any hatchery juveniles not allowed to migrate volitionally from rearing ponds or raceways.
- Number of adult collected, spawned, recycled
- Number of wild fish collected
- Number of hatchery fish collected that originated from outside of the Lewis River basin
- Number of hatchery fish observed on spawning grounds
- General hatchery operations data required for regulatory/permitting

## 4.4 IMPACTS ON ESA LISTED SPECIES AND LOWER RIVER FISH POPULATIONS

The primary impacts to ESA listed and other lower river fish populations' results from hatchery operations. The release of over 3.4 million hatchery juveniles to the lower river will put these populations at risk from competition, predation and disease. In addition, hatchery adults spawning with wild adults in lower river tributaries pose both genetic and competition risks to these same populations.

The H&S Plan attempts to reduce these risks by operating the hatchery programs consistent with HSRG guidelines, to the extent possible. The majority of the hatchery programs would be operated as Segregated programs to reduce risks. Segregated programs for example, require that the percent hatchery fish observed on the spawning grounds be kept at low levels (~5%). This reduces genetic impacts to native fish populations from genetic introgression. In addition, the off-spring of these hatchery fish would have low abundance, and thus competition effects would also be reduced.

The data needed to determine hatchery impacts on lower river anadromous fish populations include:

- Hatchery fish abundance in lower river tributaries
- Reproductive success of hatchery fish in the natural environment
- Hatchery juvenile behavior after release (residence time in Lewis River)
- Number of wild adults captured in fisheries directed at hatchery fish
- Mortality rate of wild fish captured in fisheries (hooking mortality)

The role each resource agency and PacifiCorp Energy would play in collecting these data would need to be worked out through the ACC.

## 4.5 IMPACTS ON ESA LISTED SPECIES AND UPPER RIVER FISH POPULATIONS

Comments received from the ACC on the Draft H&S Plan indicated that they were concerned about the effect reintroducing anadromous fish into the upper basin may have on ESA listed bull trout and other resident species. For example, a concern was expressed that if coho entered and spawned in Rush Creek or Cougar Creek, they may negatively impact bull trout spawning success.

The H&S Plan proposes to conduct spawning/carcass surveys throughout the upper basin to collect marks, determine distribution etc. which should provide data to identify those areas where species may compete. However, unless actions such as constructing weirs at the mouths of streams like Cougar Creek to prevent coho access are implemented, then collecting data on such interactions may have little value.

The H&S Plan assumes that since bull trout and other species were present historically in the upper basin, the reintroduction program would simply restore ecological function in the system. Impacts such as bull trout feeding on anadromous juveniles or vice-versa are simply accepted.

# 5.0 ADAPTIVE MANAGEMENT

The Adaptive Management Plan (AMP) presented below describes some of the key decision points, needed studies, and suggests possible directions the ACC may take in adjusting the fisheries program over time as new data become available.

## 5.1 ADAPTIVE MANAGEMENT FOR THE LEWIS RIVER

Adaptive management is defined as "an adaptive policy that is designed from the outset to test clearly formulated hypothesis about the behavior of the ecosystem being changed by human use" (Lee 1993). Generally, these hypotheses are predictions about how one or more important species will respond to management actions (Lee 1993).

The major assumption, or hypothesis, being tested in this plan is whether hatchery origin fish can be used to restore anadromous fish production above a series of dams. The ultimate goal being to achieve self-sustaining runs of harvestable fish in this habitat.

The H&S Plan assumes that the best approach for achieving program goals is to rear fish using HSRG and APRE guidelines, and implement a juvenile and adult supplementation program to restore upper basin anadromous fish production. And finally, it is assumed that these actions will not only be successful, but also that they will have little or at least acceptable impacts on other basin fish populations such as ESA listed bull trout and lower river coho, Chinook and steelhead.

The combined actions and analysis tools used to select these provide the conceptual framework for how basin fish populations will respond to the H&S Plan. An effective AMP should be designed to constantly test whether the conceptual framework remains valid in light of study results from both within and outside of the basin.

### 5.1.1 Key Hypotheses

The key hypotheses (as well as decision points) that will be used to test the conceptual framework are discussed by hypothesis below.

#### 5.1.1.1 HSRG Guidelines

The H&S Plan relies on HSRG guidelines as the scientific basis for hatchery operations. However, these guidelines have never been tested, but simply represent HSRG understanding of best management practices for hatcheries attempting to achieve conservation or harvest goals. Although the H&S Plan will not attempt to validate these guidelines, data is needed to ensure that the recommendations are being carried out.

Of critical importance in the success of the reintroduction program is whether or not managers can effectively control the mix of wild and hatchery fish in lower basin tributaries and in the upper basin.

The H&S Plan calls for operating Segregated hatchery programs in the lower river, which to be successful requires that hatchery fish not make up more than 5% of the total spawning population. Thus the first hypothesis or research question:

*Can the Segregated hatchery programs be operated so that these fish make up 5% or less of the entire natural spawning population?*

If the data collected as part of H&S Plan or WDFW sponsored spawning surveys conclude that this metric can be met the programs may continue. If not, the ACC will need to review the collected data and evaluate management alternatives.

5.1.1.1.1 Key Decision Point

In year 5 of the H&S Plan sufficient data should be available to answer this research question.

5.1.1.2 Juvenile Supplementation Effectiveness

Four research questions are associated with the juvenile supplementation program.

*Is the survival and collection rate of juveniles released above Swift No.1 Dam sufficient to meet program goals?*

The Settlement Agreement requires that juvenile supplementation be used as one of the approaches to restore anadromous fish production to the upper basin. For this program to be successful, the juveniles released above Swift must survive at a high rate to juvenile bypass facilities, and then the majority of these effectively collected, transported and released downstream of Merwin Dam. If not, the ACC should consider altering or stopping the program temporarily until survival increases (e.g. collection efficiency improves).

*Do supplemented juveniles have the same or greater SAR than hatchery fish released below Merwin Dam?*

There may be a survival cost associated with releasing juvenile fish above Swift No.1 dam in comparison to below Merwin Dam. Juveniles released in the upper basin have to migrate through reservoirs and dams to reach the lower river, which may result in significant loss. If the overall SAR for supplemented juvenile fish is lower than for fish released below Merwin Dam, then the ACC may want to revisit the need for this strategy. This decision would be influenced by the answer to the third question.

*Will returning adults from the late winter juvenile supplementation program spawn successfully in the Upper Lewis River basin?*

The H&S Plan collects wild late winter steelhead adults from the lower river, rears the off-spring to 1+ smolts, and then releases these fish below Merwin Dam. Upon their return as adults, they are transported and released above Swift Reservoir. As the behavior of these fish is unknown, a portion will need to be radio-tagged and their distribution tracked. If these fish do not distribute themselves throughout the watershed, then the program may need to be revised. Possible changes include acclimating the juveniles prior to their release below

Merwin Dam, or rearing and releasing these fish at a smaller size (subyearling) in the upper watershed, similar to what was done at Cowlitz Falls.

*Do adults from supplemented juveniles have a higher spawning success rate than hatchery adults released into the same streams?*

A key assumption of any juvenile supplementation effort is that acclimating or releasing juvenile fish near the spawning grounds results in increased homing fidelity and improved spawning success compared to releases of hatchery adults. If this assumption is false, then considerable resources are being expended for no increase in fish production. Because both adult and juvenile supplementation programs are proposed, at least for spring Chinook, it will be difficult to determine the success of both strategies at the same time, as they confound each other (can not tell whether resulting juvenile production was from hatchery adults or adults supplemented as juveniles). DNA testing might be used to track parentage over time, but costs may be prohibitive.

5.1.1.2.1 Key Decision Point

The juvenile collector at Swift is schedule for testing in Year 4.5 of the license. It is suggested that at least one year of testing be conducted before juvenile fish are released as part of the supplementation program. If juveniles were released in the same year as testing, coordination would be needed with the facility evaluation program.

Additionally, SAR values will first be available within 3 years of the first releases. The ACC should review the adult survival data to determine if program changes need to be made.

5.1.1.3 Adult Supplementation Effectiveness

*What is the egg-to-smolt (or recruits per adult spawner) survival of hatchery adults released in the upper basin?*

Because surplus adult hatchery fish are generally available, the H&S Plan relies on adult supplementation as the only method to reintroduce Type S Coho and late winter steelhead into the upper basin. This strategy has been highly successful for these species on the Cowlitz River according to WDFW biologists (WDFW 2004d). For example, in 2004 WDFW estimated a smolt yield of over 300,000 coho smolts. Studies conducted during Lewis River relicensing also showed large numbers of coho juveniles resulting from adult releases. However, as the Settlement Agreement emphasized juvenile supplementation, data is needed on the effectiveness of the adult supplementation strategy to produce smolts.

5.1.1.3.1 Key Decision Point

The spawning and reproductive success of hatchery adults released into the upper basin can start in year 1. The Settlement Agreement calls for releasing hatchery fish for five years starting 6-months after the effective date. The H&S Plan calls for collecting this data the first year adults are released into the upper basin.

#### 5.1.1.4 EDT Modeling Results

*Do EDT estimates of system productivity align with observed data?*

EDT modeling was used to estimate potential juvenile and adult production originating from streams located above Swift No.1 Dam. The accuracy of these estimates is unknown, but do provide a template for which to compare to observed data once fish production is re-established. The EDT estimates of production are important for they were used to set the minimum adult escapement targets for the upper basin. Determining the accuracy of these estimates would help the ACC better adaptively manage the number of juveniles and adult released as part of the supplementation program.

In addition, the Beverton-Holt production function produced by EDT provides managers the ability to forecast resulting juvenile production that may result from different spawner escapements. These estimates could then be compared to the number calculated entering reservoirs and juvenile collection facilities. If numbers do not match, then studies should be undertaken to identify erroneous assumptions in the model. This data would be useful in developing the limiting factors analysis required in year 27.

### 5.1.2 Independent Review

The Settlement Agreement calls for an independent review of the program in year 5. This review will provide the ACC with a chance to revisit proposed actions and implement corrective measures. The AMP should also be revisited at this time and adjusted as needed.

# 6.0 EXPECTED OUTCOMES

The All-H Hatchery Analyzer (AHA) model used in the development of this H&S Plan used current EDT habitat productivity/capacity estimates, anticipated harvest rates, and proposed hatchery operations to estimate the number of adult salmon and steelhead returning to the upper basin, the hatchery complex, and caught in freshwater and ocean fisheries.

It should be noted that the harvest and smolt-to-adult survival rates used in this analysis were approximated from the Lewis River Fish Planning Document (Cramer and Associates 2004), and comments received from WDFW on the November 2005 Draft H&S Plan. The SAR values used in the AHA analysis are shown in Table 6-1. It should be recognized that survival values could change by an order of magnitude for any given brood year[23].

**Table 6-1. A comparison of SARs developed or reviewed as part of the development of the H&S Plan.**

| Species | Cramer Hatchery[1] | AHA Hatchery | EDT (Wild or NOR) |
|---|---|---|---|
| Spring Chinook | 0.5%- 2.2% | 0.7% | 3% |
| Type N Coho | 2%-4.4% | 2.2% | NA |
| Type S Coho | 2%-4.4% | 2.2% | 4.8% |
| Late Winter Steelhead | NA | NA | 6% |
| Winter Steelhead | 1.4%-2.8% | 1.6%* | NA |
| Summer Steelhead | 6.8%-13.6% | 2%* | NA |

NA- Not applicable as wild fish production is not included in the H&S Plan.
1-Data taken from Table D-5, Cramer and Associates 2004 (Lewis River Fish Planning Document)
*- WDFW supplied survival estimates for winter and summer steelhead

A key difference in the SAR values used in this analysis and the Cramer and Associates (2004) analysis are the values for summer steelhead. Cramer and Associates (2004) used an SAR values greater than 6%, while this plan uses the 2% value submitted by WDFW. To meet steelhead hatchery production targets requires that the combined steelhead SAR (both species) average 4.8%. This SAR assumption would include all steelhead caught in fisheries, observed on the spawning grounds, and collected at the hatcheries or fish ladders. Because of this difference in SAR assumptions between the two analysis, the H&S Plan indicates that hatchery steelhead adult targets may be difficult to achieve.

[23] Note that the AHA model varies SAR by brood year over a range of SAR values.

## 6.1 SPRING CHINOOK

The H&S Plan spring Chinook supplementation program uses 65 adults from the existing Lewis River hatchery program to produce approximately 100,000 smolts that will be released into the upper watershed (Table 6-2). The upper watershed is also seeded with up to 2,000 adults (based on a corrected (for fish passage) habitat capacity of 1,942 fish).

**Table 6-2. Expected outcomes of the Lewis River H&S Plan spring Chinook program.**

| Phase | Broodstock | NOR's Spawning Naturally | HOR's (Supplemented) Spawning Naturally | Mixed Stock Harvest | Terminal Area Harvest | Average Adult Ocean Recruits |
|---|---|---|---|---|---|---|
| Supplementation Phase | 65 | 1,159 | 390 | 372 | 66 | ~2,100 |
| End of Supplementation | NA | 1,215 | NA | 264 | 47 | ~1,500 |
| Segregated Harvest Program | 800 (+3,123 surplus) | NA | NA | 1,308 | 2,319 | ~7,600 |

Ideally, the spring Chinook supplementation program will collect 100 percent of its broodstock from natural origin fish resulting from the "start-up" phase. Also, only natural origin adults would be allowed to spawn in the upper watershed. Hatchery origin spring Chinook will only be used if the number of adults produced from above Swift is not sufficient to meet the broodstock needs (approximately 65 adults) or the adult supplementation objective of 2,000 adults. Under this scenario, the number of spawners of natural origin or produced from the juvenile supplementation program is expected to be approximately 1,559 adults (NOR + HOR Supplemented). Harvest occurs primarily in mixed-stock fisheries, with little harvest occurring in the terminal fishery. On average, in Years 1-12 of the program approximately 2,100 adults would be produced.

Once supplementation efforts are ended, upper basin adult escapement is reduced to 1,215. Harvest still occurs primarily in mixed-stock fisheries, with little terminal harvest. However, WDFW and NOAA may alter harvest patterns as needed. The estimated number of naturally produced adult ocean recruits produced under this scenario is about 1,500 (Table 6-2).

The Spring Chinook segregated harvest program represents the total catch and escapement of hatchery origin spring Chinook produced from the proposed Segregated harvest program. The total contribution of hatchery origin fish from the proposed segregated harvest program is on average about 7,600 fish (Table 6-2). This includes meeting the hatchery broodstock needs of 800 fish, having a surplus of 3,123 fish at the hatchery and contributing 3,627 fish to harvest (1,308 in mixed stock harvest and 2,319 in the terminal area). The expected surplus of hatchery fish indicates that on average, the existing hatchery program can supply the juveniles (100,000) and adults (2,000) for re-introduction into the upper watershed.

## 6.2 COHO

Because of the large number of surplus early coho (Type-S) adults available from the hatchery and the potential productivity and capacity of the upper watershed, no juveniles are needed for the proposed early coho supplementation program. Based on the estimates of habitat productivity and capacity, simply relying on adult supplementation (up to 9,000 adults) results in an average of 5,812 Type-S coho spawning in the upper watershed (Table 6-3). Initially they will be 100 percent hatchery origin, but ultimately should consist of 100 percent natural origin fish.

**Table 6-3. Expected outcomes of the Lewis River H&S Plan early (Type-S) coho program.**

| Phase | Brood-stock | NOR's Spawning Naturally | HOR's Spawning Naturally | Mixed Stock Harvest | Terminal Area Harvest | Average Adult Ocean Recruits |
|---|---|---|---|---|---|---|
| Type S After Supplementation | NA | 5,812 | NA | 1,013 | 69 | ~6,900 |
| Type S Segregated Harvest Program | 800 | NA | NA | 2,895 | 1,971 | ~19,700* |
| Type-N Segregated Harvest Program | 800 | NA | NA | 8,663 | 2,119 | ~21,000** |

* Includes 14,044 surplus hatchery fish. ** Includes 9,547 surplus hatchery fish.

Under the proposed Type S coho Segregated Harvest program, the total contribution of hatchery origin fish is on average about 19,700 (Table 6-3). This includes meeting the hatchery broodstock needs of 800 fish, having a surplus of 14,044 fish at the hatchery and contributing 4,866 fish to harvest (2,895 in mixed stock harvest and 1,971 in the terminal area). This program contributes a much lower proportion of the total run to harvest (24.6 percent) than the late coho harvest program (51 percent). However, the expected surplus of hatchery fish indicates that on average, the existing hatchery program can supply the 9,000 Type S adults needed for reintroduction into the upper watershed.

The proposed Lewis River Type N coho segregated harvest program produces 900,000 smolts that are 100 percent derived from adult returns to the hatchery. This scenario assumes that 100 percent of the hatchery origin returns from the Segregated Harvest program return to the hatchery. The total contribution of hatchery origin fish from this program is on average about 21,000 fish (Table 6-3). This includes meeting the hatchery broodstock needs of 800 fish, having a surplus of 9,547 fish at the hatchery and contributing 10,782 fish to harvest (8,663 in mixed stock harvest and 2,119 in the terminal area). This program contributes a much higher proportion of the total run to harvest (51 percent) than the early coho harvest program (24.6 percent).

## 6.3 STEELHEAD

The proposed Lewis River late-winter steelhead supplementation program (Years 1-15) uses 50 adults returning to Lewis River traps to start an Integrated Conservation/Restoration recovery program. These 50 adults produce about 50,000 smolts. When these smolts return

as adults, they will all be allowed to spawn in the upper watershed. Harvest is expected to be minimal as it is assumed selective fisheries are in place. Broodstock will continue to be taken from other adult returns to the trap in order to increase the effective population size of the spawners in the upper watershed. On average this strategy results in about 2,000 fish spawning in the upper watershed, with 40 percent being wild origin supplemented spawners (Table 6-4).

**Table 6-4. Expected outcomes of the Lewis River H&S Plan winter and summer steelhead program.**

| Phase | Brood-stock[1] | NOR's Spawning Naturally | Wild (Supplemented) Spawning Naturally | Mixed Stock Harvest | Terminal Area Harvest | Average Adult Ocean Recruits |
|---|---|---|---|---|---|---|
| Late-winter Supplementation Years (wild broodstock) | 50 | 1,200 | 800 | 65 | 108 | ~2,200 |
| Late-winter After Supplementation (NOR) | NA | 1,300 | NA | 42 | 70 | ~1,400 |
| Winter Segregated Harvest Program | 90 | NA | NA | 55 | 915 | ~1,800* |
| Summer Segregated Harvest Program | 160 | NA | NA | 239 | 2,383 | ~4,000** |

1-Broodstock numbers are an estimate; will vary based on fecundity and survival values for upgraded hatchery facilities

* Includes 779 surplus hatchery fish.

** Includes 1,211 surplus hatchery fish.

NA- Not Applicable

The late-winter steelhead (NOR) row represents a potential long-term conservation program for above Swift No. 1 Dam winter steelhead with supplementation efforts eliminated[24]. Under the conditions modeled, spawning escapement in the upper watershed is ~1,300. There is harvest opportunity but it is limited to approximately 112 adults (Table 6-4).

The winter steelhead Segregated harvest program produces approximately 4,000 ocean recruits, 55 adults to mixed stock fisheries and 915 to terminal area harvest. These adults were produced from a release of 100,000 smolts.

The proposed Lewis River summer steelhead Segregated Harvest program produces about 175,000 smolts that are 100 percent derived from adult returns to the hatchery. The total contribution of hatchery origin fish from this harvest program is on average approximately 13,800 fish (Table 6-4). This includes meeting the hatchery broodstock needs of 160 fish, having a surplus of 4,573 fish at the hatchery and contributing 9,055 fish to harvest (827 in mixed stock harvest and 8,228 in the terminal area).

[24] Note that total adult ocean recruits are lower because the lower river wild later winter steelhead population is no longer being mined for supplementation.

## 6.4 RAINBOW TROUT AND KOKANEE

The proposed resident rainbow trout and kokanee programs are expected to maintain the existing recreational fisheries in Swift Reservoir and Lake Merwin; however, the potential adverse effects of these programs on reintroduced salmon and steelhead are unknown. Resident trout plants in Swift reservoir would be evaluated to determine impacts on reintroduced anadromous fish.

# 7.0 ANNUAL OPERATING PLAN

The Settlement Agreement Calls for the development of an annual operating plan (AOP), which will be designed to implement the H&S Plan. The AOP needs to provide the following information:

1. Production Plan: Specifies the species to be reared and broodstock source.

2. Hatchery and Juvenile Production Targets: Identifies and adult and juvenile targets by species for each hatchery program.

3. Fish Release Schedule: Identifies by species the rearing schedule and planned distribution of fish and the schedules and locations of release.

4. List of Hatchery Facility Upgrades: Identifies upgrades to be implemented at each hatchery facility

A discussion of each of the four AOP elements is presented below.

## 7.1 PRODUCTION PLAN

The species (and stocks) to be released as part of the H&S Plan are presented in Table 7-1.

**Table 7-1. Species and broodstock source of hatchery fish reared and released as part of the H&S Plan.**

| Species and Stock | Broodstock Source |
|---|---|
| Type N Coho | Lewis River Hatchery Complex |
| Type S Coho | Lewis River Hatchery Complex |
| Late Winter Steelhead | Lower Lewis River Wild |
| Winter Steelhead | Lewis River Hatchery Complex |
| Summer Steelhead | Lewis River Hatchery Complex |

## 7.2 HATCHERY AND JUVENILE PRODUCTION TARGETS

The adult and juvenile production targets are shown in Table 7-2.

**Table 7-2. Adult and juvenile hatchery production targets**

| Species and Stock | Adult Hatchery Targets | Juvenile Hatchery Targets |
|---|---|---|
| Coho | 60,000 | 1.8 million |
| Late Winter Steelhead | None | 50,000 |
| Steelhead | 13,200 | 275,000 |
| Spring Chinook | 12,800 | 1.35 million |
| Total | 86,000 | 3.475 million |

## 7.3 FISH RELEASE SCHEDULE

The location and schedule for all hatchery fish releases will be developed once the hatchery upgrades are completed.

## 7.4 HATCHERY FACILITY UPGRADES

The hatchery upgrades that will be implemented this year (2006) are:

1 Incubation building expansion for kokanee rearing (Speelyai Hatchery)

2. Upgrades to the ozone system (Merwin Hatchery)

3. Upstream intake and pond pipe maintenance (Lewis River Hatchery)

4. Siting and permitting of Net Pens

## 8.0 REFERENCES

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# Appendix A

*Existing Hatchery Facilities and Operations in the Lewis River Basin*

# Appendix B

*Section 8 of the Lewis River Settlement Agreement*

# Appendix C

*ISAB Clarification on Mass Marking and Mark-Selective Fisheries*

# Appendix D

*Ocean Recruits Calculations*

# Appendix E

*Response to Comments on Draft Hatchery and Supplementation Plan*