Yakima Subbasin Summer- and Fall-Run Chinook and Coho Salmon Hatchery

Master Plan

Volume 1

Submitted by

The Confederated Tribes and Bands of the Yakama Nation

Toppenish, Washington

May 2012

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APPENDICES (VOLUME 2)

Appendix A	Draft Hatchery and Genetic Management Plan: Yakima River Summer/Fall Chinook Production Program
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Appendix C	Bioprogramming Reports and Hatchery Operations Schedule Technical Memo: Biological Criteria for Coho, Summer and Fall Chinook
Appendix D	Water Supply Reports
Appendix E	In-Season Implementation Tool
Appendix F	Memorandum of Agreement between Yakama Nation, BPA, Corps of Engineers and Bureau of Reclamation
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EXECUTIVE SUMMARY

In this Master Plan, the Yakama Nation proposes to implement hatchery strategies that will contribute primarily to harvest and secondarily to cultural/conservation goals identified for Yakima coho and summer and fall Chinook. The purpose of the proposed actions is to increase harvest levels, natural spawning abundance, and spatial/temporal distribution of both species in the Yakima River Basin. No substantial new production is proposed.

The coho and Chinook programs will be components of the ongoing Yakima-Klickitat Fisheries Project under which the Yakama Nation and its partners are enhancing existing stocks of anadromous fish in the Yakima and Klickitat river basins while maintaining genetic resources and reintroducing stocks formerly present in the subbasins. The decline of these species has greatly reduced the Tribe's ability to exercise its Treaty-reserved fishing right; therefore, the proposed strategies are intended to enhance fishing opportunities for Tribal members as guaranteed by the Treaty of 1855 and confirmed by US vs. Oregon.

Two Chinook hatchery programs with distinct and separate purposes are proposed: one addresses the goal of reestablishing a locally adapted, naturally spawning summer/fall Chinook population in the Yakima River upstream of Prosser Dam; the other addresses the need to improve the performance of the Upriver Bright (URB) fall Chinook harvest program in the lower Yakima River (downstream of Prosser Dam). In this document, the two programs will be referred to as the ***Yakima Summer/Fall Chinook Program*** and ***Yakima URB Harvest Program***. Table ES-1 outlines the goals for conservation and harvest for Yakima summer/fall Chinook and URB fall Chinook and the role the proposed hatchery programs are expected to play in meeting those goals. Detailed descriptions and rationales for the two proposed Chinook hatchery programs are provided in Section 4.

Table ES-1. Overview of the two Chinook programs addressed in this Master Plan.

	Yakima Summer/Fall Chinook Program	Yakima Upriver Bright Harvest Program
Associated Natural Population	Yakima River Summer-Fall Chinook (extirpated)	Hanford/Priest Rapids URB Fall Chinook
ESU	Upper Columbia Summer/Fall Chinook ESU	Upper Columbia Summer/Fall Chinook ESU
ESA Status	Not Listed	Not Listed
Spawning Area	Yakima River, upstream of Prosser Dam	Lower Yakima River, downstream of Prosser Dam and the mainstem and Upper Columbia River
Conservation Goals for Natural Population	• Long term: 7,000 natural origin (NOR) spawners above Prosser • Near term: 5,000 total spawners (NOR+HOR) above Prosser	Contribute toward US v. Oregon combined escapement target at McNary Dam
Harvest Goals	Temporally and spatially expand fishing season in the Yakima River to historic patterns	• Long term: contribute >18,000 adults to all fisheries • Near term: contribute >6,000 adults to all fisheries

	Yakima Summer/Fall Chinook Program	Yakima Upriver Bright Harvest Program
Yakama Nation Cultural Goals	• Natural spawning of Chinook salmon over historic range and time periods in the Yakima River • Meet ceremonial and subsistence requirements	Meet treaty harvest entitlements as confirmed and specified in US v. Oregon agreements
Hatchery Program Purpose	**Harvest** and reestablishment (**re-colonization**) of a naturally spawning, locally adapting, bi-modal summer-fall Chinook population spawning above Prosser Dam	**Harvest**
Broodstock origin	• Early component: Upper Columbia summer-fall Chinook via Wells Hatchery • Late Component: Hanford Reach fall Chinook via local returns to Prosser	Hanford Reach fall Chinook via Priest Rapids Hatchery
Broodstock Management	Transition to an **integrated** program over time as natural-origin returns become available for broodstock.	The Yakima program is integrated relative to the Hanford Reach/Priest Rapids URB Fall Chinook; however, it is a **segregated** hatchery population relative to the Yakima River summer-fall population.
Broodstock Collection Locations	Prosser Dam, Sunnyside Dam and Marion Drain	Prosser Dam, Priest Rapids Hatchery, Priest Rapids Dam, and a new facility downstream of Prosser
Hatchery Program Size	• Option 1:750,000 sub-yearlings and 250,000 yearlings • Option 2: 1.0 million sub-yearlings	1.7 million sub-yearlings
Release Locations	Marion Drain and Yakima River above Sunnyside Dam	Below Prosser

The primary goal for the Yakama Nation's coho hatchery program described in this Master Plan is to increase harvest opportunity for tribal members as provided in the Treaty of 1855 (12 Stat.951) and US v Oregon (1969). The program has a secondary goal to restore natural spawning coho in the Yakima Basin.

Two coho programs are addressed: a segregated harvest program in the lower Yakima River, referred to as the ***Lower Yakima Segregated Coho Program***, and an upper Yakima reintroduction program, referred to as the ***Upper Yakima Integrated Coho Program*** (see Table ES-2). The purpose of the former is to provide harvest. The purpose of the latter is to contribute to harvest, but also to reestablish natural spawning coho in tributaries where they historically spawned. The initial phases of both programs have been completed and the modifications proposed under this Master Plan will implement the final program phases (referred to as Phases 3 and 4).

Table ES-2. Overview of the two Yakima coho programs addressed in this Master Plan.

	Lower Yakima Segregated Coho Program	Upper Yakima Integrated Yakima Coho Program
Natural population	None	Extirpated
ESA Status	Not Listed	Not Listed
Spawning Area	Not intended to spawn	Yakima River tributaries
Conservation Goals		Reestablish a naturally spawning coho population in the Yakima Basin with > 3500 natural-origin spawners in the long term
Harvest Goals	Contribute > 20,000 adults to all fisheries, > 8,000 to Zone 6 and the Yakima River fisheries	
Yakama Nation Cultural Goal	Meet treaty harvest entitlements per US v. Oregon agreements	Reestablish natural spawning of coho in tributaries where they occurred historically
Broodstock Origin	Lower Columbia hatchery coho	Lower Columbia hatchery coho
Hatchery Program Purpose	**Harvest**	**Harvest** and reestablishment (**re-colonization**) of a naturally spawning coho population
Hatchery Broodstock Management	This currently is and will continue to be a **segregated** program. It will transition to a **segregated "stepping stone"** program over time providing genetic continuity with the Upper Yakima integrated program.	This program has completed two of four phases. In phase 3, broodstock will transition to local brood. In phase 4, it will incorporate natural-origin returns in the brood and become **integrated.**
Hatchery Broodstock Collection Locations	With the implementation of this Master Plan, broodstock will be drawn from hatchery returns from the local program at Prosser to increase survival and homing.	With implementation of this Master Plan, broodstock primarily will be drawn from natural-origin returns (Phase 4)..
Hatchery Program Size—Phase 3	500,000 smolts	500,000 parr 200,000 smolts
Hatchery Program Size—Phase 4	800,000 smolts total for the two programs	
Release Locations	Below Prosser	Tributaries and upper Yakima and Naches mainstem reaches

This plan also describes proposed modifications to existing hatchery facilities at Prosser and Marion Drain hatcheries, development of a new hatchery at Holmes Ranch, and the development of fish collection facilities at Sunnyside Dam. The summer/fall Chinook program would be conducted at expanded Marion Drain and Prosser hatcheries; the upriver bright fall Chinook program would continue at an expanded Prosser Hatchery and at a new acclimation/release site downstream of Benton City; and the coho programs would be conducted at Prosser Hatchery and a new hatchery at Holmes Ranch. A new fish collection facility is proposed at Sunnyside Dam.

Facilities proposed to be modified and/or constructed under this Master Plan are described in detail in Sections 4.4 and 5.4, with preliminary design drawings included in Appendix G. Highlights of the proposal include the following:

- Holmes Ranch Hatchery: A new hatchery would be constructed at Holmes Ranch that will be very similar to facilities proposed at Marion Drain. A new 28,000-square-foot hatchery and administration building would be designed for the coho incubation and rearing program. Because the Holmes Ranch site has limited ground and surface water, water re-use technology is proposed to supply the rearing phase of the fish culture operation so that program production goals can be achieved. This would be the first facility developed under this Master Plan.

- Prosser Hatchery would be modernized with a variety of improvements to water supplies, fish culture incubators and rearing units, power and control systems, and support buildings in order to achieve the coho and fall Chinook production goals.

- Marion Drain Hatchery: The Tribe proposes to modernize the Marion Drain Hatchery with a variety of improvements to water supplies, fish culture incubators and rearing units, power and control systems, and support buildings in order to achieve the summer Chinook production goals. A new 28,000-square-foot hatchery and administration building would incubate and rear the full summer component of the summer/fall Chinook program and coho. The facility would have 25 percent make-up flow reuse systems to produce high quality fish with the limited available water supply.

- Sunnyside Dam Broodstock Collection Facility: There are no fish trapping or sorting facilities at Sunnyside Dam, a US Bureau of Reclamation low head irrigation diversion dam located at RM 103.8 of the Yakima River. Three existing fish ladders operate on the left and right banks and in the center of the river. The right bank fish ladder is proposed to be modified to capture adult broodstock for the summer/fall Chinook program.

The Tribe's proposed program includes an adaptive management component to address uncertainty and to determine when criteria are met for moving the programs from one phase to the next (see Section 3.3).

The Yakama Nation is submitting this Yakima Summer/Fall Chinook and Coho Master Plan (BPA Project No. 1997-013-25) to fulfill the Council's requirement that all entities seeking funding for artificial production projects involving new construction and/or programs that will produce fish for reintroduction, submit plans and documentation consistent with the Council's Step Review process.

ACKNOWLEDGEMENTS

The authors thank the Yakama Tribal Council for their continued commitment to restoration and enhancement of Yakima Subbasin fisheries. In particular, we are grateful to the Yakama Nation Fish & Wildlife Committee for their guidance and encouragement. We also acknowledge Melvin Sampson, Paul Ward, and Lynn Hatcher (retired) for their direction and support as project /program managers. Our partners in the subbasin have provided valuable assistance, including the Bureau of Reclamation, Recovery Board, the Washington Department of Fish and Wildlife. Technical assistance in developing these programs and preparing this Master Plan was provided by DJ Warren & Associates, McMillen Engineering, Meridian Environmental, and Malone Environmental Consulting. Finally, we deeply appreciate the efforts of the numerous fisheries technicians who, over the years, gathered the data that form the foundation of this Master Plan.

ABBREVIATIONS AND ACRONYMS

ACOE	Army Corps of Engineers
AER	Adult Equivalent Run
APR	Annual Project Review
ASR	All Species Review
BPA	Bonneville Power Administration
BLM	Bureau of Land Management
C+E	Catch plus Escapement
CESRF	Cle Elum Supplementation and Research Facility
cf	Cubic feet
cfs	Cubic feet per second
CRITFC	Columbia River Inter-Tribal Fish Commission
CSMEP	Collaborative Systemwide Monitoring and Evaluation Project
CSS	Comparative Survival Study
CWT	Coded wire tag
EDT	Ecosystem Diagnosis and Treatment
ESA	Endangered Species Act
ESU	Ecologically Significant Unit
FCRPS	Federal Columbia River Power System
fpp	Fish per pound
gpm	Gallons per minute
HGMP	Hatchery Genetics Management Plan
HOB	Hatchery–origin broodstock
HOR	Hatchery origin
HSRG	Hatchery Scientific Review Group

ICTRT	Interior Columbia Technical Recovery Team
IEAB	Independent Economic Analysis Board
ISAB	Independent Scientific Advisory Board
ISIT	In-season Implementation Tool
ISMP	In-season Management Plan
ISRP	Independent Scientific Review Panel
LCR	Lower Columbia River
M&E	Monitoring and evaluation
MIPT	Monitoring Implementation Planning Team
MSY	Maximum sustainable yield
NFH	National Fish Hatchery
NMFS	National Marine Fisheries Service
NOAA Fisheries	National Oceanic and Atmospheric Administration – Fisheries
NOB	Natural-origin broodstock
NOR	Natural origin
NPCC	Northwest Power and Conservation Council
pHOS	Number of hatchery fish present on the spawning grounds
PIT Tag	Passive Integrated Transponder tag
PNAMP	Pacific Northwest Aquatic Monitoring Program
PNI	Proportionate Natural Influence
pNOB	Proportion of Natural-Origin Broodstock
Rkm	River kilometer
RM	River mile
R/S	Recruits per spawner
SA	Supplemental Analysis

SAR	Smolt-to-adult (SAR survival rate is measured from the point where a juvenile fish is released or captured to their return to the same point as an adult)
STAC	Science/Technical Advisory Committee
TAC	Technical Advisory Committee
URB	Upriver Bright Chinook
USBR	United States Bureau of Reclamation
VSP	Viable Salmon Population
WDFW	Washington Department of Fish and Wildlife
WDOE	Washington Department of Ecology
YKFP	Yakima-Klickitat Fisheries Project
YN	Yakama Nation

1.0 INTRODUCTION

1.1 NORTHWEST POWER AND CONSERVATION COUNCIL'S THREE-STEP REVIEW

The Northwest Power and Conservation Council (NPCC) was directed by the Northwest Power Act of 1980 to develop a program to protect, mitigate and enhance the fish and wildlife that have been affected by the development of hydropower projects in the Columbia River Basin. The resulting Columbia River Basin Fish and Wildlife Program is the basis upon which the NPCC makes project funding recommendations to the Bonneville Power Administration (BPA). In 2009, the NPCC adopted a revised Columbia Basin Fish and Wildlife Program that incorporates a three step review as part of the project approval process.

The three step review process was originally implemented in 1997 for all "artificial production initiatives". An artificial production initiative is targeted for the review process if the project proposes to construct new production facilities, plant fish in waters where they have not been planted before, significantly increase the number of fish being introduced, change stocks or the number of stocks, or change the location of production facilities.

The step review includes a thorough evaluation by the Independent Scientific Review Panel (ISRP) and the NPCC at three junctures: master or conceptual planning, preliminary design, and final design. Projects do not move from one phase to the next without a favorable review. The 2009 revised Fish and Wildlife Program states that:

> "The Council intends the Step-Review process to be flexible and cost-efficient. Depending on the nature and status of the proposed project, the Council may allow for a review that combines two or more steps in a single submission and review, or for a submission and review that addresses just part of a step of the review process."

Table 1-1 describes the NPCC's three step review objectives for new aquaculture facilities.

Table 1-1. Three step review objectives for new aquaculture facilities.

NPCC-defined Steps	Objectives
Step 1	Develop conceptual engineering design to an accuracy level varying from +/-35% to 50 %
	Prepare and obtain NPCC approval of conceptual program in the form of a Master Plan
Step 2	Develop preliminary engineering design and cost estimates to an accuracy level varying from +/- 25% to 35%
	Prepare an Environmental Impact Statement or Environmental Assessment in compliance with NEPA. Prepare a Biological Assessment in compliance with the Endangered Species Act.
	Obtain NPCC approval of preliminary design
Step 3	Develop final design and engineering cost estimates for construction bidding to an accuracy level varying from +/- 10% to 15%

NPCC-defined Steps	Objectives
	Prepare all permit applications for project construction
	Obtain NPCC approval of final program design and operational conditions

Step 1 is the master plan or conceptual phase of the process. Project proponents identify all major development components, how they could be arranged on the selected site, and how the facility will be operated. Planning level facility sizing, configurations, and costs are estimated to a confidence level of +/- 35 percent to 50 percent. In addition, project proponents assess their proposal's consistency with review elements identified by the NPCC. These include consistency with the NPCC's eight scientific principles; links to other projects and activities in the subbasin; defined biological objectives with measurable attributes that define progress, provide accountability and track changes through time; defined project benefits; descriptions of implementation strategies; relationship to Fish and Wildlife Program habitat strategies; review of cost-effective alternate measures; identification of alternates for resolving the resources problem; historical and current status of anadromous and resident fish and wildlife in the subbasin; current and planned management of fish and wildlife in the subbasin; consistency of the proposal with fishery management plans and recovery plans; status of an environmental assessment; description of the monitoring and evaluation plan; description of cost estimates for ten fiscal years for planning and design, construction, operation and maintenance and monitoring and evaluation; and finally, consistency with the artificial production policies of the Columbia Basin Fish and Wildlife Program (NPCC 2009).

Once the NPCC approves the Step 1 Master Plan, development plans are advanced to a confidence level of +/- 25 percent to 35 percent in the Step 2 submittal. At this stage, design is advanced to a degree that allows preparation of a full environmental review document. While Step 2 design is still considered preliminary, technical detail is sufficiently refined to identify implementation constraints, costs and configurations that will subsequently change in only minor ways. Step 2 submittals include a summary of the completed Environmental Impact Statement or Environmental Assessment, and preliminary design documents.

Step 3 is the final design review prior to construction. Development plans are advanced to a confidence level of +/- 10 percent to 15 percent and are ready for bid. A 100 percent cost estimate accompanies this submittal along with details on all operational plans.

1.2 DOCUMENT OVERVIEW AND ORGANIZATION

Chapter 1 is an overview of the Council's review process for new or modified hatchery programs. The organization of this Master Plan is described and it should be explained that two species are being addressed. The Yakama Nation views restoration of both summer/fall Chinook and Yakima coho as integral to advancing its ongoing YKFP programs in the upper and lower Yakima Basin. These programs and their associated facilities are described in the following nine chapters and ten appendices, each of which is summarized below.

In Chapter 2, a context overview is provided of the current Chinook and coho programs along with tables that summarize the proposed programs. This is followed by highlights of each proposed production facility, their operations schedules, water requirements and production objectives.

In Chapter 3, presents the framework for adaptively managing the proposed Chinook and coho programs using the In-Season Implementation Tool. The metrics that are the basis of this tool and key assumptions of how the program are expected to evolve are defined in the biological objectives for the two Chinook and two coho programs. Additionally, a monitoring and evaluation framework is presented.

Chapter 4 describes the proposed Yakima summer/fall Chinook and Yakima upriver bright Chinook programs to be expanded at Prosser Hatchery and Marion Drain Hatchery. Detail is provided on the artificial production strategy as well as alternative strategies that were considered. Existing facilities are described, followed by the conceptual modifications at Prosser and Marion Drain. Broodstock collection facilities proposed at Sunnyside Dam are also described. This chapter also contains an analysis of Chinook program consistency with the Council's eight scientific principles, a discussion of the program links to related fisheries and habitat measures, and its consistency with the Council's artificial production policies.

Chapter 5 describes the proposed Yakima coho programs and provides the same information for this species as is presented in Chapter 4 for Chinook.

Chapter 6 describes the Yakima Basin and the current status of fish and wildlife resources, and current and planned management actions. This chapter also describes aquatic management and resource issues at local and regional scales.

Chapter 7 identifies the environmental compliance steps that will be undertaken in subsequent phases of this program.

Chapter 8 provides cost estimates for facility planning and design, construction, capital equipment, environmental compliance, operations and maintenance, monitoring and evaluation, and projected ten-year future costs. Costs are presented separately for each major project facility: Prosser Hatchery, Marion Drain Hatchery, Sunnyside Adult Collection Facility, and Holmes Ranch Hatchery.

Chapter 9 lists the documents cited in this Master Plan.

The ten appendices provide supporting information and documentation as follows:

- Appendix A: Draft summer/fall Chinook Hatchery and Genetic Management Plan
- Appendix B: Draft Yakima coho Hatchery and Genetic Management Plan
- Appendix C: Biological criteria for coho and summer/fall Chinook
- Appendix D: Water supply reports
- Appendix E: In-Season Implementation Tool
- Appendix F:Fish Accord MOA with the Yakama Nation
- Appendix G:Preliminary design drawings
- Appendix H: Detailed program cost tables
- Appendix I: Floodplain evaluation
- Appendix J: Fall Chinook Lower River Acclimation and Adult Capture Facility Study.

2.0 SUMMARY AND CONTEXT OF PROPOSED PROJECTS

This section provides an overview of the proposed projects in the context of historic conditions and future expectations. The Master Plan specifically addresses proposed hatchery strategies designed to contribute toward harvest and conservation goals for coho, fall Chinook, and summer-fall Chinook within the Yakima Basin. More detailed information about the proposed programs is provided in Section 4 (Chinook) and Section 5 (coho).

The hatchery programs described in this Master Plan will be components of the Yakima-Klickitat Fisheries Project (YKFP). The YKFP is a joint project of the Yakama Nation (lead entity) and the Washington Department of Fish and Wildlife (WDFW) focused on enhancing existing stocks of anadromous fish in the Yakima and Klickitat river basins while maintaining genetic resources, and reintroducing stocks formerly present in the basins. Under the YKFP, the Tribe is committed to salmon recovery using a combination of hatchery production and habitat protection and restoration strategies. The YKFP is an integral part of the comprehensive Yakima Subbasin and Recovery planning efforts.

Another important goal of the YKFP is to provide harvest opportunities. Fishing opportunities for Tribal members are guaranteed by the Treaty of 1855 (12 Stat. 951) between the Yakama Nation and the United States of America. Indian fishing rights were confirmed by a federal court in *U.S. v Oregon* in 1969. Long-term *U.S. v Oregon* agreements call for construction of a Yakima River hatchery for fall and summer Chinook (CRITFC 1988). The existing coho hatchery program is also part of an agreement under *U.S. v Oregon.*

2.1 CHINOOK PROGRAM OVERVIEW

This Master Plan describes the Yakama Nation's proposed modifications to existing hatchery facilities and production strategies for summer and fall run Chinook salmon. The purpose of the proposed actions is to increase harvest and natural spawning of Chinook salmon in the Yakima Basin. Establishment of a sustainable natural population of summer/fall Chinook is expected within a 25-year time frame.

Two Chinook hatchery programs with distinct and separate purposes are proposed: one addresses the goal of reestablishing a locally adapted, naturally spawning summer/fall Chinook population in the Yakima River upstream of Prosser Dam, the other addresses the need to improve the performance of the Upriver Bright (URB) fall Chinook harvest program in the lower Yakima River (downstream of Prosser Dam). In this document, the two programs will be referred to as the ***Yakima Summer/Fall Chinook Program*** and ***Yakima URB Harvest Program***. Table 2.1 outlines the goals for conservation and harvest for Yakima summer/fall Chinook and URB fall Chinook and the role of the proposed hatchery programs are expected to play in meeting those goals. Detailed descriptions and rationales for the two proposed Chinook hatchery programs (Yakima summer/Fall Chinook program and Yakima URB harvest program) are provided in Section 4.

Table 2-1. Overview of the two Chinook programs addressed in this Master Plan.

	Yakima Summer/Fall Chinook Program	Yakima Upriver Bright Harvest Program
Associated Natural Population	Yakima River Summer-Fall Chinook (extirpated)	Hanford/Priest Rapids URB Fall Chinook
ESU	Upper Columbia Summer/Fall Chinook ESU	Upper Columbia Summer/Fall Chinook ESU
ESA Status	Not Listed	Not Listed
Spawning Area	Yakima River, upstream of Prosser Dam	Lower Yakima River, downstream of Prosser Dam and the mainstem and Upper Columbia River
Conservation Goals for Natural Population	• Long term: 7,000 natural origin (NOR) spawners above Prosser • Near term: 5,000 total spawners (NOR+HOR) above Prosser	Contribute toward US v. Oregon combined escapement target at McNary Dam
Harvest Goals	Temporally and spatially expand fishing season in the Yakima River to historic patterns	• Long term: contribute >18,000 adults to all fisheries • Near term: contribute >6,000 adults to all fisheries
Yakama Nation Cultural Goals	• Natural spawning of Chinook salmon over historic range and time periods in the Yakima River • Meet ceremonial and subsistence requirements	Meet treaty harvest entitlements as confirmed and specified in US v. Oregon agreements
Hatchery Program Purpose	**Harvest** and reestablishment (**re-colonization**) of a naturally spawning, locally adapting, bi-modal summer-fall Chinook population spawning above Prosser Dam	**Harvest**
Broodstock origin	• Early component: Upper Columbia summer-fall Chinook via Wells Hatchery • Late Component: Hanford Reach fall Chinook via local returns to Prosser	Hanford Reach fall Chinook via Priest Rapids Hatchery
Broodstock Management	Transition to an **integrated** program over time as natural-origin returns become available for broodstock.	The Yakima program is integrated relative to the Hanford Reach/Priest Rapids URB Fall Chinook; however, it is a **segregated** hatchery population relative to the Yakima River summer-fall population.
Broodstock Collection Locations	Prosser Dam, Sunnyside Dam and Marion Drain	Prosser Dam, Priest Rapids Hatchery, Priest Rapids Dam, and a new facility downstream of Prosser
Hatchery Program Size	• Option 1: 750,000 sub-yearlings and 250,000 yearlings • Option 2: 1.0 million sub-yearlings	1.7 million sub-yearlings
Release Locations	Marion Drain and Yakima River above Sunnyside	Below Prosser

2.1.1 Historic Context and Population Status

The Yakima Basin historically supported an abundance of Chinook salmon with broad temporal and spatial diversity (Figure 2-1). Early arriving, spring type Chinook spawned in the upper reaches and tributaries of the Yakima and Naches rivers. Naturally spawning summer-fall type Chinook were once abundant in the Yakima River Basin. Spawning occurred from the mouth of the Yakima upstream past the middle river, where the city of Yakima is now located. As a result of past land and water development and fisheries management practices, the naturally-reproducing population was severely reduced in abundance, run-timing, and spawner distribution. By 1970, the earlier timed component of the summer-fall Chinook population that once spawned higher in the watershed was completely eliminated, leaving a large portion of the Yakima Basin barren of Chinook salmon (Figure 2-2).

The URB fall Chinook currently present in the lower Yakima River are either of hatchery origin (from Priest Rapids stock) or recent descendants of hatchery-origin fish. What remains is essentially a hatchery population that is sustained by and genetically linked to the Hanford Reach URB fall Chinook population.

Before the 1850s, the Yakama tribe could rely on Chinook salmon for a continuous supply of fish for subsistence, cultural and ceremonial purposes from spring through fall of each year. These opportunities no longer exist. The desire to restore the presence of naturally spawning Chinook as well as a prolonged harvest season are strong motivators for the hatchery programs proposed in this Master Plan. Figure 2-3 illustrates the Chinook spawning distribution that would be re-established by this program.

URB fall Chinook as well as the Upper Columbia summer-run Chinook are part of the Upper Columbia River summer/fall Chinook Evolutionarily Significant Unit (ESU). In 1998, the National Marine Fisheries Service (NMFS) determined that the Upper Columbia River summer/fall Chinook ESU did not warrant listing. Existing hatchery and naturally spawning fall Chinook in the Yakima Basin are part of this ESU.

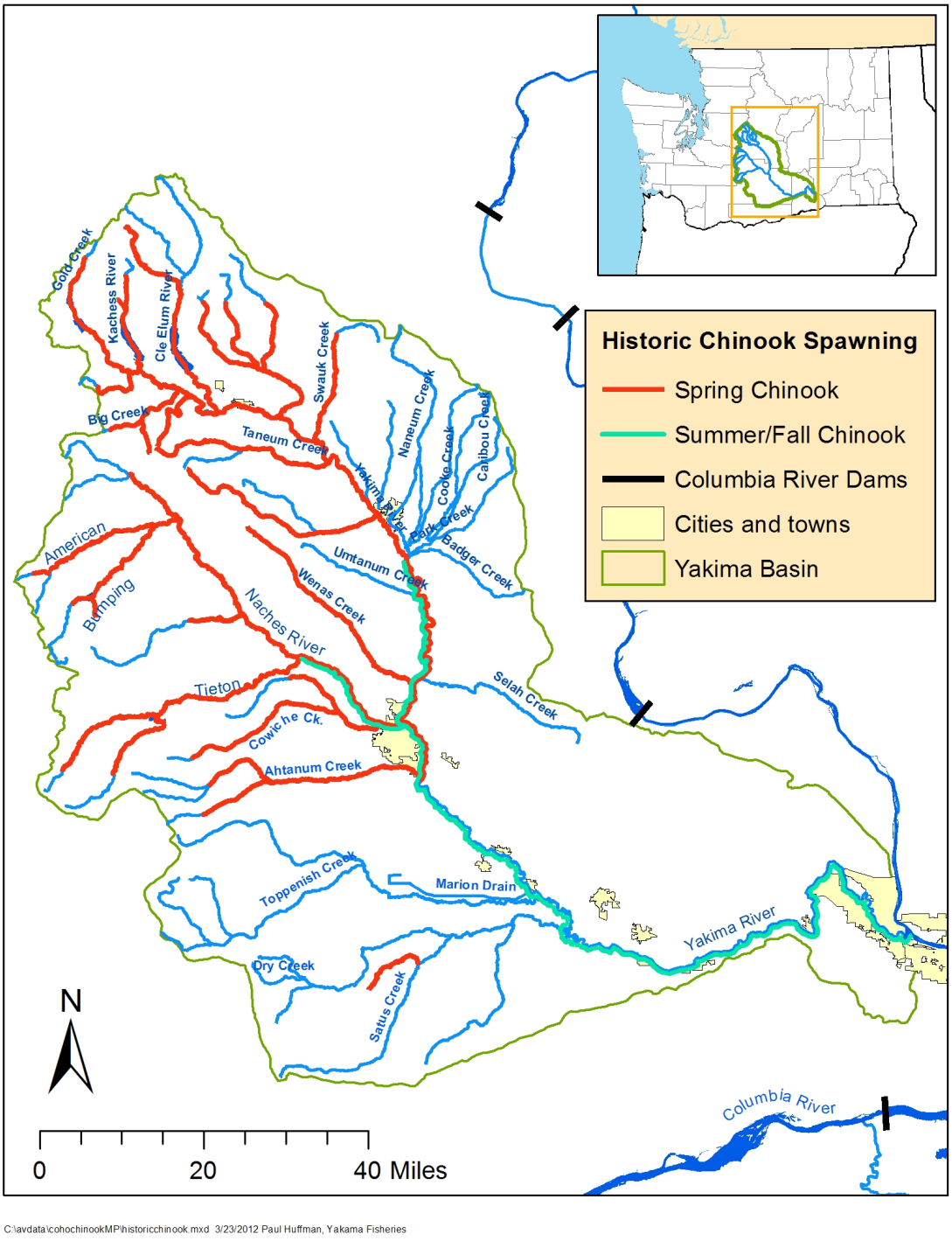


Figure 2-1. Historic Yakima Basin spawning reaches used by Chinook salmon.

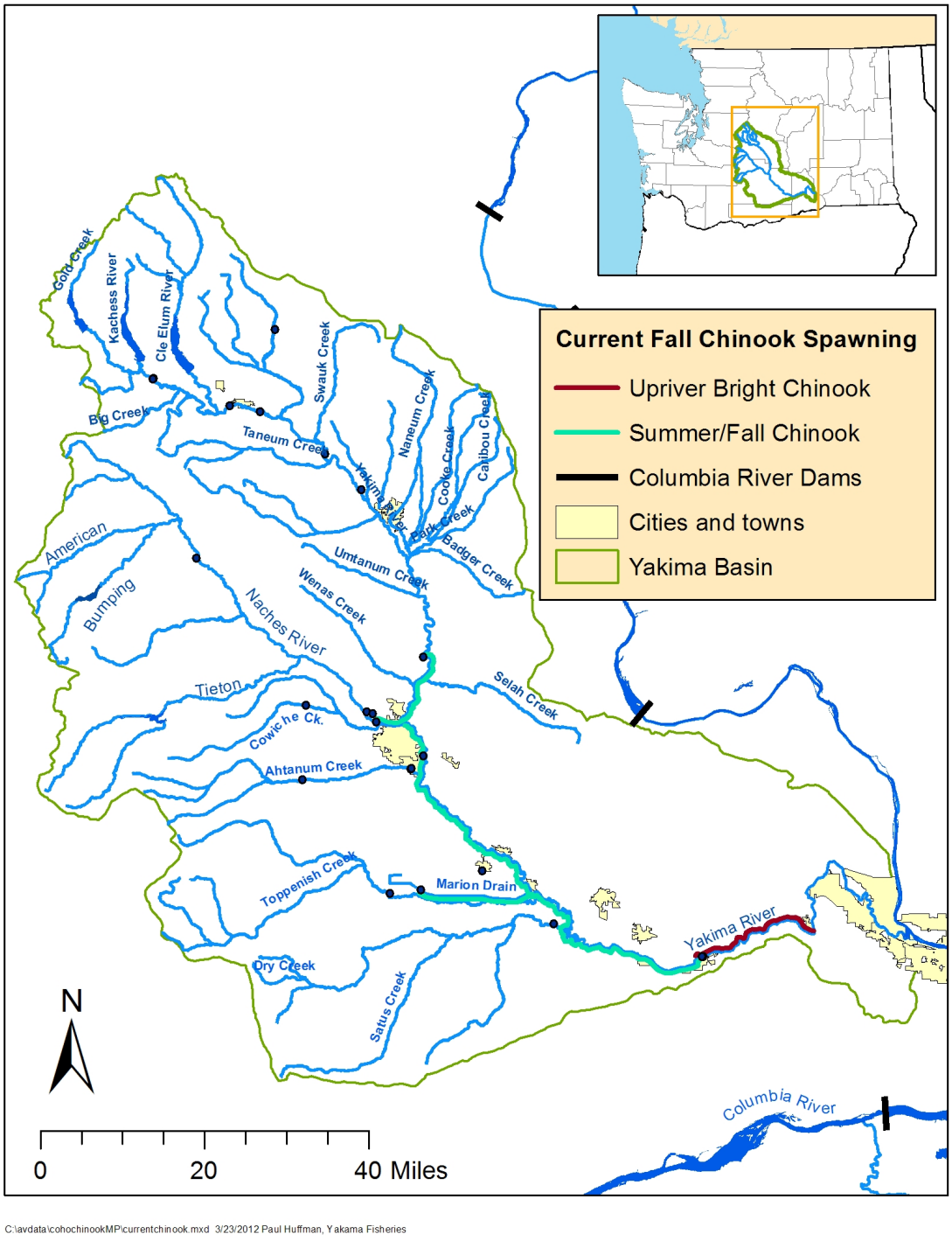


Figure 2-2. Current spawning distribution of Yakima Basin summer/fall and URB fall Chinook.

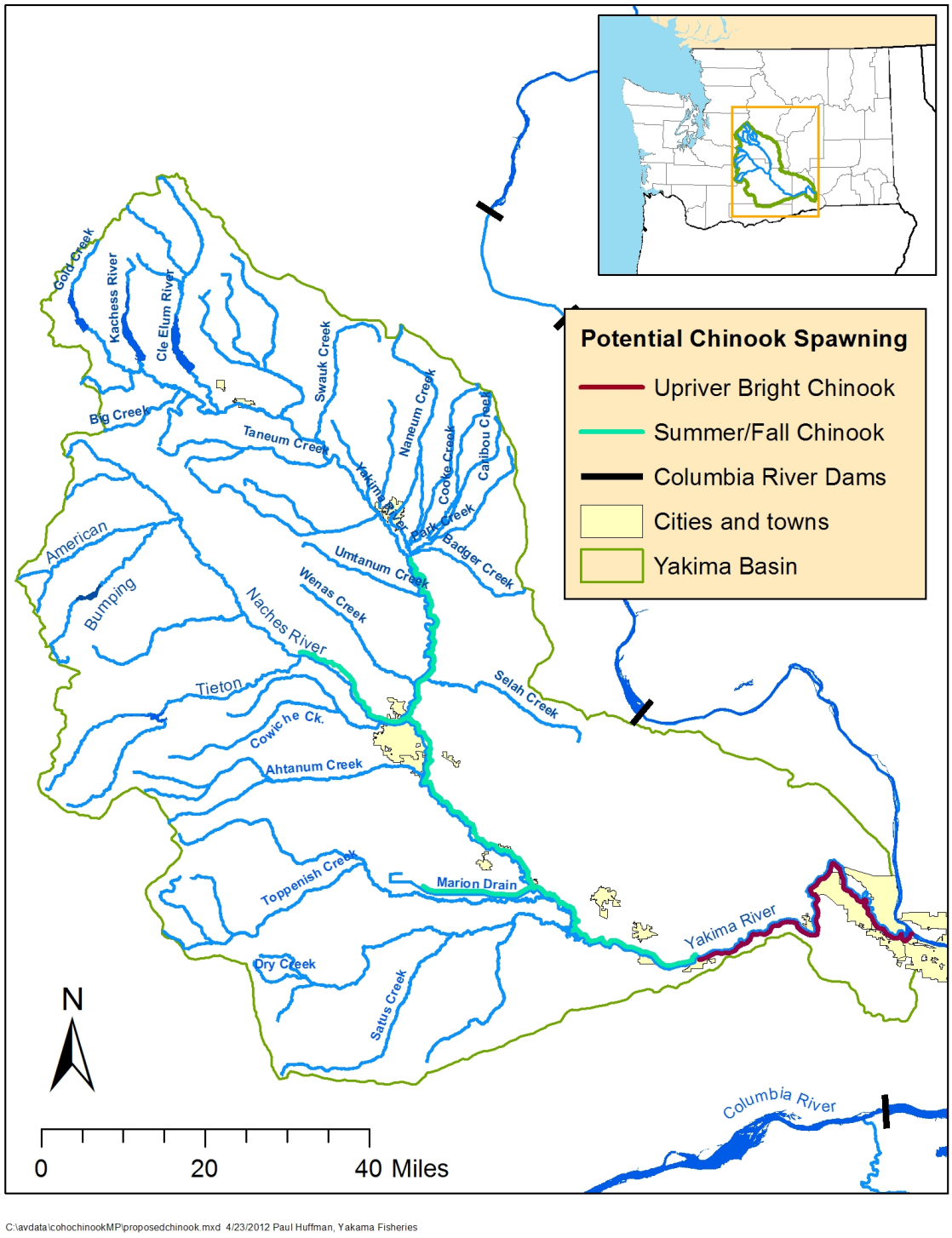


Figure 2-3. Expected spawning distribution of Yakima Basin summer/fall and URB fall Chinook.

2.1.2 Habitat Context

To be successful, hatchery programs must be part of an integrated, "all H" (Hatcheries, Habitat, Harvest, and Hydro) strategy. While hydro system activities are outside the scope of this Master Plan, the effects of mainstem Columbia River and Yakima Basin irrigation storage dams (Hydro) on the survival of fish populations originating in the Yakima River have been taken into consideration when setting hatchery release numbers, adult escapement, and harvest goals.

Protecting existing high quality stream habitat and restoring degraded habitat is essential to restoring sustainable fisheries. The Yakima Subbasin and Recovery Plans identify major habitat factors limiting fish production and propose strategies and actions to improve habitat quality and quantity. These habitat strategies are expected to provide benefits to all resident and anadromous fish species in the Basin. The YKFP, which includes the proposed and all other hatchery programs in the basin, is an integral part of the comprehensive basin planning process.

As a result of recent and on-going efforts to restore habitat (for examples, see YBFWRB 2011), there is reason to be optimistic that the middle reaches of Yakima Basin will once again be able to support natural spawning of Chinook. The Yakama Nation believes that time is now right to begin the process of reestablishing the lost summer/fall Chinook life history to the Yakima River.

2.1.3 Current Hatchery Programs

The hatchery programs described in this Master Plan will be components of the Yakima-Klickitat Fisheries Project (YKFP). Species currently being enhanced by the YKFP and the Yakama Nation Fisheries Program are spring, and fall Chinook salmon, coho salmon, sockeye salmon, and steelhead trout. The Tribe's hatchery production programs for URB fall Chinook began in the Yakima Basin in 1983 (Yakama Nation 2007); for spring Chinook in 1997; and for coho in 1995 (Dunningan et al. 2002; Yakama Nation 2004)[1]. The Tribe has conducted an interim fish reintroduction program since 2005 at Cle Elum Reservoir that has included coho since 2012 and sockeye since 2009 (BPA 2009; USBR and WDOE 2011).

The Cle Elum Supplementation and Research Facility (CESRF) collected its first spring Chinook broodstock in 1997, released its first fish in 1999, and age-4 adults have been returning since 2001, with the first F2 generation (offspring of CESRF and wild fish spawning in the wild) returning as adults in 2005.

The YKFP is releasing of over 2.0 million URB fall Chinook smolts annually from the Prosser and Marion Drain hatcheries. These fish are of Priest Rapids origin. A portion of the production is derived from broodstock collected in the vicinity of Prosser Dam, while the remainder is from Priest Rapids stock reared at Little White Salmon National Fish Hatchery and moved to Prosser Hatchery for final rearing and release. Marion Drain broodstock are collected from adult returns to a fish wheel in the drain.

The Yakima URB fall Chinook program began in 1983. In early years the program consisted of direct stream and/or acclimated releases transferred from out-of-basin facilities. The first year of operation for the Prosser Hatchery was 1994. The first year of operation for the Marion Drain Hatchery was 1997.

In 2008, the YN began a limited release of Wells Hatchery-origin summer Chinook at Prosser. From 2008 to 2011, the Tribe released approximately 200,000 Wells Hatchery summer Chinook per year to the river.

[1] Hatchery coho releases by the Tribe extend back to the mid-1980s.

The total number of late-run URB fall Chinook returning to the basin has averaged about 5,000 adults (hatchery and natural origin) since 2010 (Table 2-2)[2]. Recreational anglers harvest about 16 percent of the annual Chinook returns to the basin each year. Because of the quantity and relatively higher quality of late-run URB fall Chinook available to tribal fishers in Zone 6 Columbia River fisheries, historical Yakima River tribal harvest is typically less than 2 percent of the total run each year. Releasing hatchery URB fall Chinook juveniles at RM 10 is expected to improve fish quality and increase in-river tribal fishing effort and success substantially.

Table 2-2. Estimated late component fall Chinook return, escapement, and recreational harvest in the Yakima River, 2000-2010.

Year	NOR Smolts	Total Return		Above Prosser		Below Prosser		WA Recreational Harvest			Total Escapement
		Adult	Jack	Adult	Jack	Adult	Jack	Adult	Jack	Rate	
2000	198,002	4,557	1,138	1,371	922	2,931	194	255	22	4.9%	5,418
2001	-----[1]	5,886	869	3,651	660	1,293	151	942	58	14.8%	5,755
2002	95,424	13,369	211	6,146	95	4,923	116	2,300	0	16.9%	11,280
2003	113,577	10,092	193	4,796	79	3,874	73	1,422	41	14.2%	8,822
2004	217,832	5,825	354	2,862	85	2,231	223	732	46	12.6%	5,401
2005	182,278	3,121	45	1,920	22	491	7	710	16	22.9%	2,440
2006	43,716	2,299	67	1,499	29	363	10	437	28	19.7%	1,901
2007	28,989	1,318	460	892	240	194	26	232	194	24.0%	1,352
2008	88,905	3,403	208	2,739	124	137	17	527	67	16.4%	3,017
2009	77,312	3,315	772	2,381	591	424	106	510	75	14.3%	3,502
2010	268,827	3,474	176	2,763	125	270	12	441	39	13.2%	3,170
2011	55,516	3,318	705	2,311	400	470	81	537	224	18.9%	3,262
Aver	124,580	4,998	433	2,778	281	1,467	85	754	68	16%	4,610

Source: WDFW and Yakama Nation databases

[1] Due to severe drought in 2001, NOR counts are not considered in this total.

2.2 COHO OVERVIEW

The primary goal for the Yakama Nation's coho hatchery program is to increase harvest opportunity for tribal members as provided in the Treaty of 1855 (12 Stat.951) and US v Oregon (1969). The program has a secondary goal, which is to restore natural spawning of coho in the Yakima Basin. However, significant habitat improvement will be necessary before sustainable natural production is achievable.

Two coho programs are addressed in this Master Plan: a segregated harvest program in the lower Yakima River, referred to as the ***Lower Yakima Segregated Coho Program***, and an upper Yakima reintroduction program, referred to as the ***Upper Yakima Integrated Coho Program*** (Table 2-3). The purpose of the former is to provide harvest. The purpose of the latter is to contribute to harvest, but also to reestablish natural spawning of coho in tributaries where they historically spawned. The initial

[2] Because hatchery fish are not 100% marked, it has not been possible to determine the proportion of the run that is of natural origin.

phases of both programs have been completed and the modifications proposed under this Master Plan will implement the final program phases (referred to as Phases 3 and 4). Figure 2-4 illustrates the historic Yakima Basin coho spawning areas and Figure 2-5 shows tributaries that have been or are targeted for coho reintroduction.

Table 2-3. Overview of the two Yakima coho programs addressed in this Master Plan.

	Lower Yakima Segregated Coho Program	Upper Yakima Integrated Yakima Coho Program
Natural population	None	Extirpated
ESA Status	Not Listed	Not Listed
Spawning Area	Not intended to spawn	Yakima River tributaries
Conservation Goals		Reestablish a naturally spawning coho population in the Yakima Basin with > 3500 natural-origin spawners in the long term
Harvest Goals	Contribute > 20,000 adults to all fisheries, > 8,000 to Zone 6 and the Yakima River fisheries	
Yakama Nation Cultural Goal	Meet treaty harvest entitlements per US v. Oregon agreements	Reestablish natural spawning of coho in tributaries where they occurred historically
Broodstock Origin	Lower Columbia hatchery coho	Lower Columbia hatchery coho
Hatchery Program Purpose	**Harvest**	**Harvest** and reestablishment (**re-colonization**) of a naturally spawning coho population
Hatchery Broodstock Management	This currently is and will continue to be a **segregated** program. It will transition to a **segregated "stepping stone"** program over time providing genetic continuity with the Upper Yakima integrated program.	This program has completed two of four phases. In phase 3, broodstock will transition to local brood. In phase 4, it will incorporate natural-origin returns in the brood and become **integrated.**
Hatchery Broodstock Collection Locations	With the implementation of this Master Plan, broodstock will be drawn from returns from the local program at Prosser to increase survival and homing.	
Hatchery Program Size—Phase 3	500,000 smolts	500,000 parr 200,000 smolts
Hatchery Program Size—Phase 4	800,000 smolts total for the two programs	
Release Locations	Below Prosser	Tributaries and upper Yakima and Naches mainstem reaches

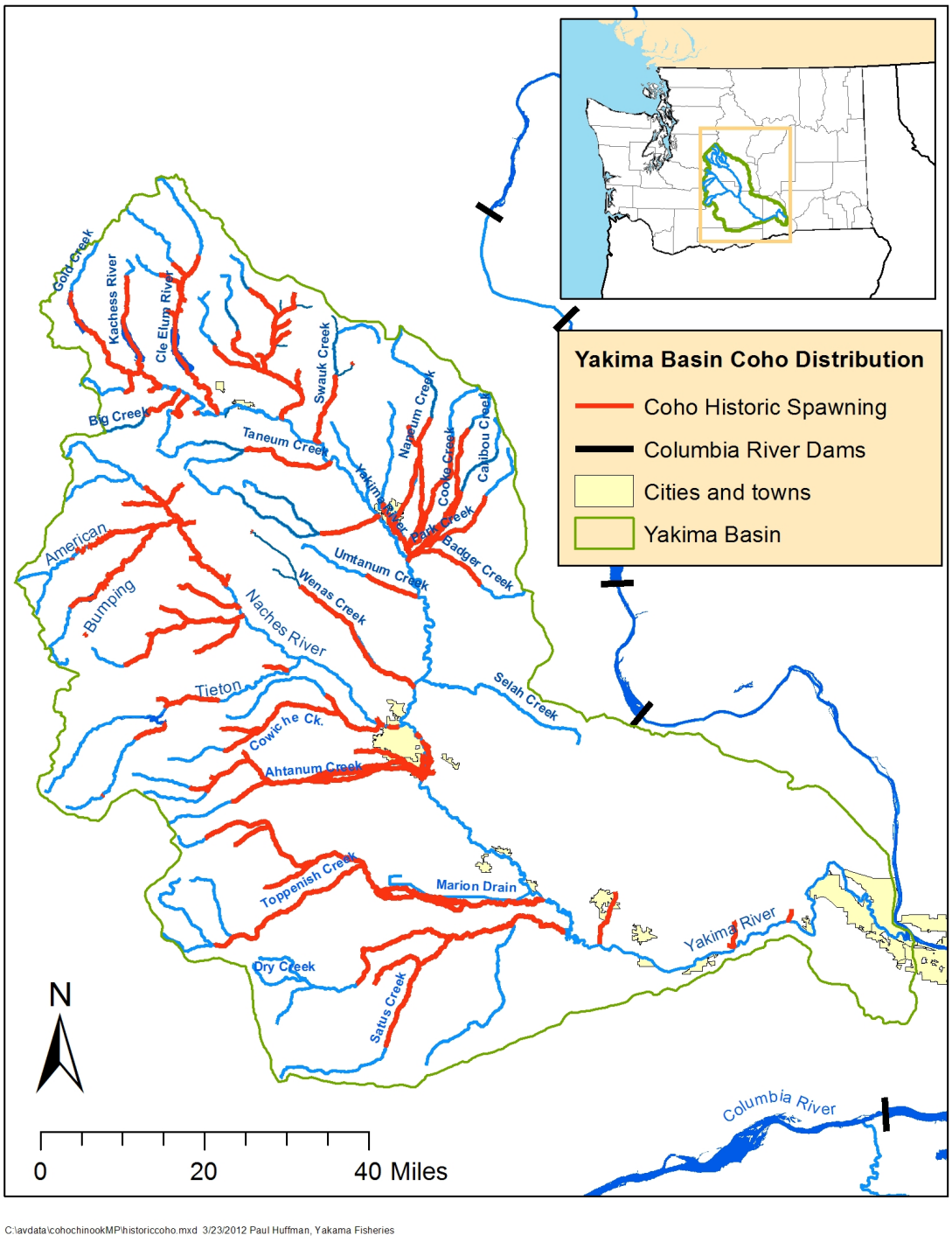


Figure 2-4. Historic coho spawning areas in the Yakima Basin.

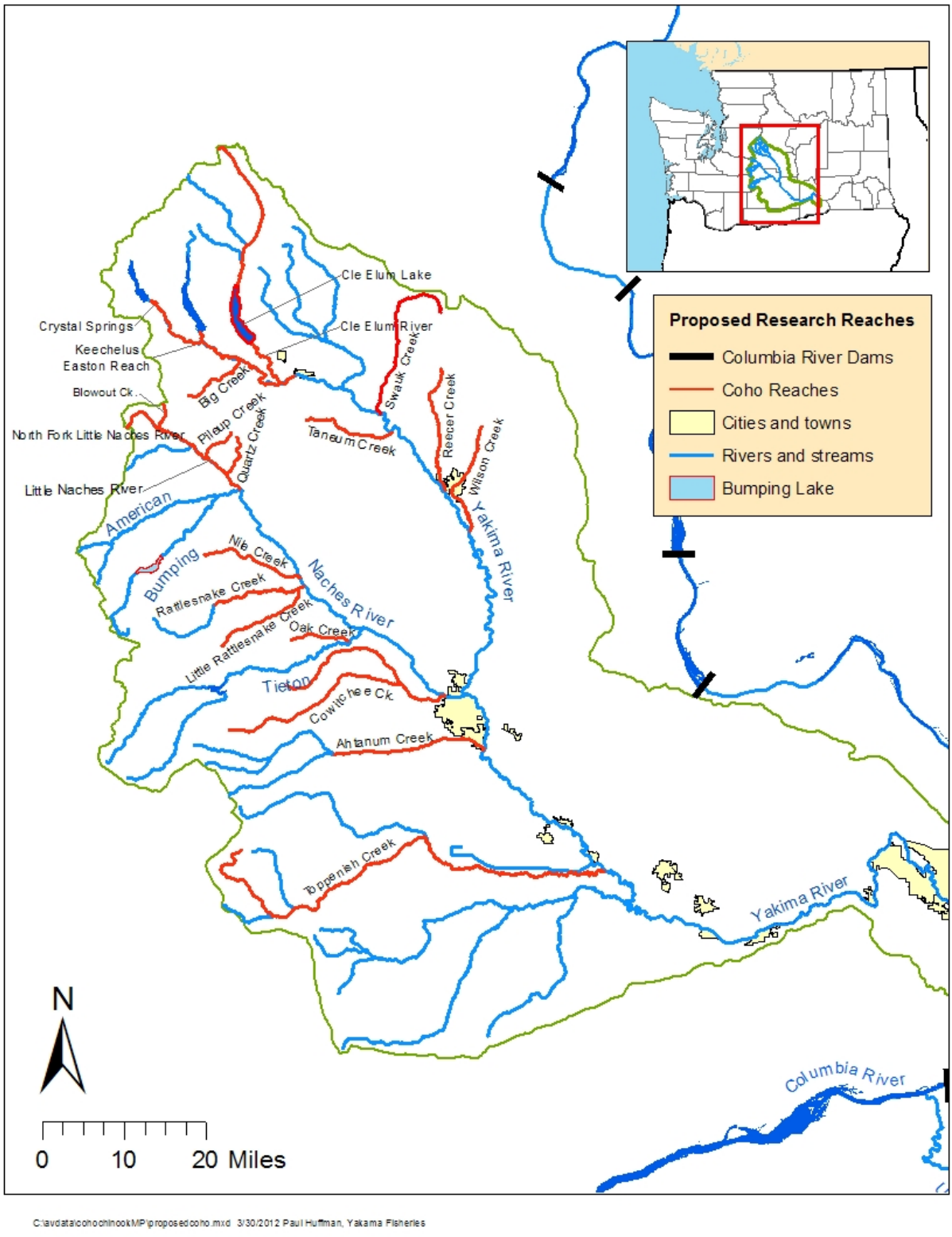


Figure 2-5. Reaches targeted for coho reintroduction.

2.2.1 Historic Context and Coho Population Status

Historical returns of coho to the Yakima River Basin are estimated to have been in the range of 44,000 (Kreeger and McNeil 1993) to more than 100,000 fish annually. Coho were extirpated from the Yakima Basin by the early 1980s. Habitat loss and high pre-terminal exploitation rates contributed to the demise of the natural coho population in the Yakima Basin. Those coho currently found in the Yakima Basin are the result of hatchery releases that began in the mid-1980s. Presence of naturally spawning coho in the Yakima River and its tributaries has high cultural significance to the YN.

The Yakima River coho population has not been defined formally by Endangered Species Act petitions or listings because it is derived from reintroduced non-native stocks. Yakima River smolt and adult production is shown in Table 2-4. Estimated average hatchery and natural coho smolt production from 2000-2010 has been approximately 210,000 and 31,000, respectively. Over this same period, combined adult natural and hatchery coho returns have averaged about 5,000 fish.

Table 2-4. Summary of Yakima River coho smolt and adult production and adult SAR for migration years 2000-2010.

Juvenile Migration Year	Hatchery-origin Coho			Natural-origin Coho			Total Smolts	Total Adults
	Chandler Smolts[a]	Prosser Adults[b]	SAR Index	Chandler Smolts[a]	Prosser Adults[b]	SAR Index[C]		
2000	317,655	3,546	1.12%	61,587	1,432	2.33%	379,242	4,978
2001	102,283	166	0.16%	40,605	309	0.76%	142,888	475
2002	197,938	669	0.34%	42,605	1,523	3.57%	240,543	2,192
2003	121,802	505	0.41%	19,970	1,820	9.11%	141,773	2,325
2004	172,611	2,341	1.36%	18,787	472	2.51%	191,398	2,813
2005	353,433	2,612	0.74%	48,393	1,562	3.23%	401,826	4,174
2006	256,572	2,211	0.86%	17,699	1,049	5.93%	274,270	3,260
2007	259,797	3,925	1.51%	16,375	665	4.06%	276,171	4,590
2008	354,973	7,962	2.24%	57,090	1,855	3.25%	412,063	9,817
2009	456,477	3,300	0.72%	110,958	2,408	2.17%	567,435	5,708
2010	307,530	5,615	1.83%	107,539	2,403	2.23%	415,069	8,018
Average	263,734	2,987	1.0%	49,237	1,409	3.6%	312,971	4,395

[a] Yakama Nation estimates of coho smolt passage at Chandler (for details see Neeley 2006).
[b] Yakama Nation estimates of age-2 and age-3 coho returns to Prosser Dam for this juvenile migration cohort.

2.2.2 Habitat Context

As described for Chinook in Section 2.1.2, to be successful, these hatchery programs will be more successful in combination with habitat improvements. The habitat context for Yakima coho is the same as that described in Section 2.1.2 for Chinook.

Continued habitat improvements are need before long term and sustainable natural coho production will be assured; however, given the success of the initial reintroduction efforts, the time is now right to

move the reintroduction into its third phase and complete the transition to local brood and continue to test the productivity of the habitat.

2.2.3 Current Hatchery Programs

The coho hatchery programs described in this Master Plan will be components of the YKFP (see Section 2.1.3 above) with the goal of enhancing existing stocks of anadromous fish in the Yakima and Klickitat river basins while maintaining genetic resources, reintroducing stocks formerly present in the basins, and apply knowledge gained about hatchery supplementation throughout the Columbia River Basin. Another goal of the YKFP is to provide harvest opportunities.

Hatchery produced coho were first introduced in the Yakima Basin in 1983 with the release of 324,000 Little White Salmon Hatchery smolts. This harvest augmentation program was modified when it was incorporated into the BPA-funded YKFP in 1996, with a goal of using hatchery production to reestablish or increase natural production of anadromous salmonids and to increase harvest opportunities. The feasibility of achieving these goals was confirmed at the conclusion of the first phase of the YKFP in 2004. From 2000 to 2003, releases from Yakima-origin broodstock had significantly higher smolt-to-smolt survival indices than releases from out-of-basin broodstock (Bosch et al. 2007).

The second phase of the coho program began in 2004 to establish a naturally producing coho population in upper and lower Yakima tributaries and in the Naches River and its tributaries. It was also intended to study the life history of reintroduced coho and their ecological interactions with other species. Prior to 2008, this second phase acclimated and released less than 500,000 Yakima-origin smolts annually in these two systems, a number that increased in subsequent years. Eagle Creek National Fish Hatchery provided broodstock to supplement Yakima-origin returns during the second phase of the program. This phase is expected to end in 2012 with the transition to local broodstock.

The YKFP has been releasing over 1.0 million coho smolts annually from acclimation sites in the Naches and Upper Yakima subbasins. These fish are a combination of in-basin production from broodstock collected near Prosser Dam plus out-of-basin stock generally reared at Willard or Eagle Creek National Fish Hatcheries and moved to the Yakima Basin for final rearing and release. YKFP monitoring of these efforts to reintroduce a sustainable, naturally spawning coho population indicates that adult returns averaged over 3,600 fish from 1997-2009[3], including estimated returns of natural coho averaging nearly 1,400 fish since 2001. Coho reintroduction research has demonstrated that hatchery-origin coho, with a legacy of as many as 10 to 30 generations of hatchery influence, can reestablish a naturalized population after as few as 3 to 5 generations of outplanting in the wild (Bosch et al. 2007).

In this Master Plan, two separate hatchery programs are defined and described: a Lower Yakima Segregated Program intended to provide harvest benefits; and an Upper Yakima Integrated Program intended to provide both harvest and natural production (re-colonization) benefits. The biological objectives and strategies for each of those programs are described in Section 5.

[3] An order of magnitude greater than the average for years prior to the project.

2.3 SUMMARY OF PROPOSED PRODUCTION FACILITIES AND OPERATIONS SCHEDULES

Programs will be expanded or developed at three Tribal facilities, Prosser, Marion Drain and Holmes Ranch hatcheries. Aquaculture programs currently operate at each of these sites but will be expanded to accommodate the proposed program modifications. The coho, summer/fall Chinook and URB fall Chinook program components proposed at each facility are identified in Table 2-5.

Table 2-5. Facilities proposed for coho, summer/fall Chinook and URB program components.

Facility	Life Stage	Dates in Use
Coho		
Prosser	Adult holding	Oct - Nov
Holmes Ranch	Adult holding	Oct - Jan
Prosser	Incubation	Oct - Feb
Holmes Ranch	Incubation	Oct - Feb
Prosser	Juvenile rearing	Feb - April
Holmes Ranch	Sub-yearling rearing	Mar - July
Summer Component of the Summer/Fall Chinook Program		
Marion Drain	Adult holding	Aug - Oct
Marion Drain	Incubation	Oct - Jan
Marion Drain	Subyearling rearing	Feb - May
Marion Drain	Yearling rearing (Option 1)	Feb – Mar (of following year)
URB and Fall Component of the Summer/Fall Chinook Program		
Prosser	Adult holding	Sept - Nov
Prosser	Incubate eggs (URB) for program downstream of Prosser	Oct - Jan
Prosser	Incubate upstream of Prosser eggs for summer/fall program	Oct- March
Prosser	Rear juveniles (URB) for downstream of Prosser program	Jan - Feb
Prosser	Rear summer/fall program juveniles	Jan - April

Facility decisions evolved during biological and engineering evaluations that were based on program objectives defined by the Yakama Nation. Once these biological goals and parameters were defined, hatchery operations schedules were developed to determine the size of the facilities needed to support the proposed programs. These schedules, presented in Appendix C, demonstrate how the target production for each salmon program will be achieved.

The primary biological variables used to prepare the preliminary operations schedule include water temperature, a species-specific condition factor, and density and flow indices. Water temperature is the primary determining factor in the development and growth rate of fish. The schedules show the use of a combination of groundwater and surface water at each facility; growth rates were calculated accordingly. In general, groundwater will be used for incubation and early rearing, and for juvenile rearing from June through October when the surface water is too warm for optimum fish health. River water will be used for adult holding (except for the coho program), juvenile rearing from November through May, and for acclimation prior to release.

A density of 0.5 lb/cf of rearing volume and a flow index of 1.0 have been used for each program reflecting the experience of Yakama Nation fish culturists. The resulting schedules depict water use by month and space requirements for each operational area of the fish culture process, including incubation, early start-up rearing and juvenile rearing in outdoor raceways. The adult holding component of each program is also identified.

The preliminary operations schedules depict a two-year period in order to understand and incorporate potential overlapping water requirements for juvenile fish (reared to a yearling stage) from two brood years on site at one time. Information presented in these schedules is summarized for each facility below. Detailed descriptions of facilities associated with each of the four programs are provided in Sections 4 and 5.

2.3.1 Summary of Proposed Prosser Hatchery Operations

A summary schedule of all fish programs at Prosser Hatchery is provided in Table 2-6.

Table 2-6. Prosser Hatchery operations schedule for proposed URB fall Chinook, fall component of the summer/fall Chinook and lower Yakima coho programs.

Species/Life Stage	Timeframe	No. of Fish	Water Requirement	Holding Volume
Fall Chinook / Adult Holding	Sept – Nov	350 adults	875 gpm surface water	1,750 cf
Coho / Adult Holding	Oct – Nov	780 adults	945 gpm chilled groundwater	3,000 cf
URB Chinook / Downstream of Prosser Program Incubation	Oct – mid-Jan	2,145,000 eggs	160 gpm chilled groundwater	500 isolation buckets, transferred to 27 double stacks of Marisource trays (5,000 eggs per tray)
Fall component of summer/fall Chinook / Upstream of Prosser Program Incubation	Oct – mid-Mar	556,000 eggs	44 gpm chilled groundwater	FRP troughs, transferred to 8 double stacks of Marisource trays (5,000 eggs per tray)
Coho Incubation	Oct – Feb	770,000 eggs	77 gpm chilled groundwater	FRP troughs, transferred to 13 double stacks of Marisource trays (4,000 eggs per tray)

Species/Life Stage	Timeframe	No. of Fish	Water Requirement	Holding Volume
URB Chinook / Downstream of Prosser Program Juvenile Rearing	Jan – Feb	1,700,000	2,375 gpm groundwater transitioning to surface	10,000 cf of raceway volume
	Feb – Jun	1,700,000 moved to acclimation site	6,400 gpm surface water	45,300 cf
Fall component of summer/fall Chinook / Upstream of Prosser Program Juvenile Rearing	Jan – Apr	500,000 sub-yearlings	1,500 gpm groundwater transitioning to surface	9,300 cf
Coho / Juvenile Rearing	Feb – Apr	500,000 yearlings	5,560 gpm	62,400 cf

In addition to supporting these fall Chinook and coho life stages at Prosser Hatchery, the Tribe intends to continue to operate its steelhead kelt reconditioning and lamprey programs. While these two programs are not components of this Master Plan, the space and water supply requirements are listed here for completeness.

- **Steelhead Kelt Reconditioning**: Kelt reconditioning is conducted year round in existing circular tanks using 2 cfs of groundwater.

- **Lamprey Research**: Lamprey are produced as part of an experimental program that extends year round in circular tanks that use 20 gpm of ground and surface water.

2.3.2 Summary of Proposed Marion Drain Hatchery Operations

Proposed improvements at Marion Drain Hatchery will support the summer component of the summer/fall Chinook program. Due to limitations in river water and groundwater supplies, the rearing phases of summer Chinook yearlings and sub-yearlings will use a 25 percent make-up water reuse system. Troughs will be used for bulk incubation of green eggs, and Marisource trays will be used for eyed eggs. Juveniles will be reared in 30-foot-diameter round tanks, with each pair of tanks sharing a reuse water system. Primary reuse system components will consist of a micro-strainer for solids removal, a pump sump and recirculation pumps, and aeration tower for stripping CO^2 and re-oxygenation of the water before it flows back into the rearing tanks. This type of system was recently tested at Eastbank Hatchery with good results (Summerfelt 2008). The operating schedule for the Marion Drain summer Chinook program component is summarized in Table 2-7 below. Note that the table reflects two options to achieve adult production targets at Marion Drain. Under Option 1, 250,000 sub-yearlings and 250,000 yearlings would be produced. Under Option 2, 1 million sub-yearlings and no yearlings would be produced.

Table 2-7. Marion Drain Hatchery operations schedule for summer component of the summer/fall Chinook program upstream of Prosser—Options 1 and 2.

Species/Life Stage	Timeframe	No. of Fish		Water Requirement		Holding Volume	
		Option 1	Option 2	Option 1	Option 2	Option 1	Option 2
Summer Chinook/ Adult Holding	August – October	350 adults	600 adults	875 gpm surface water	1,500 gpm surface water	1,750 cf	3,000 cfs
Summer Fall Chinook/ Incubation	October – mid-January	578,000 eggs	1,156,000 eggs	43 gpm chilled ground-water	87 gpm chilled groundwater	FRP troughs, transferred to 8 double stacks of Marisource trays (5,000 eggs per tray)	
Summer Chinook/ Sub-yearling Rearing	February – May	250,000 sub-yearlings	1 mill sub-yearlings	244 gpm peak ground-water	322 gpm peak ground-water; 644 gpm surface water makeup needed	6,720 cf	15,000 cf
Summer Chinook/ Yearling Rearing	February – March of the following year	250,000 yearlings	None	483 gpm groundwater make-up flow through Oct.; 1,449 gpm surface water makeup flow rate	None	33,000 cf	

In addition to supporting these summer/fall Chinook life stages at Marion Drain Hatchery, the Tribe intends to continue to operate a sturgeon program at this site. This program is not a component of this Master Plan, and the space and water supply it requires are completely distinct from the existing and proposed Chinook facilities.

2.3.3 Summary of Proposed Holmes Ranch Hatchery Operations

Improvements are proposed at Holmes Ranch Hatchery to support the upper Yakima coho program. Due to limited surface and groundwater supplies, the rearing phases for both yearling and sub-yearling (parr) coho will use a 25 percent make-up water reuse system similar to that proposed at Marion Drain. The operating schedule for the coho program is summarized in Table 2-8 below.

Table 2-8. Holmes Ranch Hatchery operations schedule for the Upper Yakima coho program.

Species/Life Stage	Timeframe	No. of Fish	Water Requirement	Holding Volume
Coho / Adult Holding	October – January	1,000 adults (up to 400 in the facility at one time)	300 gpm chilled groundwater in Oct.; transitioning to peak flow of 800 gpm river water in Nov.	2,000 cf
Coho / Incubation	October – February	1,080,000 eggs	100 gpm chilled groundwater	FRP troughs, transferred to 17 double stacks of Marisource trays (4,000 eggs per tray)
Coho / Sub-yearling Rearing	March – July	500,000 sub-yearlings (parr)	Combo ground and surface water; 480 gpm peak make-up flow; 1,460 gpm total recirculation flow	10,600 cf
Coho / Yearling Rearing	March – March of the following year	200,000 yearlings	810 gpm max groundwater makeup flow June – Oct.; 966 gpm surface flow Nov. – March	19,000 cf

3.0 ADAPTIVE MANAGEMENT AND DECISION MAKING PROCESS FOR THE CHINOOK AND COHO PROGRAMS

The success of the four hatchery programs covered in this Master Plan is premised on well-established knowledge, assumptions supported by available data, expectations about future conditions, and most importantly an adaptive management framework for addressing uncertainties and preparing for the unexpected. A strategy is described for using hatchery programs as tools for meeting resource goals, however, it also recognizes that key assumptions may be wrong and circumstance may change over time. The adaptive management framework described in this section is intended to assure a) that resource goals are clearly articulated and communicated to mangers and staff involved in program operations; b) that hatchery strategies implemented are scientifically defensible, i.e., they are based on a working hypothesis that is supported by the best available information; and c) that information gained through research and monitoring and evaluation is effectively incorporated in an annual decision making process.

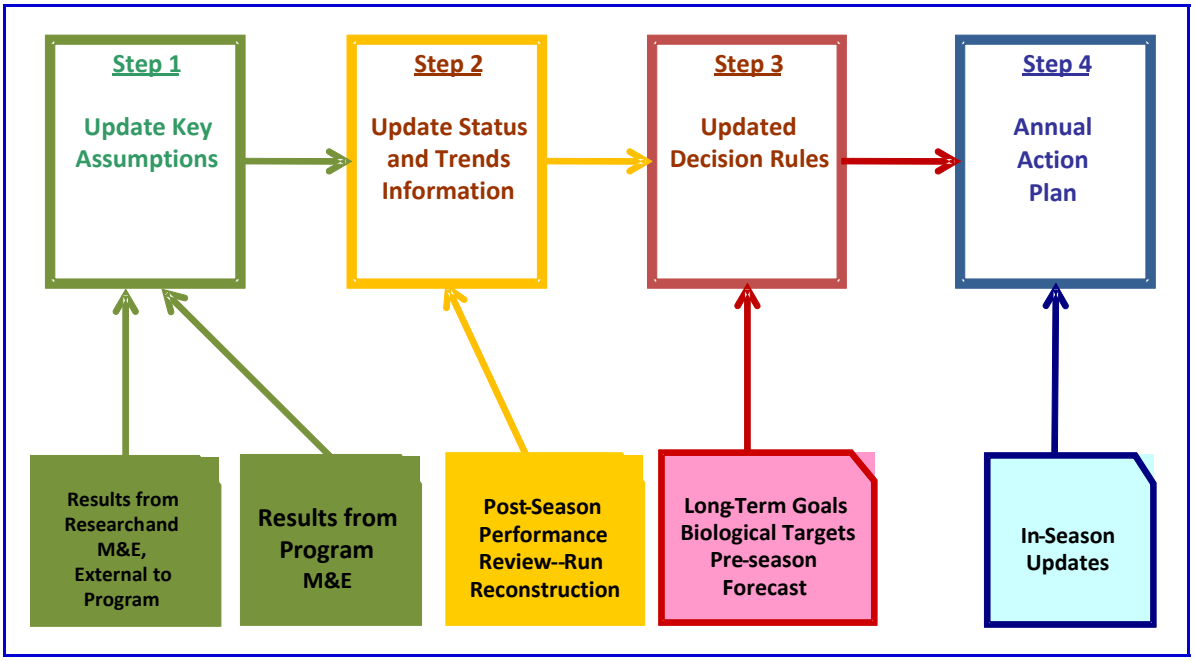
3.1 UNCERTAINTY AND ADAPTIVE MANAGEMENT

Given the uncertainty in managing fishery programs, a fundamental feature of the Tribe's Master Plan is a proposed in-season adaptive management and decision-making process.

The purpose of the annual decision process is to produce an annual action plan that assures progress toward the long-term harvest and production goals. The action plan incorporates monitoring and

evaluation (M&E) components, which are then fed back into the decision process to complete the adaptive management loop, assuring that the most recent information is used to guide decisions. The annual decision process also provides an important opportunity to inform and engage the tribal community, co-managers, the broader scientific community and other interested parties.

The process has four steps: (1) establish and document a scientifically defensible working hypothesis (key assumptions) for the programs; (2) report and review the most recent empirical data on key population metrics (status and trends); (3) establish biological targets and management triggers to assure appropriate responses to annual variations in population abundance (referred to as the Decision Rules); and (4) apply the Decision Rules to set targets for hatchery broodstock, natural escapement, terminal harvest and priorities for M&E for the coming season (this is the annual Action Plan). This process is illustrated in Figure 3-1.



Source: D.J. Warren & Associates 2009

Figure 3-1. Components of the annual decision/adaptive management process.

Opportunities to make progress toward long-term goals will vary from year to year depending on status and trends in population abundance and productivity and forecasts for the coming season. Other unforeseen events and circumstances may also warrant in-season management responses.

3.1.1 Annual Decision Making Process

The annual decision making process centers around a pre-season workshop where status and trends, key assumptions, and previously agreed upon Decision Rules are reviewed and translated into an Annual Action Plan. This workshop may be held in conjunction with the annual Yakima Basin Aquatic Science and Management Conference. Prior to this workshop, YKFP staff will update key assumptions and status and trends based on monitoring results from the most recent season. This information will be captured

in a form similar to the In-Season Implementation Tool (ISIT) (DJ Warren & Associates 2009), a database and calculator described in Appendix E. Decision Rules will be reviewed each year, but barring extraordinary circumstances, should only be updated every five to ten years. In other words, decisions will change each year due to new information, but the rules for making those decisions should remain stable. The Decision Rules are described in Section 3.4.4 for coho and Section 3.3.4 for Chinook programs.

The agenda for the pre-season workshop is driven by the outline of the key assumptions (Sections 3.2.2 and 3.3.2) and status and trends (Sections 3.2.3 and 3.3.3), where the new information obtained from the M&E program will be highlighted. The key assumptions part of the agenda will identify the following for each population component: habitat and natural production parameters, smolt-to-adult survival parameters, harvest parameters (e.g., pre-terminal exploitation rates), and hatchery production parameters (e.g., updated in-hatchery survival projections). The status and trends portion of the agenda will address natural production (e.g., most recent spawning escapement abundance and composition), harvest, and hatchery production by species and hatchery program.

The process described here is not intended to in any way alter the legal and policy mandates and responsibilities of the entities involved in the fishery management process in the Yakima Basin. Instead it is meant to provide a structure within which those responsibilities can be carried out in a manner that is consistent with the existing agreements.

3.1.2 Annual Adaptive Management Work Products

End products from the annual workshop will be an updated version of the program status and trends, key assumptions, and previously agreed upon Decision Rules. Management decisions informed by this material and the updated M&E and research priorities (Section 3.4 and 3.5) will be translated into the Action Plan. This Annual Action Plan is the blueprint for actions related to programs described in this Master Plan for the coming year. All work products produced as part of the annual review process, including the Action Plan, will be included in a comprehensive annual report.

The artificial production programs described in this Master Plan will be implemented within an adaptive management framework (Section 3.1). The hatchery production strategy laid out in this plan is based on knowledge about the biological system (the species and their environment), and on a set of assumptions about how this system will respond to the planned anthropogenic interventions. This understanding of the system, or working hypothesis, is captured in a set of key assumptions. These key assumptions are consistent with available data and information, but are still subject to uncertainty, hence the need for an experimental/adaptive management approach.

By following the working hypothesis, in combination with habitat improvement, the hatchery programs described in this plan will progress towards the harvest and conservation goals for Yakima coho and Chinook. The biological requirements to meet these goals, given the working hypothesis, are translated into a set of measurable biological objectives that define success for the hatchery programs.

Outcomes of the adaptively managed programs will be reported annually as the realized recruitment of adult fish, catch, and spawning escapement. Over time, this empirical data illustrates the status and trends of the resource. Status and trend information informs managers about progress toward long-term goals and about effectiveness of the adaptive management process.

A basic presumption is that given the up-to-date population status, there is a "right strategy" for managing the hatchery programs in the coming season. The right strategy is one that meets annual harvest needs, while assuring that progress is made toward other long-term goals. This strategy is captured in a set of Decision Rules based on key assumptions and biological objectives. The decision rules would change only when key assumptions are updated. As described in Section 3.1.1, an adaptive management strategy is implemented each year at the Annual Project Review (APR). The monitoring and evaluation program (Section 3.4) is the backbone of the adaptive management process. Management precision is directly related to the completeness and quality of the information collected.

In the following sections, the biological objectives, key assumptions, status and trends, decision rules, annual project review, and monitoring and evaluation components of the adaptive management framework are described for each phase of the coho and Chinook hatchery programs covered in this master plan.

3.2 COHO

3.2.1 Biological Objectives

In the long-term, the goals of the Yakima coho programs are to increase harvest opportunities for coho consistent with U.S. v Oregon agreements and to establish a sustainable natural population of coho in Yakima River tributaries and mainstem reaches. Biological objectives required to meet these goals are identified in Table 3.1.

Table 3-1. Biological objectives for the two Yakima coho programs by phase.

Phase 3		Phase 4	
Lower Yakima Segregated Program	**Upper Yakima Integrated Program**	**Lower Yakima Segregated Program**	**Upper Yakima Integrated Program**
	>5,000 (NOR+HOR) spawners		>3,500 NOR spawners
All local broodstock	All local broodstock	All brood from upper Yakima integrated HORs	Integrated broodstock resulting in PNI > 0.75 and pHOS < 30%
Average annual harvest contribution from both programs to all fisheries > 14,000 coho		Average annual harvest contribution from both programs to all fisheries > 20,000 coho	
Average annual harvest contribution from both programs to Zone 6 and Yakima River fisheries > 5,000 coho		Average annual harvest contribution from both programs to Zone 6 and Yakima River fisheries > 8,000 coho	

3.2.2 Key Assumptions

The annual working hypotheses, or key assumptions, for natural (Table 3-2) and hatchery (Table 3-3) coho production in Phase 3 and Phase 4 are identified below. Assumptions may be modified each year based on research, and monitoring and evaluation outcomes. These assumptions were incorporated into the ISIT tool for forecasting outcomes regarding harvest and conservation benefits.

Table 3-2. Natural production assumptions for Yakima coho in Phases 3 and 4.

	Phase 3	Phase 4
Productivity (Smolts/Spawner)*	34	93
Capacity (Smolts)*	72,059	256,720
SAR (Prosser to Prosser)	5.0%	5.0%
Fitness	0.50	0.91
PNI	0.32	0.77
pHOS	63%	22%
Ocean Harvest Rate	8%	8%
Lower Columbia Harvest Rate	8%	8%
Upper Columbia Harvest Rate	10%	10%
Terminal Harvest Rate	10%	10%
Percent of NORs Accessible at Prosser	30%	30%
* Productivity and capacity values include fitness loss.		

Table 3-3. Hatchery production assumptions for Yakima coho in Phases 3 and 4.

	Phase 3		Phase 4	
	Lower Yakima Segregated Program	Upper Yakima Integrated Program	Lower Yakima Segregated Program	Upper Yakima Integrated Program
Local Broodstock	100%	100%	[*]	100%
Imported	0%	0%	0%	0%
Percent HORs Returning to Hatchery	>95%	20%	95%	20%
SAR	1.9%	1.38%	1.9%	1.9%
Minimum pNOB	0%	30%	[*]	75%
NOB as a percent of NOR Escapement	0%	7%	0%	2%
Ocean Harvest Rate	33%	8%	33%	33%
Lower Columbia Harvest Rate	29%	8%	29%	29%
Upper Columbia Harvest Rate	10%	10%	30%	30%
Terminal Harvest Rate	10%	10%	20%	20%
Percent of HORs Accessible at Prosser	30%	30%	30%	30%
[*] Brood for the segregated program will be 100% HORs from the integrated program.				

3.2.3 Status and Trends

To confirm progress toward long-term biological goals, measured parameters will be compiled annually to depict status and trends. An example of how data may be presented is shown in Table 3-4.

Table 3-4. Sample table for reporting annual coho population status and trends.

	Lower Yakima Segregated Coho Program			Upper Yakima Integrated Coho Program				Coho Returns to Prosser	
	Imported Brood	Local Brood	Release	Imported Brood	Local Brood	NOR Brood	Release	Hatchery Origin	Natural Origin
2008									
2009									
2010									
2011									
2012									
2013									
2014									
2015									

3.2.4 Decision Rules

The strategy for achieving program and biological objectives is defined by a set of Decision Rules. These fundamental rules will be modified only when new information indicates that basic assumptions are no longer appropriate. Decision Rules, to be developed in detail in Step 2 of the master planning process, will be used to establish targets for broodstock management, escapement and harvest, as identified in Table 3-5.

Table 3-5. Decision Rules for the two Yakima coho programs under Phases 3 and 4.

Phase 3		Phase 4	
Lower Yakima Segregated Program	Upper Yakima Integrated Program	Lower Yakima Segregated Program	Upper Yakima Integrated Program
Broodstock will be any HORs from the integrated program available after (a) integrated broodstock needs and (b) minimum escapement (3,500 adults) above Prosser are met. The remainder of the 500 adults needed will be drawn from HORs returning from the segregated program. Imported brood will be used only as a last resort.	Natural-origin broodstock (NOB) will be the smaller of 20% of the natural-origin (NOR) run at Prosser or 225 (the 30% target for pNOB)	Broodstock will be any HORs from the integrated program available after (a) integrated broodstock needs and (b) minimum escapement (3,500 adults) above Prosser are met. The remainder of the 500 adults needed will be drawn from HORs returning from the segregated program.	Decision Rules for managing broodstock and natural spawning escapement are provided in the ISIT spreadsheet in Appendix E.
	Hatchery-origin broodstock (HOB) will be the smaller of 30% of the hatchery-origin (HOR) run at Prosser or 650 (i.e., the total broodstock target) less NOB		Decision Rules are driven by the size of the NOR return to Prosser. A minimum of 150 NOR adults will be used for a 200,000 smolt integrated program at Holmes Ranch. No other NORs will be taken as brood until the NOR escapement above Prosser exceeds 3,500 adults.

3.3 YAKIMA SUMMER/FALL CHINOOK AND YAKIMA UPRIVER BRIGHT FALL CHINOOK

3.3.1 Biological Objectives

In the long-term, the program goals are: to increase harvest opportunities for URB fall Chinook consistent with U.S. v Oregon agreements; to establish a sustainable natural population of summer/fall Chinook spawning between Prosser Dam and Roza Dam in the Yakima River and up to the mouth of the Tieton River in the Naches River subbasin; and to expand harvest opportunities temporally and spatially within the Yakima Basin.

Substantial habitat improvements will be required to meet long-term Chinook goals and objectives. In the meantime, during an extended transition phase, the objectives will be to 1) increase harvest opportunities for URB fall Chinook consistent with U.S. v Oregon agreements; 2) begin to reestablish historic timing and distribution of natural spawning of summer/fall Chinook in the Yakima River upstream of Prosser; and 3) begin to expand harvest opportunities temporally and spatially within the Yakima Basin. Biological objectives required for each phase (transition and long-term) to meet these goals are identified in Table 3-6.

Table 3-6. Biological objectives for the Yakima summer/fall Chinook program and the Yakima URB harvest program by phase.

Transition Phase		Long-Term Phase	
Yakima Summer/Fall Chinook Program	**Yakima URB Harvest Program**	**Yakima Summer/Fall Chinook Program**	**Yakima URB Harvest Program**
5,000 natural- and hatchery-origin adults past Prosser on average	Meet US vs. Oregon combined URB fall Chinook escapement targets to McNary Dam	7,000 natural-origin adults past Prosser on average	Meet US vs. Oregon combined URB fall Chinook escapement targets to McNary Dam
Average >6,000 adult contribution to all fisheries from both programs combined		Average >18,000 adult contribution to all fisheries from both programs combined	
Average of 1,800 adults harvested in Zone 6 and terminal fishery from both programs combined		Average of 5,000 adults harvested in Zone 6 and terminal fishery from both programs combined	

3.3.2 Key Assumptions for Chinook

The working hypotheses, or key assumptions, for both natural and hatchery production in the long-term and transition phases are identified below (Tables 3-7 through 3-9). These assumptions were incorporated into the ISIT tool (DJ Warren & Associates 2009) for forecasting outcomes regarding harvest and conservation benefits (Appendix E). Assumptions will be reviewed annually and will be modified as appropriate based on research, monitoring and evaluation outcomes.

Table 3-7. Natural production assumptions for Yakima summer/fall Chinook by phase.

	Transition Phase		Long-Term Phase	
	Summer-run Component	Fall-run Component	Summer-run Component	Fall-run Component
Productivity (Smolts/Spawner)	114	120	271	209
Capacity (Smolts)	838,000	515,000	2,300,000	1,300,000
Capacity Overlap Between Summer- and Fall-run Components	10%	10%	10%	10%
SAR	0.98%	1.58%	0.98%	1.58%
Relative Fitness	0.50		0.82	
PNI	0		0.77	
pHOS	50%		25%	
Ocean Harvest Rate	43%	35%	43%	35%
Lower Columbia Harvest Rate	9%	8%	9%	8%
Upper Columbia Harvest Rate	20%	16%	30%	16%
Terminal Harvest Rate	12%	11%	11%	11%

Table 3-8. Hatchery production assumptions for the Yakima summer/fall Chinook by phase.

	Yakima Summer/Fall Program			
	Transition Phase		Long-Term Phase	
	Summer Component	Fall Component	Summer Component	Fall Component
Imported Broodstock	0%	0%	0%	0%
SAR	0.57%	0.34%	0.45%*	0.34%
pNOB	0%	0%	100%	50%
NOB as a Percent of NOR Escapement	0%	0%	18%	2%
Ocean Harvest Rate	43%	35%	43%	35%
Lower Columbia Harvest Rate	9%	8%	9%	8%
Upper Columbia Harvest Rate	20%	16%	30%	16%
Terminal Harvest Rate	12%	11%	11%	11%

*SAR varies depending on release type (sub-yearlings or yearlings)

Table 3-9. Hatchery production assumptions for the Yakima URB Chinook harvest program by phase.

	Yakima URB Harvest Program	
	Transition Phase	Long-Term Phase
Imported Broodstock	100%	0%
SAR	0.34%	0.34%
pNOB	0%	0%
NOB as a Percent of NOR Escapement	0%	0%
Ocean Harvest Rate	35%	35%
Lower Columbia Harvest Rate	8%	8%
Upper Columbia Harvest Rate	16%	16%
Terminal Harvest Rate	11%	11%

3.3.3 Status and Trends

To confirm progress toward long-term biological goals, measured parameters will be compiled annually to depict status and trends. An example of how data may be presented is shown below (Table 3-10).

Table 3-10. Sample table for reporting status and trends for the Yakima summer/fall Chinook and Yakima URB harvest programs.

	Yakima URB Harvest Program			Yakima Summer/Fall Chinook Program				Returns to Prosser	
	Imported Brood	Local Brood	Release	Imported Brood	Local Brood	NOR Brood	Release	Hatchery Origin	Natural Origin
2008									
2009									
2010									
2011									
2012									
2013									
2014									
2015									

3.3.4 Decision Rules

Detailed Decision Rules for broodstock management and trigger points for initiating the long-term phase of the summer/fall Chinook program will be developed in detail in Step 2 of this planning process. Preliminary sets of Decision Rules can be found in Appendix E.

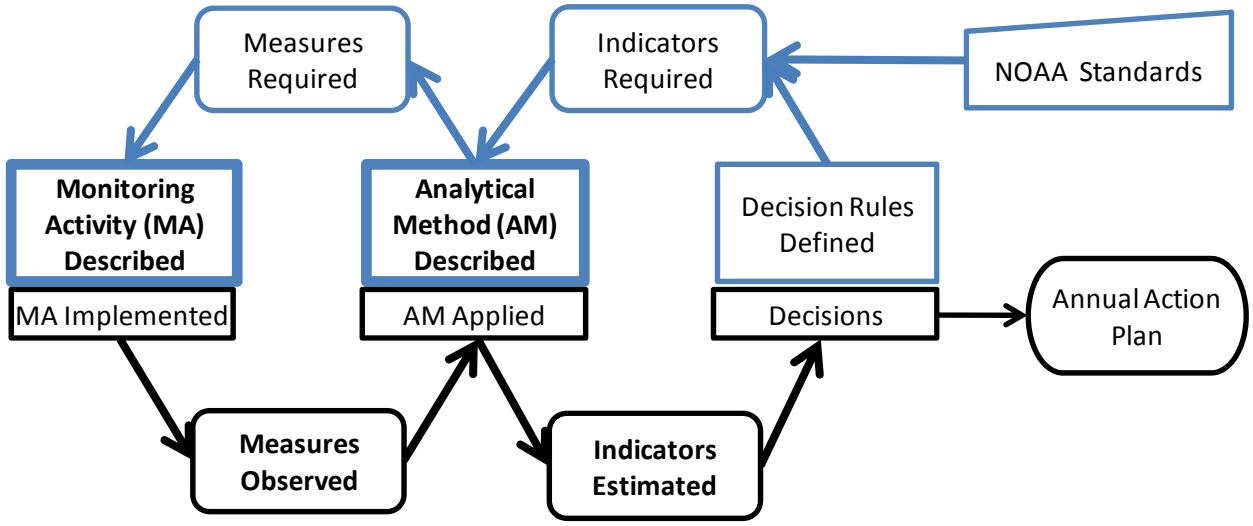
3.4 MONITORING AND EVALUATION FRAMEWORK (CHINOOK AND COHO)

Outlined below is the Monitoring and Evaluation (M&E) framework. The specific experimental designs and protocols required to implement the M&E plan will be included in the Step 2 documentation for NPCC review. The purpose of the M&E plan is to:

- Evaluate performance relative to goals and expectations and adjust hatchery and harvest management operations according to the Decision Rules. Indicators of program success include benefits to fisheries as well as abundance, productivity, distribution, and composition of naturally-produced populations;

- Test key assumptions and adjust the Decision Rules accordingly.

The steps in the M&E process that lead from field observations to decisions are illustrated in Figure 3-2. The specific information (indicators) needed to support decision making will be identified in Step 2. These information requirements, combined with the appropriate standards for accuracy and precision (e.g., NOAA Guidance for Monitoring Recovery of Salmon and Steelhead: 2011), drive the analysis and monitoring needs (blue arrows in diagram). The future M&E plan will describe the monitoring activities (MAs) that produce the data (measures) needed for the analytical methods (AMs) that will be used to estimate the indicators that support decision making (black arrows).



Source: D.J. Warren & Associates 2009

Figure 3-2. Steps in the monitoring and evaluation process that go into making an Annual Action Plan.

3.5 ONGOING AND PROPOSED RESEARCH

The Yakima-Klickitat Fisheries Project (YKPF) was specifically designed to address scientific uncertainties regarding the use of hatchery supplementation to meet harvest and production objectives while limiting adverse ecological and genetic impacts. To date, most of the YKFP research effort in the Yakima Basin

has focused on the Cle Elum spring Chinook supplementation program, with over 50 articles relating to this work published in peer-reviewed literature through 2010 (for a list of publications, see http://www.cbfish.org/proposal.mvc/summary/RMECAT-1995-063-25).

As noted earlier, Phase I feasibility results for the coho reintroduction program were published in Bosch et al. 2007. The YN is presently collaborating with WDFW to study the effects of coho adult outplants on juvenile productivity, interactions, and biomass in Taneum Creek (Temple et al. 2011). Results of this work are expected to be journal-published in the near future. With respect to fall Chinook, the YN expects to intensively monitor efforts to reestablish a naturally spawning, local adapting bi-modal summer-fall Chinook population above Prosser Dam, work that also is expected to result in future publications.

The YN is also conducting steelhead viable salmon population and kelt reconditioning research; protecting, restoring and enhancing habitat; and working to reestablish sockeye, lamprey and sturgeon in the Yakima Basin.

Because these research and restoration efforts are so broad and involve so many regional partners, the Tribe has been conducting Yakima Basin Aquatic Science and Management Conferences annually since 2003 to review and coordinate activities in the basin. Summaries of these conferences are available at http://ykfp.org/par.html.

4.0 PROPOSED HATCHERY PROGRAMS FOR YAKIMA SUMMER/FALL CHINOOK AND THE YAKIMA UPRIVER BRIGHT CHINOOK

4.1 PROGRAM NEED AND JUSTIFICATION

The Yakama Nation was guaranteed fishing rights by the Treaty of 1855 (Stat. 951). These rights were confirmed by a federal court in US vs. Oregon in 1969. Since 1977, the parties to U.S. vs. Oregon have been involved in negotiating a series of plans for fisheries management in the Columbia River Basin. These plans have been adopted by the orders of the U.S. District Court for the District of Oregon. The planning process is the principal forum through which issues about anadromous fish harvest, stock restoration, and production are addressed. The 2008-2017 Plan identifies a short-term production goal of 1.7 million fall Chinook to be released in the Yakima River Basin.

Historically, the Yakama Tribal members fished for Chinook, coho, steelhead and other species in the Yakima River and throughout the Columbia River Basin. Over time, habitat conditions were degraded to the point where by the 1970s, sustainable runs of early and late run Chinook were extirpated from the basin.

To meet treaty obligations, a program is therefore needed that will increase harvest toward historic levels and restore natural production of historic salmon populations in the Yakima Basin. In addition to the long-established 1.7 million US vs. Oregon fall Chinook program, this will require continuing recently established hatchery production of summer/fall Chinook at a sustained level of 1.0 million annually over

the short term (< 25 years), primarily to produce fish to colonize spawning habitat above Prosser Dam. The long-term strategy (> 25 years) for meeting treaty obligations is to implement actions that will improve critical habitat throughout the basin and in the Columbia River migration corridor. Because it may require decades of work before basin habitat is able to sustain summer/fall Chinook production at sufficient levels to meet harvest and natural spawning goals, the tool of artificial production will be adopted to move towards those goals in the interim.

Two distinct hatchery programs are described in this section: a segregated harvest program downstream of Prosser Dam (the Yakima URB Harvest Program), and an integrated harvest program upstream of Prosser Dam (the Yakima Summer/Fall Chinook Program).

The Yakima Summer/Fall Chinook Program will move through two distinct phases, a **transition phase** to recolonize habitat and provide fish for harvest; and a **long-term phase** of sustainable natural production.

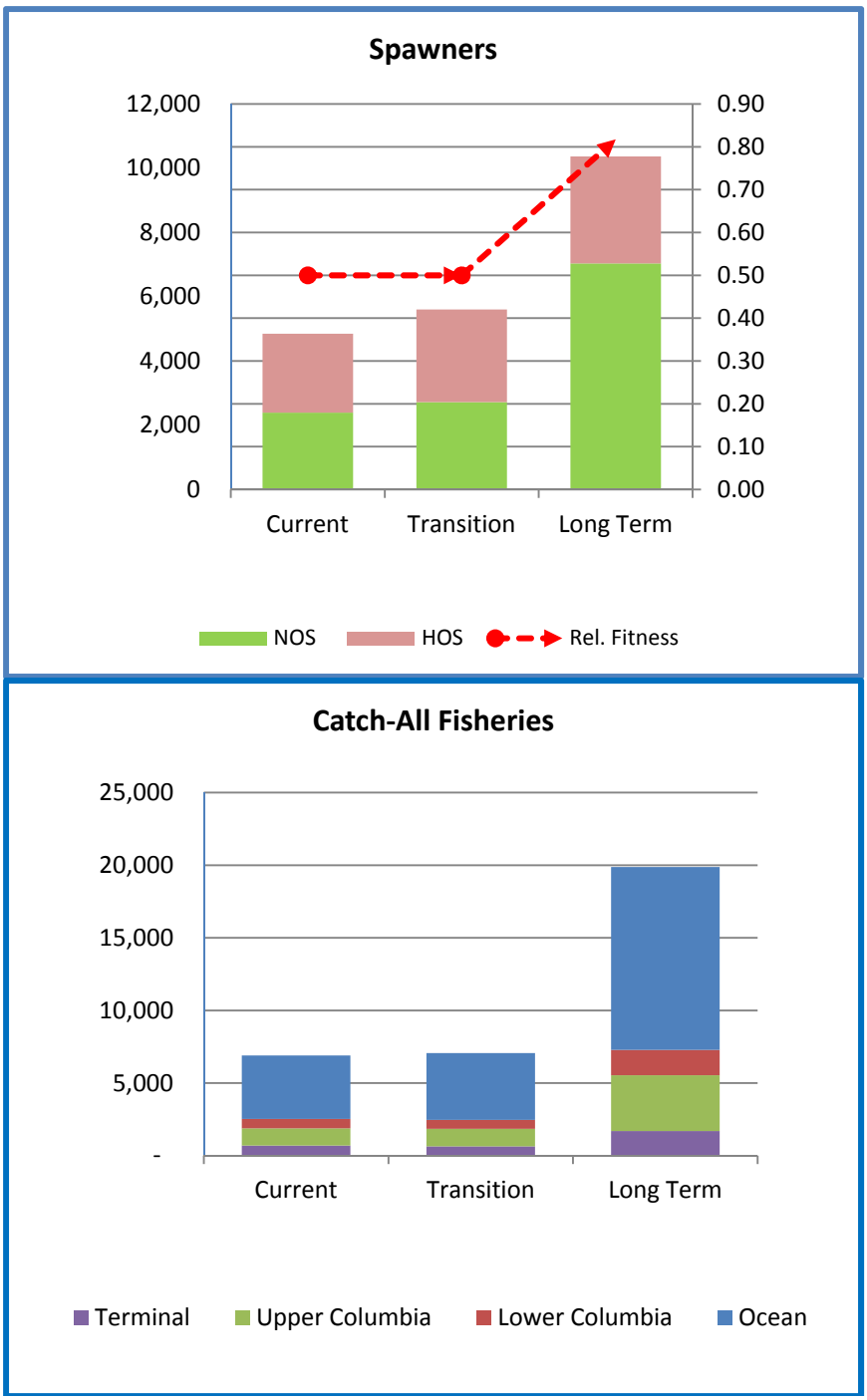
4.2 BIOLOGICAL OBJECTIVES FOR CHINOOK

The artificial production of Yakima summer/fall Chinook and URB fall Chinook is being used to achieve both short- and long-term treaty obligations, including economic, cultural and biological objectives. From a legal perspective, the program will provide fish for harvest as guaranteed by treaties and enshrined in law under US vs. Oregon. Some fish produced by the program will spawn naturally in the basin, contributing to the Yakama Nation's cultural objective of seeing fish complete their life cycle in the wild. Biological objectives for the program are measurable targets that guide management toward the long-term goals.

The integrated and segregated programs will progress through two phases; a near-term transition phase and a long-term phase. The Decision Rules whereby the program switches from one phase to the next were outlined in Section 3.3. Detailed Decision Rules for broodstock management and trigger points for initiating the long-term phase of the summer-fall Chinook program will be developed in detail in Step 2 of this planning process. Preliminary sets of Decision Rules can be found in Appendix E.

The biological objectives for both phases are shown in Table 3-6. Expectations in terms of harvest and natural escapement are also illustrated in Figure 4-1. These numbers were developed based on modeling results provided in Appendix E.

Although the Master Plan focuses on artificial production, habitat actions being implemented by multiple entities are expected to increase habitat quality and quantity (for examples, see YBFWRB 2011). The combined effect of hatchery and habitat actions are hypothesized to increase population productivity by 50 percent over the long term (25 years).



Note: Projections are based on key assumptions listed in Section 3.3.2 and detailed in Appendix E.

Figure 4-1. Expected spawning escapement and catch in all fisheries for the current, transition and long-term phases for Yakima summer/ fall Chinook and Yakima URB Chinook.

4.3 PROPOSED STRATEGY

Strategies for habitat improvement are described below, as are the integrated (Yakima summer/fall Chinook) and segregated (Yakima URB harvest) hatchery production strategies.

4.3.1 Habitat Strategies

Habitat actions have been identified and/or are being implemented as part of subbasin planning (YRBSRB 2004), the YKFP, the Yakima River Basin Integrated Water Resource Management Plan Draft Programmatic EIS (USDI and WDOE 2011), and through other basin activities. A recovery strategy proposed for Chinook (and other species) is documented in the subbasin plan and a good summary of the limiting factors and types of actions proposed to address each can be found in Appendix I of that document (YRBSRB 2004). For early- and late-run fall Chinook, in-basin actions are centered on reducing stream temperature and better mimicking the historical flow pattern in the mid- to lower Yakima River Basin. Major factors inhibiting Yakima River early and late run Chinook production are as follows:

- Sub-lethal to lethal water temperatures are typically present by June below Prosser Dam (RM 47)
- Low flow conditions (especially in poor water years) between Prosser Dam and the Chandler power-plant outfall
- Predation by birds (especially in poor water years), and both native and exotic piscivorous fish (particularly smallmouth bass)
- Loss of structurally complex rearing habitat
- Excessive sediments from irrigation drains (although this has been slowly improving in recent years) in major spawning areas
- Smolt mortality associated with predation in the vicinity of bypass outfalls at Wapato, Sunnyside and Prosser dams, and a number of smaller Yakima Basin dams (e.g., Marion Drain re-use diversion, Columbia and Richland Ditches at Horn Rapids Dam)
- Adult mortality associated with mainstem Columbia dams
- Smolt mortalities associated with traversing mainstem Columbia dams and impoundments

More detail on the habitat strategy in place in the Yakima Basin is described in Sections 6.3 and 6.4.2 of this Master Plan.

4.3.2 Artificial Production Strategies

This Master Plan focuses on the artificial production of the Yakima URB Chinook and Yakima summer/fall Chinook. The plan proposes to implement two separate programs: (1) a locally adapted integrated harvest program upstream of Prosser Dam using facilities at Prosser and Marion Drain hatcheries, and (2) a segregated harvest program downstream of Prosser Dam using Prosser Hatchery and a lower river acclimation site. The former program (1) will be referred to as the Yakima

Summer/Fall Chinook Program, the latter (2) as the Yakima URB Harvest Program. Each program is described below.

4.3.2.1 Yakima Summer/Fall Chinook Integrated Hatchery Program

The Yakima Summer/Fall Chinook Program will release fish into the Yakima and Naches Rivers upstream of Prosser Dam. In order to reestablish the historic bi-modal summer/fall run-timing, initial brood for this program will come from two sources: summer-run from Upper Columbia (Wells Dam) and fall-run from local returns to Prosser Dam. The concept is to introduce diversity of life histories and let the habitat drive the combined population toward local adaptation over time. The hatchery program will be operated to maintain run-time diversity, but also to incorporate natural origin adults in the hatchery broodstock in sufficient proportion to allow the natural environment to drive adaptation of the integrated population.

Given the current habitat and fishery exploitation rates (> 60 percent), habitat analysis (EDT modeling) supported by empirical observations indicates that it is unlikely that the Yakima Basin can sustain natural production of summer/fall Chinook without significant habitat improvements.

The existing naturally spawning fall Chinook population is composed largely of first and second generation URB hatchery fish. Reliable estimates of natural productivity are unavailable because less than 100 percent of hatchery fish are marked. Harvest levels are not expected to decrease in the short term, and the habitat improvements needed to increase population productivity to a level that can withstand this harvest rate is not expected in the near term.

Using these basic assumptions, the strategies for the near term **transition phase** are described below. Associated program operations are also identified.

- **To provide fish for harvest**. A total of 500,000 fall-run Chinook (100 percent sub-yearlings) and 500,000 early run (50 percent sub-yearlings and 50 percent yearlings) or 1,000,000 subyearling[4] summer-run Chinook will be released at locations upstream of Prosser Dam each year to produce adults for harvest[5].

- **To achieve a locally adapting population upstream of Prosser Dam**. When available, broodstock for this program will be acquired in the following order: (1) natural-origin returns; (2) hatchery-origin returns; and (3) imported broodstock. Local adaptation is expected to increase the fitness and survival of the hatchery population (HSRG 2009, YKFP 2010). Decision Rules based on biological targets and anticipated run strength will determine how broodstock is selected each season.

- **To increase the spatial/temporal diversity of the population**. Both summer-run (originating from Wells Dam) or hatchery and local (URB origin) fall Chinook will be incorporated in the broodstock strategy. The summer-run fish are expected to return as adults earlier in the year and spawn higher in the basin than the later arriving fall-run population component. The

[4] The release of summer-run will include 250,000 yearlings and 250,000 subyearlings to maximize adult recruitment initially (yearlings have a higher post-release survival). As local returns become available in sufficient numbers, the production will then transition to 1,000,000 all sub-yearlings to reduce domestication selection.

[5] A portion of these fish will be acclimated and released into the lower Naches River and mid-Yakima River (between Prosser and Roza Dam) to achieve the spatial and temporal diversity goal.

hatchery program will not mix the two population components; they will be incubated, and reared separately. However, the expectation is that overlap in spawning will occur in the wild. In the natural environment, the summer/fall Chinook population will be managed as a single, perhaps bimodal population. Both summer and fall components will be released at or above Prosser Dam since their spawning areas overlap in the mid-Yakima River area (Figure 4-2). As habitat improves and the program moves into the long-term fully integrated phase, the naturally spawning population above Prosser will have an ever increasing influence on the life history composition of the combined hatchery-natural population.

Initially, broodstock for the late run population component will be obtained from the Prosser segregated program and broodstock for the early run population component will be from summer run stock passing Wells Dam. Importing brood from these sources will be terminated as soon as sufficient numbers of local broodstock become available.

Once local broodstock are available, fish collection and spawning will be performed on a stratified basis using run-timing criteria with a new adult trap facility at Sunnyside Dam as the primary collection point[6]. Run-timing of the early and late returning components will overlap to some extent. The intent of the mating protocols will not be to create distinct and separate population components, but to simply extend the run-timing of the summer/fall Chinook population. Broodstock for the fall component the run will be collected at Sunnyside, Prosser Dam and from the spawning grounds downstream of Sunnyside. Broodstock for the summer component may be collected at Prosser, Marion Drain and from the spawning grounds. Detailed broodstock collection and management protocols will be part of the Decision Rules that will be developed as part of Step 2 in the planning process. However, adults will be collected at Prosser Dam, Sunnyside Dam, the Marion Drain fish wheel, and from the spawning grounds according to a predetermined protocol designed to promote progress toward a summer/fall population that is adapting to the natural environment in the Yakima River as it changes over time.

Juveniles produced from summer and fall components of the Yakima summer/fall Chinook program will be released at several locations upstream of Prosser Dam, including acclimation ponds in the mid-Yakima River, Marion Drain, and also from Prosser Hatchery. These fish will be marked differentially from the URB Chinook program fish, which will be released downstream of Prosser so that the returning adults can be distinguished.

During the Transition Phase, the priority for collecting broodstock will be to use (1) natural-origin fish, (2) hatchery-origin fish produced by the program, and (3) imported fish from Wells Dam or the in-basin segregated program.

The transition phase ends when the 5-year running average NOR+HOR escapement exceeds 5,000 adults (Table 3-6). This marks the beginning of the Long-Term Phase, when the effort to fully integrate the hatchery program begins. Now a new set of Decision Rules will apply that determine program size and broodstock management as a function of annual population status.

[6] Adults also may be collected at Prosser Dam.

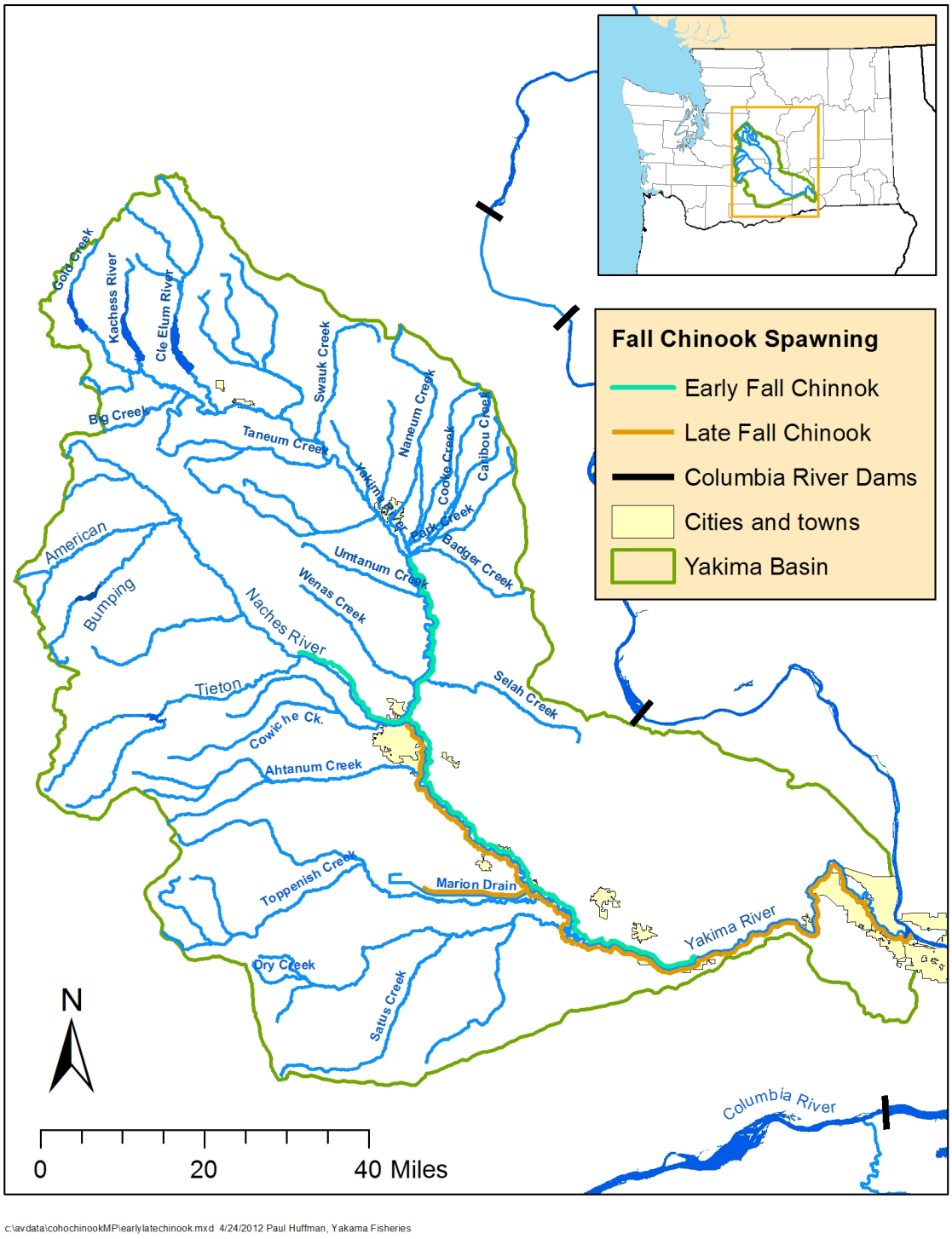
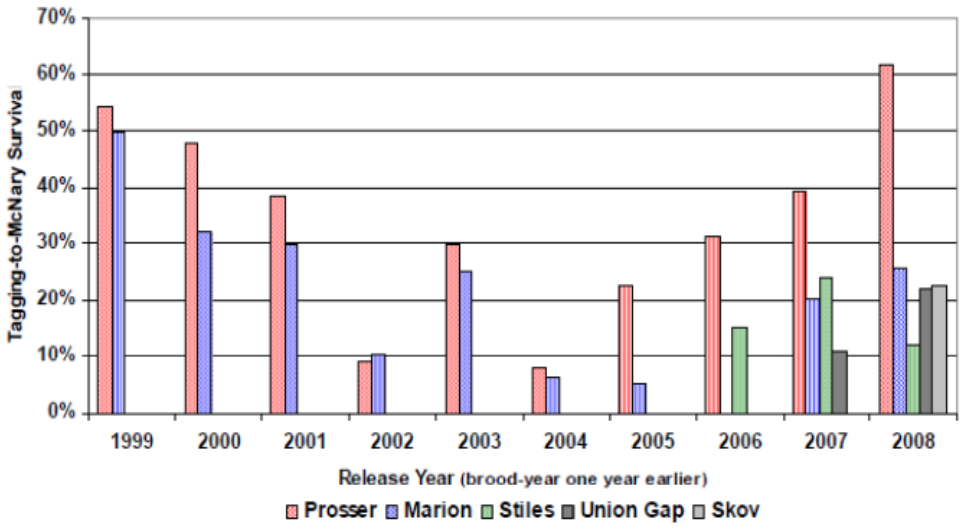


Figure 4-2. Spawning areas used by early- and late-run Chinook in the Yakima River.

4.3.2.2 Yakima URB Hatchery Harvest Program

The current Yakima URB fall Chinook Harvest program at Prosser Hatchery is designed to produce 1.7 million sub-yearling Chinook annually. The eggs or juveniles needed for the program have been imported from the Little White Salmon Hatchery. Juveniles are released at Prosser Hatchery. With implementation of the program proposed in this Master Plan, the Yakima URB Chinook releases (1.7 million) for this program will move downstream to an acclimation site(s) located within 10 river miles of the mouth of the Yakima River (see Appendix J). Shifting the release point to the lower river is expected to improve smolt-to-smolt survival rates from release to McNary Dam (Figure 4-3) and increase the number of adults available for harvest by allowing out-migrating juveniles to bypass 32 to 45 miles of relatively low quality habitat between Prosser Dam and RM 10. Additionally, acclimating these fish in the lower river will help ensure that they do not stray and spawn upstream of Prosser Dam, reducing effects on the summer/fall Chinook program above Prosser. Adult collection facilities will be provided at the acclimation site to collect broodstock for the program.

The Yakima URB harvest program will obtain broodstock from either returning adults produced by the program, or when needed, from the Priest Rapids Hatchery/Hanford Reach population with which it is genetically linked. The broodstock strategy will be determined by impacts to the Hanford Reach/Priest Rapids URB population. It may be managed as a component of an integrated Priest Rapids Hatchery program. It should be noted however, that from the point of view of the Yakima summer/fall population spawning above Prosser, it is a segregated hatchery program. Juveniles from the URB program will be marked differently than those produce from Yakima summer/fall Chinook program in order to identify and separate returning adults.



Source: YKFP 2009

Figure 4-3. Historic tagging to McNary Dam survival rates of late-run fall Chinook from release sites in the Yakima River Basin.

4.4 ALTERNATIVES CONSIDERED TO MEET BIOLOGICAL OBJECTIVES

The program described in this Master Plan is proposed because it achieves fisheries goals described in US vs. Oregon, treaties, and meets Yakama Nation cultural objectives. Other alternatives were considered, but rejected because they failed to achieve identified goals in a timely manner consistent with legal agreements, benefits of their implementation would not be realized for decades, or the programs were not scientifically sound. A brief description of the alternatives not carried forward, along with the rationale for this decision, is presented below.

4.4.1 Alternative A: Maintain Existing Program

The existing program has included the following:

- 1.7 million fall Chinook released from Prosser Hatchery annually since 1985
- 100,000 to 600,000 "local" fall Chinook released from Prosser or upstream of Prosser annually since 1999
- 200,000 to 300,000 Wells summer-run Chinook released annually from Stiles Pond since 2009

Under the existing program, fish have been released at Prosser Hatchery, near the town of Sunnyside, in Marion Drain and from acclimation ponds in the basin (additional detail is provided in Appendix A). The purpose of the early-run (summer) Chinook was to test both juvenile outmigrant survival rates to McNary Dam and smolt-to-adult survival rates back to the basin (see Appendix E, Task 1.f in Sampson et al. 2011).

This alternative is not carried forward for the following reasons:

- The use of out-of-basin broodstock for the hatchery program is not consistent with the principles and recommendations of the HSRG (2004). In separate reviews of this program, the HSRG (2009) and USFWS Columbia Basin Hatchery Review Team (USFWS 2007) recommended that this practice be discontinued and the program shifted to local broodstock.
- The program provides approximately 2,500 fish to tribal fisheries in Zone 6 and in-basin fisheries which is substantially below the long-term harvest goal of 18,500 Chinook identified by the Tribe.
- The program releases only the late component of the early/late fall Chinook population that historically inhabited the Yakima River Basin[7]. Continuing this approach means that program spatial structure and temporal diversity goals would not be achieved unless late-run Chinook run-timing and spatial distribution changed naturally over time.

[7] Releases of early run Chinook to the basin have occurred since 2008 on an experimental basis.

4.4.2 Alternative B: Eliminate Hatchery Production and Improve Habitat

The artificial production and release of early/late-run fall Chinook to the Yakima River would be discontinued under this alternative. The program would rely on habitat improvement actions and natural colonization by other stocks (e.g., Hanford Reach URBs) to produce the fish needed to achieve identified goals.

Based on All-H Analyzer (AHA) modeling and observed run-size returns to the Yakima Basin, current harvest rates and poor habitat quality create a situation where the natural production of early/late-run fall Chinook is likely not sustainable. The harvest rate issue could be addressed in the near term by implementing selective fisheries in the ocean and lower Columbia River; however, this change would require significant time to negotiate and implement. Habitat quality will improve over time as actions identified in the Subbasin Plan (YRBSP 2004) and other processes are put in place. Decades may be required for these benefits to accrue to early/late-run fall Chinook, resulting in the repeated failure to meet harvest goals established in legal agreements in the interim period.

Because the primary program goal of harvest would not be achieved for many decades under this alternative, it was eliminated from further consideration.

4.4.3 Alternative C: Implement HSRG Solution

The HSRG (2009) reviewed the existing late-run fall Chinook program in 2009. From this review, two possible solutions (with or without habitat improvement) for program operations were suggested to meet identified harvest and conservation goals (Table 4-1).

Table 4-1. Program solutions for Yakima River late-run fall Chinook developed by the Columbia River HSRG.

	Program Type/Purpose	Size	pHOS	PNI	NOS Escapement	Adult Recruits per NOR Spawner (R/S)	Total Harvest
HSRG Solution	Integrated Harvest	2.01 million	60%	0.4	1,212	0.7	7,896
HSRG Solution with 10% Habitat Improvement	Integrated Harvest	2.01 million	54%	0.43	1,546	0.8	8,474

Source: HSRG 2009
Notes: PHOS- Proportion natural-origin spawners
PNI- Proportionate Natural Influence
NOS- Natural-origin spawners

The conclusion of the HSRG analysis was that current habitat and harvest rates create a condition under which the natural population is not sustainable, as evidenced by recruit per spawner values less than 1.0 (Table 4-1). By incorporating locally adapted Chinook as broodstock, the HSRG analysis indicates that harvest levels would increase under both solutions as a result of increased population fitness.

The HSRG recommended that the highest program priority should be to develop the capability of collecting local broodstock (HSRG 2009), an action that would increase fish survival and therefore the

likelihood of meeting harvest and conservation goals. A second recommendation was that the program should mark all juvenile fish released from hatchery facilities. This action would make it possible to identify and manage the origin of broodstock, monitor the natural population and achieve desired harvest rates for hatchery- and natural-origin fish.

The HSRG solutions have not been adopted in this Master Plan because neither would achieve the Tribe's 18,000 fish harvest or spatial and temporal diversity goals. HSRG recommendations to convert to local broodstock (the above-Prosser program) and to mark 100 percent of hatchery-origin juveniles, have however, been included in the program.

4.5 CONCEPTUAL DESIGN OF CHINOOK PROGRAM FACILITIES

4.5.1 Overview of Facilities

The Yakama Nation has ongoing URB fall Chinook salmon artificial fish production programs at their existing Prosser and Marion Drain hatcheries. As described in this Master Plan, the Tribe proposes to initiate an integrated summer/fall Chinook program. Both programs will convert to local broodstock as recommended by the HSRG with the implementation of this Master Plan. To accomplish this, major upgrades are proposed to both of the existing hatcheries, a new broodstock collection facility at Sunnyside Dam is proposed, as is an acclimation and adult collection facility at a lower Yakima River site. Figure 4-4 shows the locations of the existing and proposed facilities.

The following sections describe existing conditions and proposed improvements at Prosser, Marion Drain and Sunnyside.

4.5.2 Existing Fall Chinook Facilities at Prosser Hatchery

Prosser Hatchery is located on a 14-acre parcel on the north side (left bank) of the Yakima River at RM 46.8, adjacent to the City of Prosser. The parcel is federal land managed by the U.S. Bureau of Reclamation (USBR). The Yakama Nation operates the hatchery and has constructed various fish production systems and support buildings gradually over the last 15 years at this site. Figure 4-5 is a site plan of Prosser Hatchery's existing structures and facilities.

Fish production at Prosser primarily consists of incubation, early and final rearing of URB fall Chinook and coho salmon. The facility also provides round tanks for steelhead kelt re-conditioning and lamprey research. The Chandler Juvenile Fish Monitoring Facility occupies the southeast corner of the site, and is used to monitor all downstream migrating fish species. Existing hatchery infrastructure is described below.

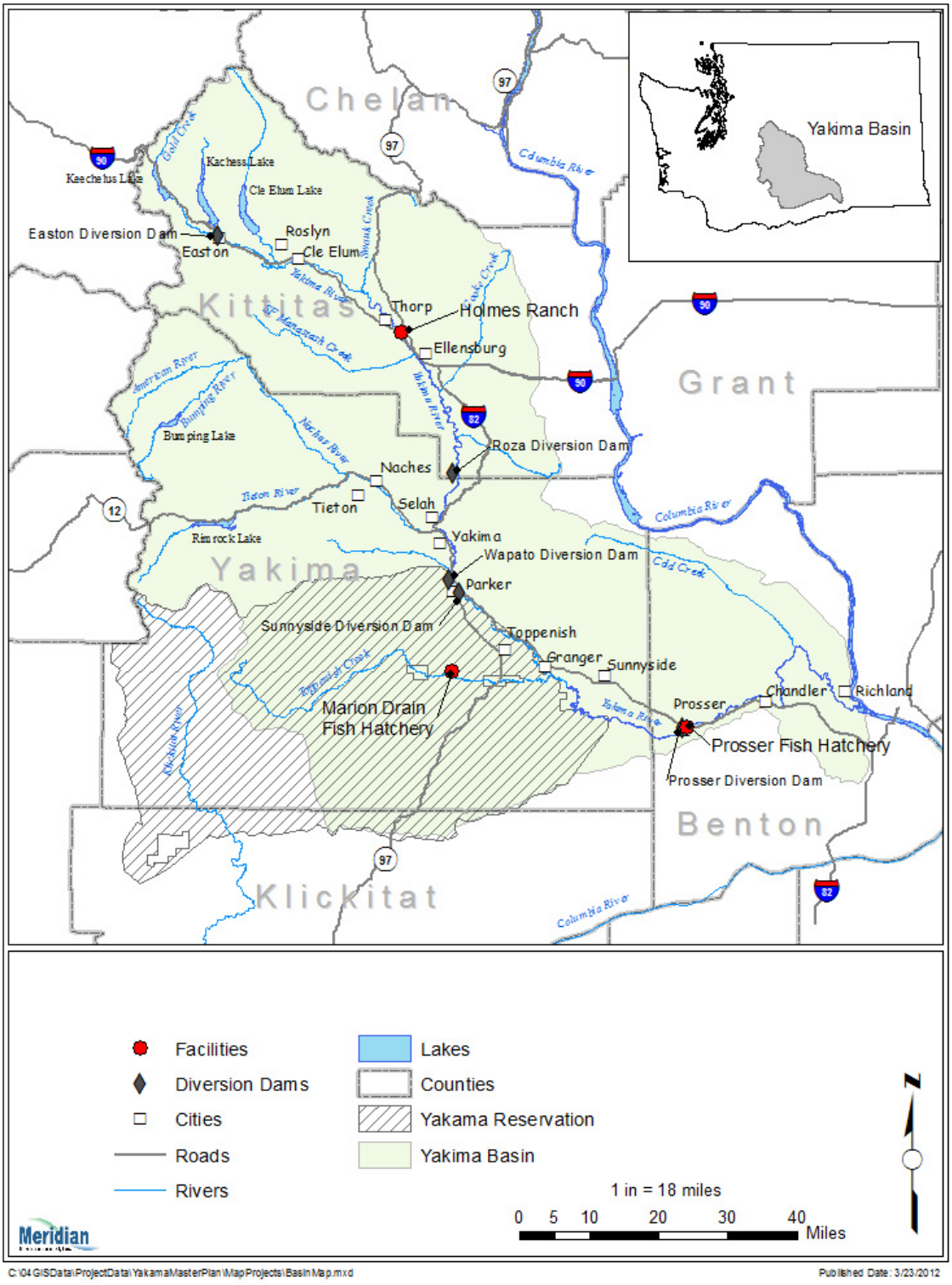


Figure 4-4. Location of existing and proposed fall Chinook aquaculture facilities

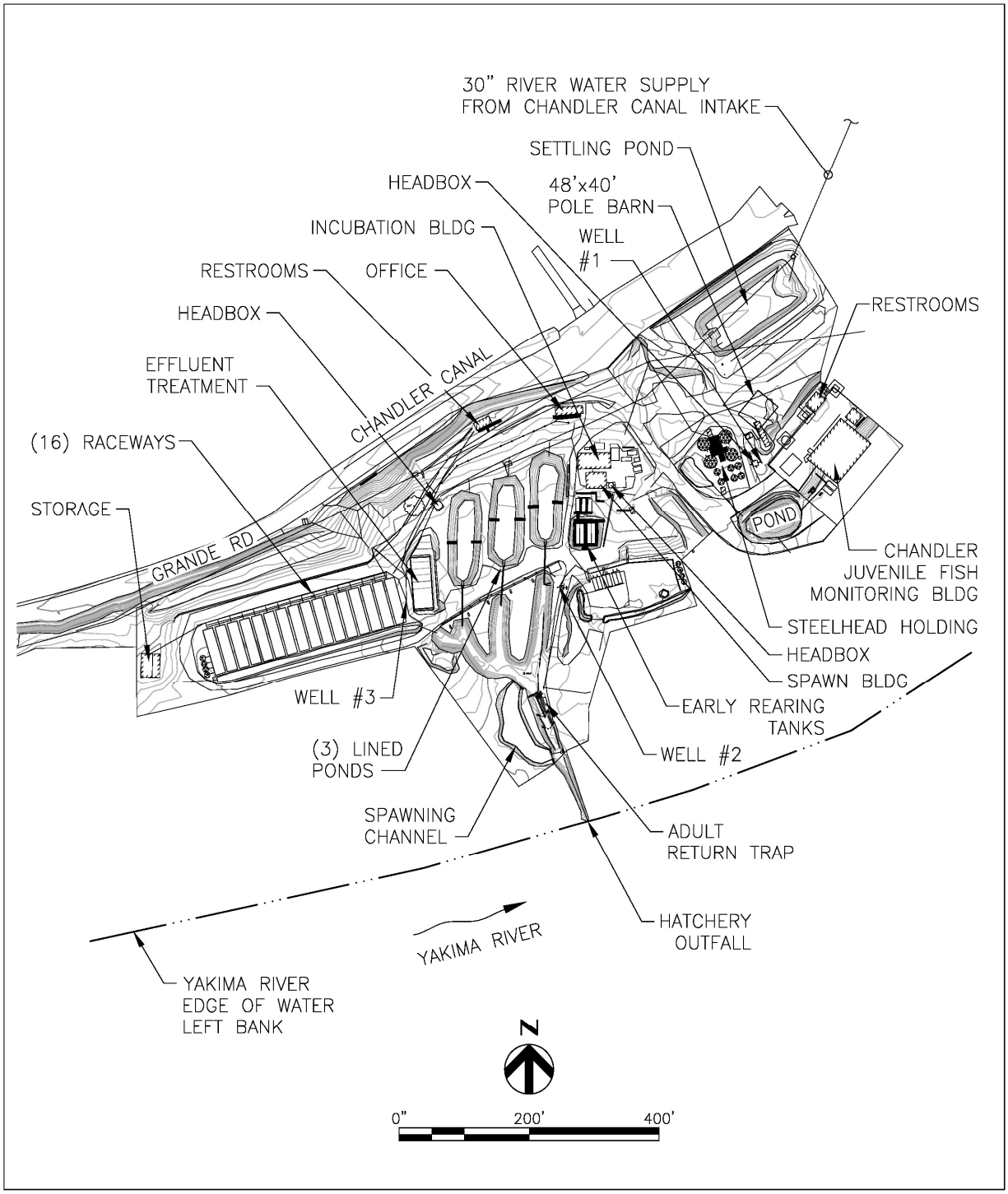


Figure 4-5. Plan view of existing facilities at Prosser Hatchery

Site Access and Security – Access to Prosser Hatchery is via Grant Street Bridge and Grande Road, a gravel road that parallels the south side of the USBR Chandler Canal. The City of Prosser wastewater

treatment plant and USBR Chandler Canal screening facility are also located along the gravel road to the west and north of the hatchery site, respectively. The 14-acre parcel has a six-foot-high chain link perimeter fence, with gates at the main entrance off of Grande Road and at the hatchery outfall near the Yakima River (Figure 4-6).

Figure 4-6. Prosser Hatchery, looking southeast from Grande Road

Topography – This irregularly shaped site slopes steeply from Grande Road at the north (elevation 641 to 643) down to the main hatchery area at elevation 625 to 630. Most existing permanent buildings, including the incubation/shop, spawning building, and visitor center/juvenile fish sampling facility, have finished floor elevations of around 627. The lowest portions of the site, along the south perimeter near the river, are at an average elevation 620. From the south central part of the site, the hatchery drain channel slopes more steeply to the river outfall. Ordinary high water in the Yakima River is approximately elevation 610.

Floodplain – A significant portion of the site appears to be within the 100-year floodplain according to available flood insurance mapping. The current federal floodplain modeling and mapping was completed in 1975 and does not take into account many changes that have occurred at and around the project site. Detailed studies are underway to update floodplain boundaries and impacts (see Appendix I). In summary, the regulatory floodway passes through the southern-most portion of the hatchery site, and no hatchery infrastructure except the portable adult collection trap and hatchery outfall channel is within the floodway footprint. The 100-year floodplain elevation is at elevation 622.8. The modular metal raceways, effluent pond, and upper portions of the hatchery drain channels are within the floodplain.

Process Water Supply Systems – Fish culture facilities are supplied by both river and groundwater through separate piping systems. The river water supply is gravity flow via a screened intake pipe located in the USBR Chandler Canal. The intake is just downstream of the Chandler Canal drum screens, and has a travelling screen for additional protection of the 30-inch intake pipe. The hatchery uses up to 30 cfs of Yakima River water during the late fall, winter and spring for outdoor rearing. River water is not used for incubation. June through October, the river water is generally too warm for salmonid culture and hatchery operations switch to groundwater from on-site wells.

The 30-inch river water supply pipe enters the northeast corner of the site, where it connects to a flow control structure (Figure 4-7). From there, flow is either routed through a small silt settling pond or bypassed directly into the hatchery water supply piping system. River water is untreated except for the coarse screening and settling described above. The settling pond is roughly 65 feet wide, 165 feet long, with an average depth of 3 feet, which is relatively small in relation to the peak flows up to 30 cfs. Significant amounts of sediment do not settle out when the river is turbid and are deposited in the rearing ponds and tanks. The existing 30-inch HDPE river water supply pipe will be protected during construction.

Figure 4-7. River water flow control structure and upper end of silt settling pond at Prosser

The USBR has requested that the Yakama Nation develop a back-up river water intake so that Chandler Canal can be dewatered each November for maintenance without interrupting the hatchery supply. A report on back-up river water supply alternatives is provided in Appendix D.

Three high production process water wells, ranging from 120 to 160 feet deep, are located on the hatchery site. Each well produces 1,000 to 1,200 gallons per minute (gpm) using submersible pumps that discharge into separate degassing head boxes. The head boxes are eight-foot-diameter plastic tanks with packing media, supported about 10 feet above grade (Figure 4-8); the support structures do not comply with present seismic codes.

Groundwater flows by gravity from each head box to various hatchery rearing or holding tanks, chiller and incubation systems. The gravity flow pipes are interconnected on the downstream side of the head boxes. There are some flow balancing problems since the head box water levels are not at the same elevations. Groundwater temperature is a fairly constant 57°F year round. For incubation, this water must be chilled to between 44 to 48°F. Hatchery staff report that the wells draw down very little during prolonged pumping and do not appear to interfere with each other in terms of flow production. The existing wells and head boxes will be protected during new facility construction to avoid water supply interruptions.

Figure 4-8. Prosser Hatchery Well No. 1 and head box (at right) and steelhead kelt re-conditioning tanks (at left)

The process water distribution systems are mostly solvent-welded PVC piping installed by the hatchery staff. As-built mapping prepared for this project showing the piping runs is included in Appendix G. Large portions of these piping systems will be retained and incorporated into the new facility.

Process Water Drain Systems – Overflow drains from the fish culture facilities are collected in a system of pipes and open channels. They are combined into a single open channel discharge to the Yakima River. The Chandler Juvenile Fish Monitoring Building has a separate drain and outfall to the river associated with the juvenile bypass system from Chandler Canal. Portions of the existing drain system will be replaced or re-routed as part of the modernization effort.

Incubation Building – The incubation building is centrally located near the site entrance off Grande Road. It is a prefabricated metal building with cast-in-place concrete floor (Figure 4-9). The western portion of the building houses 25 stacks of 8-tray Marisource incubators, 8 of them in double and 17 of them in triple stack configuration. There are also five fiberglass troughs used for bulk eyeing of green eggs for the coho and fall Chinook programs (Figure 4-10). Floor trenches for incubator drains have been cut and chipped into the floor and do not have grating covers. A six-inch drain pipe conveys drain water from the floor trenches and several floor drains to the hatchery outfall. A 100-ton chiller system

is located adjacent to the east end of the building. Chilled and ambient groundwater supply pipes are routed into the incubation room via a dual overhead piping system, with valved supply drops to each stack and tank. These facilities are used for both the fall Chinook and coho programs.

Figure 4-9. Prosser Hatchery incubation building (blue with white shed roof), with chiller and electrical panels in foreground

Figure 4-10. Prosser Hatchery incubation room, triple stacks (left), bulk eyeing trough (center) and chilled (blue) and ambient (red) groundwater supply headers

The eastern portion of the building contains a locker room, a light storage/ shop area and a small electrical room that houses the hatchery monitoring and alarm panel. The incubation building is serviceable and will be retained as part of the new facility. A small chemical storage shed, egg isolation trailer, and propane tank are located nearby. The spawning building is immediately south of the incubation building.

Outdoor Rearing Facilities – Fall Chinook are transferred directly from incubators at 1,100 fpp to three outdoor fiberglass raceways (21 feet long, 6 feet wide and 3.3 feet deep) for early rearing on groundwater. The fish are then transferred at 500 fpp to four larger fiberglass raceways (31 feet long, 6 feet wide and 3.5 feet deep), and are converted to river water. At a size of 150 fpp, the fall Chinook juveniles are transferred to the 16 large modular steel raceways (16 feet wide, 72 feet long, by 4 feet high) for acclimation on river water prior to release. The steel raceways are lined with plastic. Each of the outdoor rearing tanks are plumbed to have dual source water supply pipes configured to delivery river water, groundwater, or a blend of the two to each unit (Figure 4-11).

The fiberglass early rearing raceways are in serviceable condition and will be retained for use in the modernized hatchery. The modular steel raceways with plastic liners are nearing the end of their service life. The tank sidewalls are deflecting, causing the screens to fail, resulting in unplanned fish escapes. Replacement units are described in Section 4.4.3.

Figure 4-11. Prosser Hatchery dual source process water supply pipes into steel raceways

There are three large plastic-lined earthen ponds that are mostly used to hold adult fish (Figure 4-12). Each of these ponds has a water supply header, concrete outlet control structure, work platform, and level alarm system. An overhead cable system provides predator control. There have been problems with high groundwater floating the pond liners. In addition, the Tribe has had difficulty containing and segregating smaller fish in these ponds due to poor structural and screen tolerances at the outlet

structures. It is also difficult to crowd and sort adult fish. These ponds will be replaced with concrete holding ponds as part of the modernization effort.

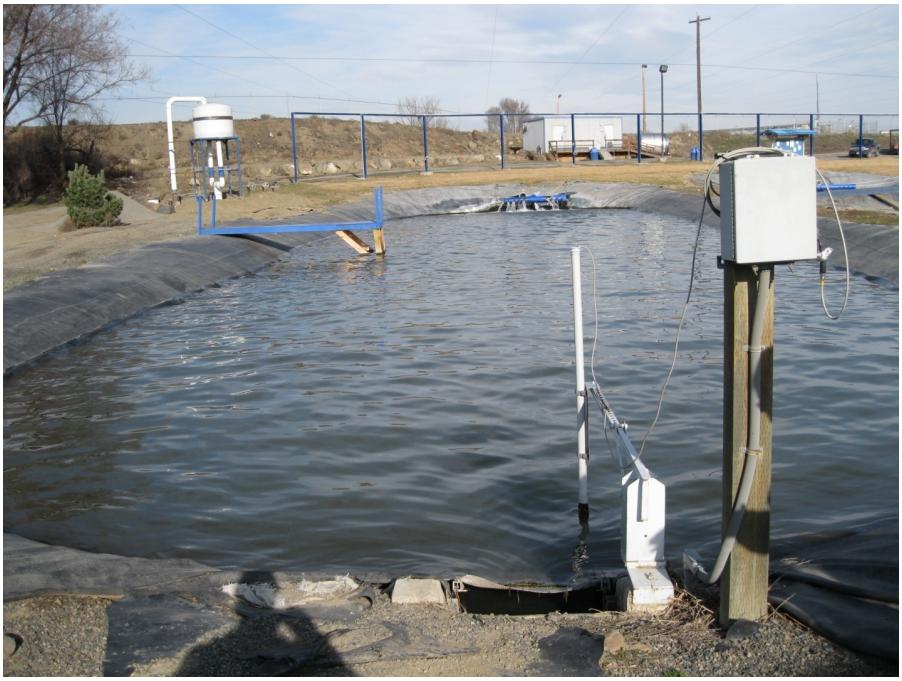


Figure 4-12. One of three large outdoor holding ponds at Prosser Hatchery

Monitoring and Alarm System – Each of the outdoor rearing raceways has a magnetic flow meter connected to a central supervisory control and data acquisition (SCADA) system that provides continuous flow rate and flow alarm functions. Dissolved oxygen sensors in each raceway and water level alarms at the head boxes are also connected to the SCADA system. It will be possible to salvage and or maintain portions of the existing SCADA system; however, much of it will need to be rebuilt to serve the modernized hatchery.

Utilities – Prosser Hatchery is connected to three-phase utility power via an overhead line extending along the north perimeter of the site. There are three separate electrical services. The main service powers the existing chiller and some of the well pumps and is connected to emergency power. The juvenile sampling facility has a separate service, and well No. 3 has yet another service that is connected to a portable emergency generator. Drawing EP2 in Appendix G is a one-line diagram of the existing power system. Propane is provided to the spawning and incubation buildings. Potable water is available to the various support buildings around the project site. Sanitary drains and restrooms are routed to pump out tanks. Data and voice communications are hard-wired in to the office and juvenile monitoring buildings.

Support Facilities - Additional infrastructure at Prosser Hatchery includes the following support facilities:

- An office trailer and modular restrooms for hatchery staff
- Spawning building

- Steelhead kelt reconditioning ponds (circular FRP tanks)
- Demonstration ponds and two public education kiosks. The ponds primarily display large sturgeon and trout.
- Freezer
- Two pole barns for feed storage and miscellaneous dry storage
- Portable emergency power generator for well No. 3
- A steep pass fishway and false weir for trapping adult fish that enter the hatchery outfall channel
- Four lamprey research tanks, eight feet in diameter

The office trailer and modular "pump-out" restrooms are temporary facilities that will be replaced with a new administration building connected to the municipal sewer. The demonstration ponds will be expanded and upgraded to provide better public interpretation and viewing opportunities. Wells will be provided with permanent emergency back-up power. The remainder of the support facilities will be retained as part of the modernized facility, although the lamprey tanks may be relocated to a different part of the site.

4.5.3 Proposed Fall Chinook Facilities at Prosser Hatchery

The Yakama Nation proposes to modernize Prosser Hatchery in order to achieve the fall Chinook production goals outlined in the preceding sections. Several of these improvements will be shared by the Prosser coho program. The proposed improvements include the following major elements:

- Enlarged silt settling pond with flow diffusers to improve the quality of the river water supply
- Two new high capacity wells for increased groundwater supply and redundancy
- New centralized degassing head box for groundwater treatment and supply
- Incubation isolation facility for out-of-basin eggs, with effluent disinfection
- Remodeled incubation building to provide double stack incubation instead of triple stacks
- Five new concrete raceways (3,250 cubic feet each) to replace existing plastic-lined steel raceways
- New concrete adult holding ponds and covered spawning area to replace the three large lined ponds
- New administration building with offices, break room, showers and lockers, mud room and a mechanical electrical room
- Roof covers with open sides for early rearing raceways
- Site paving and utility upgrades

Figure 4-13 shows a preliminary layout of the proposed improvements. These improvements are described in more detail below and in the concept design drawings in Appendix G. The improvements must be implemented without interrupting the existing fish production programs at Prosser Hatchery.

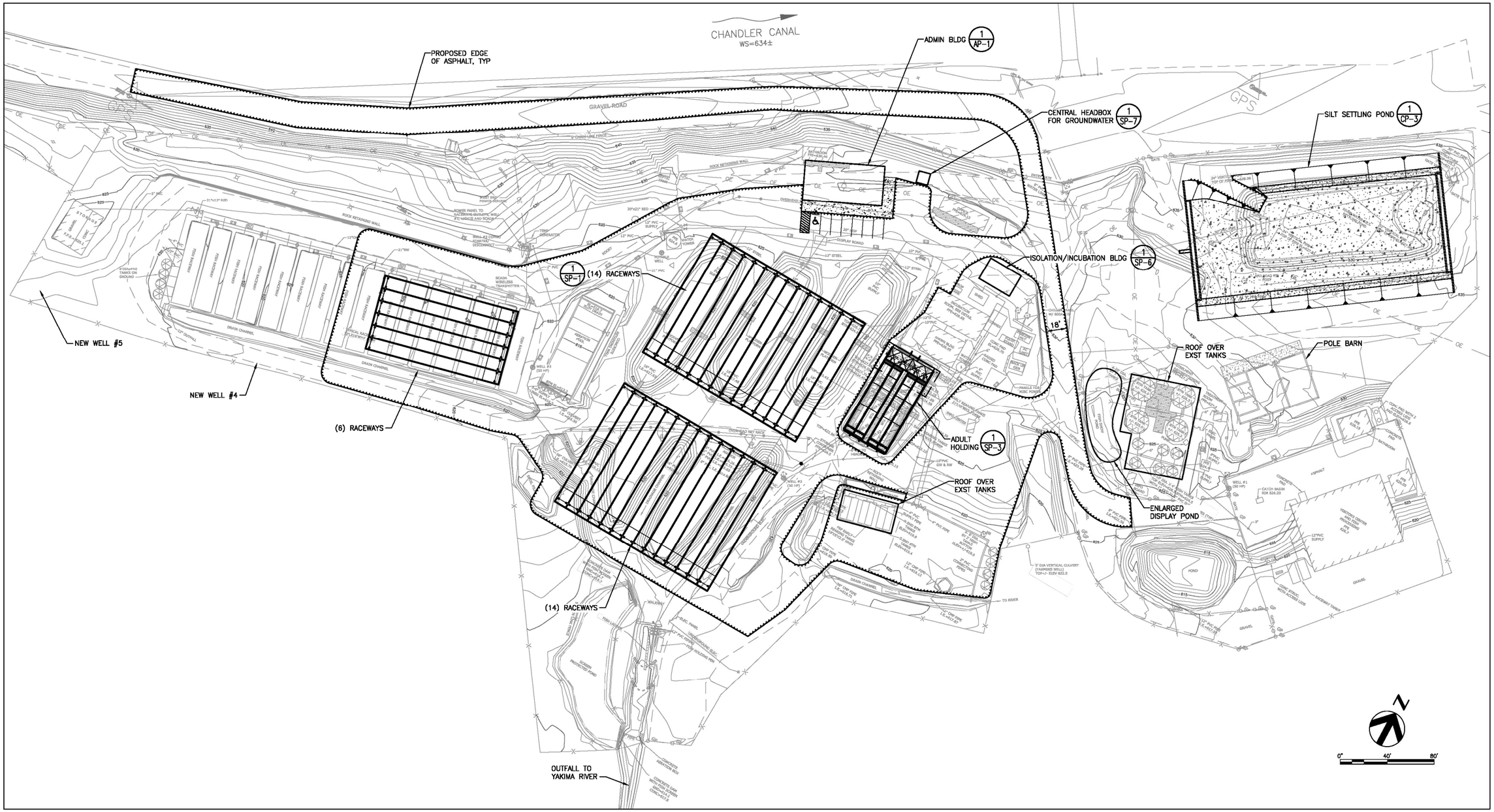


Figure 4-13. Preliminary layout of proposed improvements at Prosser Hatchery.

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Silt Settling Pond Improvements: A new silt settling pond will be constructed at the same location as the existing pond. The new pond will be approximately double in size and will also have inlet and outlet flow baffling to provide better silt settling. It will have a concrete bottom to reduce seepage losses and accommodate silt removal equipment. The pond inlet and outlets will have diffusers to minimize hydraulic short-circuiting and improve sediment removal. Large diameter flushing ports will be added at the downstream ends of the river water supply piping for periodic cleaning. It will be necessary to route a new bypass pipe around the settling pond area to maintain flow to the hatchery during settling pond reconstruction.

Two New High Capacity Wells: The three existing wells yield approximately 2.7 cfs each, for a total of 8 cfs. The peak groundwater demand for the proposed facility is 9.7 cfs. Therefore, two new wells, with capacities of 2 to 3 cfs each are proposed in order to meet peak demand and provide a stand-by well in case of a failure during a peak demand period. The increased groundwater supply will also reduce the volume of the back-up river supply needed during the annual November Chandler Canal maintenance.

Centralized Degassing Headbox: The three existing degassing head boxes are at different elevations and are constructed of materials that have a limited remaining service life. The proposed centralized head box will simplify pump and flow controls, improve flow balancing to various points of use, and improve the long term reliability of the groundwater supply system. It will consist of a rectangular 13-foot x 15-foot x 10-foot-high cast-in-place concrete head box tank, with a supply manifold with degassing columns sized for the 10 cfs target flow rate mounted above it. Groundwater will flow by gravity from the new head box to points of use. The head box will have a water level monitoring system to provide control signals to the well pumps, and level sensor alarms will report to the hatchery monitoring system. Drawing MP-1 in Appendix G shows the conceptual head box design.

Incubation Isolation Facility: An incubation isolation building will be needed to incubate the green eggs for the downstream of Prosser URB fall Chinook program. This building will be constructed just north of the existing incubation building, close to the existing chilled water system and drain system. The building will house up to 400 iso-buckets, stacked on shelves, with individual chilled and ambient water supply drops to each bucket. After eyeing, the eggs will be transferred into Marisource trays for final incubation. The trays will be configured in 29 double stacks. Iso-bucket and tray stack effluent will be collected in a single drain pipe and routed through an ozone disinfection tank prior to being combined with the main hatchery drain to the Yakima River.

Remodel Existing Incubation Building: The existing incubation building will remain largely intact to support the upstream of Prosser fall component of the Yakima summer/fall Chinook program and the Prosser coho program. The existing chilled and ambient ground water piping systems will be retained and modified as needed to supply the new incubation layout. The concrete floor slab in the incubation area will be demolished and rebuilt to provide smooth-bottomed floor trenches with grating covers for ease of cleaning and disinfection.

The remodeled building will have provisions for transferring button-up fry to outdoor rearing tanks via quick-connect wall penetrations and temporary piping or flexible hose systems.

New Concrete Raceways: Five new 3,250 cubic foot raceways will be needed to support the fall Chinook programs proposed at Prosser Hatchery. They will be part of a larger bank of raceways that will be built for the Prosser coho program described in Section 5.4.3. Each raceway will be 10 feet wide with 100 feet of rearing length and screen guides to allow each raceway to be sub-divided into three equal

sections. Screens will be installed at the upstream and downstream ends of the 100-foot rearing area to keep fish from jumping at the supply water and to create a quiescent zone for solids to settle at the downstream end. The bottom slab will be sloped at 0.5 percent (6 inches) to provide 3 feet of depth at the upstream end and 3.5 feet at the downstream end. Drawings SP1 and SP2 in Appendix G shows the conceptual raceway design.

The raceways will share common walls. Walkways will provide access for feeding and cleaning. An underwater feeding system, similar to the existing system at Cle Elum Hatchery, will be included to train fish to feed more naturally. Hinged cover panels will also be included over a portion of the raceways to provide refuge areas. Raceway banks will be covered with roofs to prevent sunburn and reduce algal growth. Predator netting will enclose the sides of the roofed area. The water supply to each raceway will be monitored with a flow meter on the supply and a dissolved oxygen sensor at the effluent end.

Adult Holding Ponds: Broodstock holding ponds will be constructed at Prosser Hatchery to support the below Prosser URB fall Chinook program and the coho program. The fall Chinook broodstock holding requirement is for 350 adult fish (1:1 male to female ratio), to be held in 1,750 cubic feet of water with a supply flow of 875 gpm. The coho broodstock holding requirement is for 960 adult fish (660 at a time, 1:1 male to female ratio) in 1,980 cubic feet of water. In addition, 300 adult fish will be held in 1,800 cubic feet of water for planting in tributaries. In order to provide flexibility to sort and segregate fish, four holding ponds with a volume of approximately 2,000 cubic feet each are proposed. Each pond will have screen guides to divide them into to three cells of 660 cubic feet, providing a total of twelve holding cells. Fall Chinook will be sorted into at least four cells in order to segregate new, ripe, green, and close-to-ripe fish. An open-sided roofed over concrete slab is provided for spawning activities at the upstream end of the holding ponds.

The combined adult holding pond facility will have an overall footprint of approximately 42 feet by 80 feet. The concrete walls of the holding cells will have five feet of freeboard plus jump panels to contain the fish. To minimize fish transport during the spawning process, the holding facilities will be located a short distance to the south of the existing spawning building.

Administration Building: The proposed administration building is approximately 2,400 square feet (Figure 4-12). It will provide office space for the hatchery manager and three staff, along with a break room/kitchen, showers lockers restrooms, mud room, and mechanical/electrical room. This building will be located to the west of the existing office trailer, and will overlook the new concrete raceway banks to the south. The existing three-phase overhead powerline in this area will need to be relocated or routed underground to avoid conflicts with the new building.

Roof Covers for Existing Tanks: New roof structures with open sides will be constructed over the top of the seven outdoor early rearing tanks located to the south of the existing spawning building. These will be column-supported roof structures and will provide protection from sunburn, algal growth and avian predators. The early rearing tank roof will be approximately 3,000 square feet.

Site Paving and Utility Upgrades: The major travel and circulation areas on the site will be asphalt surfaced to reduce dust and disease vectors and to provide all-weather driving surfaces for hatchery operations. Utility upgrades will include a possible domestic wastewater connection to the municipal sewer, treatment of stormwater run-off from parking areas, centralized emergency power, and communications upgrades.

4.5.4 Existing Acclimation and Adult Collection Facilities for Fall Chinook

Most of the current URB fall Chinook production at Prosser is acclimated on river water in the modular steel raceways described in Section 4.5.2. These fish are then released as fingerlings (at 65 fpp) directly to the river from the hatchery. Smaller releases of late-run fall Chinook at Marion Drain Hatchery will be discontinued and replaced by the early-run fall Chinook program described in Section 4.3.

The URB fall Chinook program downstream of Prosser has used adults collected at Little White Salmon National Fish Hatchery as broodstock. This program component will switch to Priest Rapids /Hanford Reach stock and may eventually transition to a local broodstock collected at a planned lower river site (see Appendix J). The fall component of the summer/fall Chinook upstream of Prosser program uses adults collected primarily by seining fish out of the Chandler Canal when it is dewatered for maintenance each November. Some fish are also collected at the trap in the right bank ladder at Prosser Dam as well as at the steep-pass trap on the Prosser Hatchery outfall channel.

Adults are held until they are ready for spawning in one or more of the three large plastic-lined ponds at the Prosser Hatchery site.

4.5.5 Proposed Adult Collection Facilities for Late-Run Fall Chinook

The Yakama Nation proposes to construct a new acclimation and adult collection facility to accommodate the 1.7 million URB fall Chinook program downstream of Prosser at an undeveloped site lower on the Yakima River. This new facility is intended to improve smolt-to-adult survival ratios and increase the number of returning adults available for harvest. The lower river release location will minimize the effects of dams on fish migration, reduce exposure to predation, and will help isolate the URB fall Chinook segregated harvest program from the summer/fall Chinook population that uses upstream portions of the Yakima River.

Three potential lower river sites were evaluated for these facilities (see Appendix J): Horn Rapids, Barker Ranch and a parcel adjacent to the Highway 224 bridge over the Yakima River. Although the final site has yet to be selected, the major elements will include at least six large acclimation ponds, fish release flume, a steep pass fishway, an adult holding and spawning facility, water supply and drain systems, emergency power, spawning waste holding tank, storage container and a concrete pad for temporary seasonal housing.

Broodstock for the fall component of the summer/fall Chinook program upstream of Prosser will be collected as described in Section 4.5.4. The program will also obtain some fish from the proposed Sunnyside trap described in Section 4.5.9 below.

4.5.6 Existing Facilities at Marion Drain Hatchery

Marion Drain Hatchery is used to incubate and rear Yakima URB fall Chinook; however, the Tribe proposes to convert this to a facility for incubation and rearing of the summer component of the summer/fall Chinook program. The hatchery is on the western side of a 38.49 acre parcel (Parcel # 19102034001) owned by Yakama Nation, located a short distance east of Lateral Road A, bounded on the south by Marion Drain (Figure 4-14). Various fish production systems and support buildings have gradually been constructed by the Tribe at this site over the last 15 years, including a sturgeon hatchery on the northeastern portion.

Facilities for the existing URB fall Chinook program consist of an incubation room; two connex trailers- one for incubation water chilling and one for isolation-incubation; water supply systems; six early rearing troughs and two plastic-lined outdoor rearing ponds. There are also storage buildings and an outdoor storage area on the northern portion of the site.

Figure 4-14. Marion Drain parcel and salmon hatchery site.

Site Access and Security – The site is reached by gravel road via Lateral Road A. The hatchery portion of the site is enclosed by a chain link fence with motorized security gates. A caretaker residence at the site entrance provides additional security.

Topography – A topographic survey was completed in June 2011 to support the planning work presented in this document. Figure 4-15 depicts the existing hatchery site conditions that include a triangular fenced area on relatively flat ground immediately north of Marion Drain. The site slopes gradually from elevation 775.0 at the north to elevation 773.0 along the top bank of the canal. The canal bank drops steeply to a toe of slope elevation of 763.0. Water depth in the canal was approximately 2 to 3 feet at the time of the survey. There are no floodplain issues at this site.

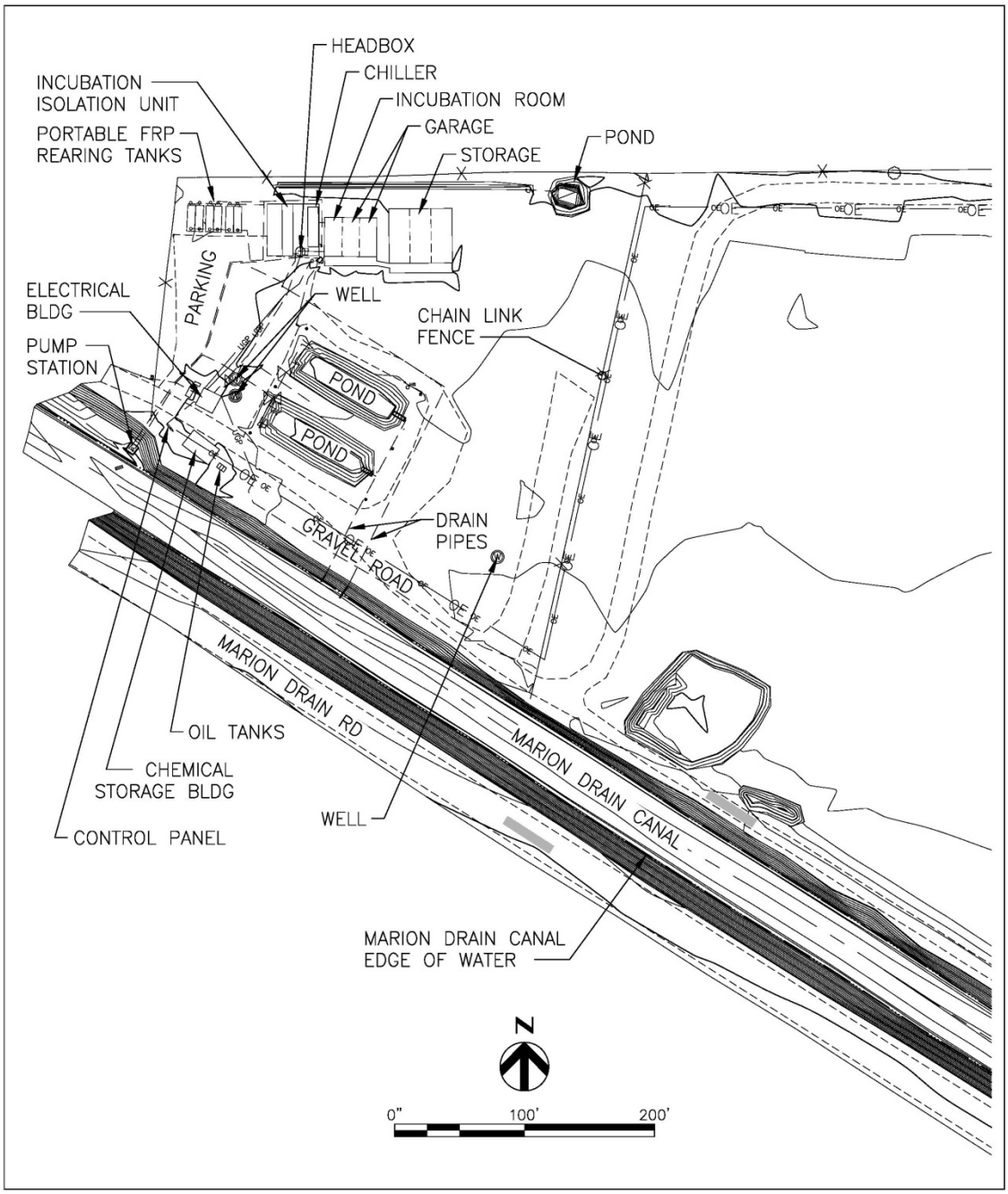


Figure 4-15. Site plan of existing facilities at Marion Drain.

Process Water Supply Systems – For fish culture purposes, the hatchery uses both groundwater from on-site wells and surface water supplied by a pump station in Marion Drain canal. Surface water pumps are mounted in a small masonry block structure on the north bank of the canal that is outfitted with compliant intake screens and has a capacity of 800 gpm (1.8 cfs). Figure 4-16 shows the two surface water pumps and their related structure. The pumps and motors are exposed to the elements and have poor service access. Historical water temperature data indicates the surface water in the canal is groundwater influenced, ranging from 46 to 64°F, with daily diurnal variations of 2 to 4°F.

Figure 4-16. Marion Drain surface water supply pump station.

There are two functional groundwater wells at Marion Drain: one is a dug cistern type that has a capacity of 80 gpm, and the other is a 6-inch drilled well with a capacity of 300 gpm (Figure 4-17). A third well was recently drilled and is not yet completely outfitted for production. This well is 16 inches in diameter and is expected to yield approximately 500 gpm based on test pumping results. The total capacity of the groundwater supply system is approximately 800 gpm (2 cfs).

The pressurized well discharge pipes are routed to a central degassing headbox located to the north of the wells. Headbox construction is similar to those at Prosser Hatchery and does not meet seismic code. Treated groundwater flows by gravity from the headbox to various points of use. The piping systems are mostly solvent-welded PVC.

Figure 4-17. Existing six-inch well at Marion Drain Hatchery.

Process Water Drain Systems – Overflow drains from the degassing headbox and fish culture facilities are collected in a system of buried pipes. They are combined into two pipes that discharge into Marion Drain as shown on Figure 4-15.

Incubation Room – The incubation room is in a metal building adjacent to the degassing headbox. There are six double-stacked Marisource incubation units and two FRP troughs that are used for bulk incubation of green eggs (Figure 4-18). Each incubator stack and trough has a separate supply pipe for chilled and ambient temperature groundwater delivery. A separate connex unit is used for isolation incubation and is located west of the head box. The remainder of the metal building is used for light storage.

Figure 4-18. Marion Drain Hatchery incubation room.

Outdoor Rearing Facilities – Outdoor rearing facilities at Marion Drain consist of six FRP early rearing troughs, 19 by 5 by 3.5 feet high, and two plastic-lined earth ponds, 100 by 36 by 5 feet deep. The early rearing troughs are in good condition and will be maintained as flex tanks the hatchery site. The plastic-lined ponds are usable, but have a limited service life. They will not be used for the proposed Chinook program, but will be retained on site for possible use in other tribal fisheries programs.

Monitoring and Alarm System – The hatchery has a simple flow-based alarm system with an auto-dialer that activates when a no flow condition is detected by a flow switch mounted in the hatchery supply pipe.

Utilities – Marion Drain Hatchery is connected to three-phase utility power via an overhead line that runs through the site. There is a small electrical building at the salmon hatchery site, with critical loads connected to an emergency power panel. Drawing EM-2 in Appendix G shows a one-line diagram of the existing power system. Potable water is available to the various support buildings around the project site. Sanitary drains and restrooms are connected to an on-site disposal system. Data and voice communications are hard-wired into the existing electrical room.

Support Facilities - Additional infrastructure at Marion Drain Hatchery includes the following support facilities:

- Garage and light storage buildings
- Outdoor storage area
- Perimeter chain link fencing
- Graveled parking and vehicle circulations area

The existing incubation, early rearing and outdoor ponds at Marion Drain are not well configured for use in the proposed summer component of the summer/fall Chinook program. They will be retained for potential future use in other tribal aquaculture production programs.

4.5.7 Proposed Facilities at Marion Drain Hatchery for Chinook

The Tribe proposes to modernize the Marion Drain Hatchery with a variety of improvements to water supplies, fish culture incubators and rearing units, power and control systems, and support buildings in order to achieve the summer/fall Chinook production goals outlined in Section 2.3.2 above. The proposed improvements are shown in Figure 4-19 and include the following major elements:

- New screens and surface water pump station in Marion Drain canal
- One new well to increase groundwater supply and redundancy
- New centralized degassing head box for groundwater treatment and supply
- New 28,000-square-foot hatchery and administration building designed to incubate and rear the full summer component of the summer/fall Chinook program. The facility will have 25 percent make-up flow reuse systems to produce high quality fish with the limited available water supply.
- Adult holding and spawning facility
- Cleaning waste treatment pond

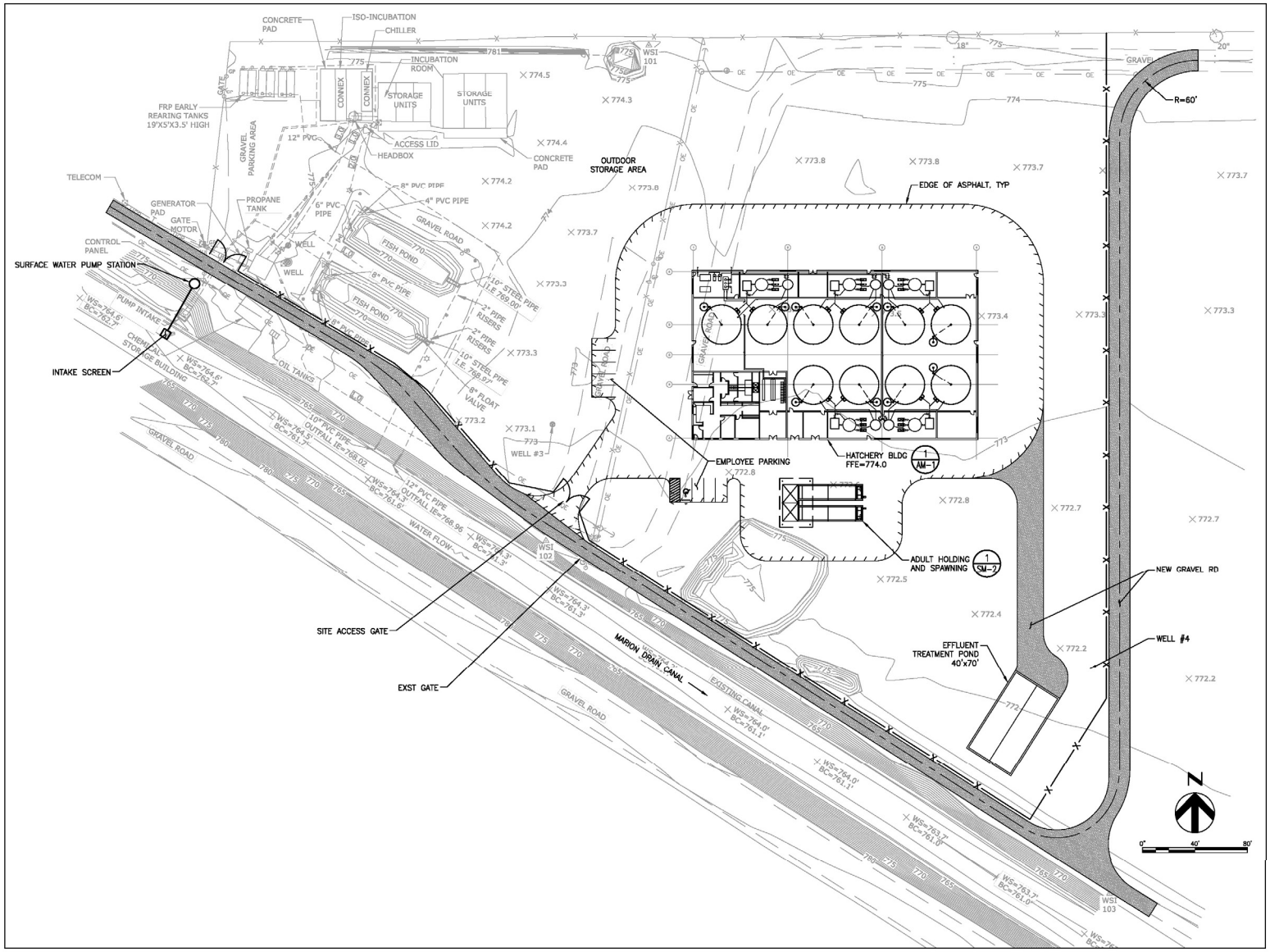


Figure 4-19. Marion Drain Hatchery proposed facility plan.

Surface Water Supply – The existing pump station will be replaced with a more permanent structure, which will have self-cleaning intake screens, an enclosed submersible wet well-type pump, improved automated controls and better maintenance access. The conceptual design includes a micro-strainer and UV on the surface water supply system. The need for this system will be verified as additional water quality data is collected during upcoming design phases.

Groundwater Well – The three existing wells have capacities of 80 gpm, 300 gpm and 500 gpm. The peak groundwater flow demand for the new facility is over 500 gpm. A new well with at least 500 gpm capacity is planned to provide a redundant source for hatchery operations if there is a problem with the existing large well.

Degassing Headbox – A new degassing headbox will be provided in the new hatchery building for treating the incoming well water to reduce nitrogen levels and increase dissolved oxygen prior to use in the incubation process. The headbox will be a fabricated aluminum structure with degassing columns mounted on top. It will have separate compartments for ambient and chilled groundwater.

Hatchery Building – The proposed hatchery building will have a rectangular footprint, approximately 218 feet long and 130 feet wide. It will house multiple critical functions with square footage assignments as shown in Table 4-2. The building is configured with a central drive-through along its long axis for truck access to transfer and mark fish.

Table 4-2. Marion Drain Hatchery building space planning

Function	Space Required
Egg Receiving and Prep Area	400 SF
Incubation – 7 Stacks and 3 Deep Troughs	600 SF
Rearing– Summer Chinook	13,200 SF
Entry Vestibule (2)	80 SF
Lobby	200 SF
Manager's Office	176 SF
4 Staff Offices (open office)	260 SF
Conference/Break Room	320 SF
Mud Room/Janitor Closet	150 SF
Men's Restroom, Lockers and Shower	320 SF
Women's Restroom, Lockers and Shower	320 SF
Miscellaneous Storage	700 SF
Chemical Storage	240SF
Reuse Equipment	4,200 SF
Water Treatment (Degassing and Chilling)	600 SF
Electrical Rooms	400 SF
Mechanical Rooms	400 SF
Feed Storage	640 SF
Circulation and Drive-through at 15%	4,400 SF
Hatchery Building Subtotal	**28,000 SF**

The building is situated with the long axis in an east-west orientation to maximize solar gain in the winter and the ability to control direct sun penetration during the hot summer months. The design includes extended overhangs on south facing exterior windows to control solar gain during the summer. Clerestory openings will allow natural light deep into the fish production area to minimize the dependence on artificial lighting, thus reducing energy consumption.

Proposed exterior materials include steel siding with a concrete or masonry base to reduce potential impact damage by equipment or trucks. Metal roofing and trim are also envisioned. Insulated translucent sandwich panels will provide natural daylight into the production area. The exterior color palette is proposed to be earth tones. Figure 4-20 presents a conceptual layout for the hatchery building, which will be located in an open field, immediately east of the existing hatchery site. The conceptual design drawings in Appendix G show additional detail on the proposed improvements.

Utility Systems – Needed improvements to utility systems include:

- Power: Overhead three-phase power is available on site and was recently upgraded. Burying a several hundred foot-long segment of the power lines may be explored at the west end of the hatchery building to eliminate a potential conflict with hatchery operations. An existing stand-by diesel generator was recently moved to the site and will be used to provide power via an automatic transfer switch.

- Communications: Phone and data services will be extended to the new hatchery building.

- Potable water: Potable water is available from a domestic well and will be extended to the hatchery building.

- Domestic Wastewater: A new onsite waste disposal system, including a septic tank and drainfield, will be constructed adjacent to the hatchery building.

- Stormwater: Run-off from the newly developed portions of the site will be directed into filter strips and/or bio-swales for treatment prior to leaving the site.

Adult Holding and Spawning Facility – Summer-run component Chinook broodstock will be collected at the Sunnyside Dam trap (Section 4.5.9) and transported to Marion Drain Hatchery for holding and spawning. The broodstock goal is 350 fish under Option 1 or 600 fish under Option 2 that will be held onsite for two to three months, from August through October of each year.

The adult holding facility will consist of two concrete post-sort pools with screen partitions to segregate new fish, green fish, ripe and un-ripe fish. Adult fish will be held on river water at maximum densities of 5 cubic feet per fish, with upwelling water supply flows of 2.0 to 2.5 gpm per fish. The holding ponds will have 4 to 5 feet of freeboard plus jump panels to contain the fish. At the head end of the ponds, a concrete pad with an open-sided roof covering will provide a spawning area for collecting eggs as the fish ripen. The concrete pad will sloped toward floor drains that will route spawning wastes to a buried holding tank that will be pumped out at the end of each season.

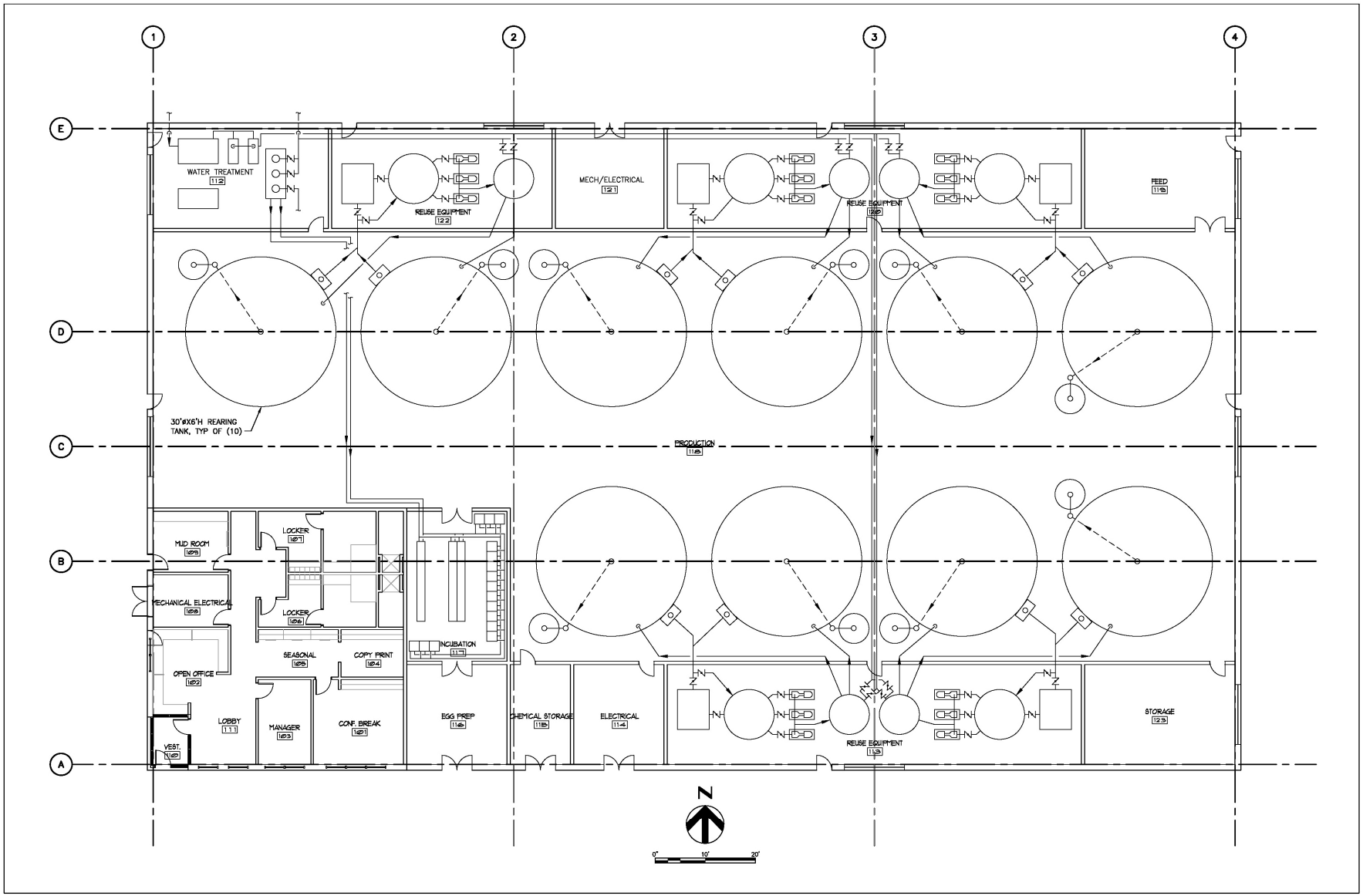


Figure 4-20. Proposed facilities at Marion Drain Hatchery for the summer component of the summer/fall Chinook program.

Incubation Facilities – Green eggs will be processed in an egg prep room located in the hatchery building. They will be loaded into bulk incubation troughs in the incubation room until eye-up, when they will be transferred into adjacent heath trays at 5,000 eggs per tray for the duration of the incubation period. Chilled and ambient groundwater supplies will be routed to each trough and incubation unit. The target incubation water temperature is 44°F, with 6 gpm of supply flow to each stack of incubators. For Option 1, eight double stacks will be required, with a total single pass flow-through rate of 48 gpm. For Option 2, 16 double stacks will be required, with a total single pass flow-through rate of 96 gpm.

A hard-piped chemical feed system will be used to deliver argentine or formalin treatments to the water supply as needed to prevent fungus growth on the eggs. Overflow water from the troughs and trays will be collected in floor trenches that convey the water into the hatchery drain system. Adequate dilution flow will be maintained through the drain system to avoid exceeding chemical concentration limits in the hatchery outfall. For the duration that the program uses out-of-basin broodstock, the effluent from the incubation facility will be disinfected with an ozone treatment system prior to discharge from the hatchery building.

Rearing Facilities – Beginning in late January, swim-up fry will be transferred from the incubators into the 30-foot-diameter fiberglass rearing tanks fitted with water reuse technology to reduce overall water demand at the facility by 75 percent. The rearing tanks will be configured in rows, with each pair of tanks connected to a common reuse system. Water to be reused will overflow from each tank via an overflow in the tank sidewall. It will then flow by gravity through a micro-strainer drum screen to remove suspended particulates, and then into a pump sump. Booster pumps will then lift the water through a UV disinfection unit and into a degassing and oxygenation tower to remove the carbon dioxide byproduct from fish respiration, and increase dissolved oxygen to near saturation before the water is returned to the rearing tanks. The 25 percent make-up water flow will be introduced via a metered connection at the top of the tower to improve water quality before it enters the rearing tanks.

For the early life stages and through the summer months, groundwater will be used as the make-up water source. In November, the make-up water will be switched to surface water pumped from Marion Drain canal. Peak make-up water flow rates to each reuse system will be 325 gpm, or 25 percent of the total flow rate.

Each tank will have a center bottom drain to collect solids and convey them along with about 15 percent of the total flow to a radial flow separator. The separator overflow line will route clarified drain water to the hatchery outfall. The separator purge line will route the concentrated feces and un-eaten along with the micro-strainer backwash drain to an offline cleaning waste settling pond.

Each tank will have screens for segregating and retaining batches of fish, as well as a weir in the overflow box for water level control. A grated floor trench will run the length of the room at the downstream end of the tanks to collect overflow/drain water and route it into the hatchery drain pipe system.

Hatchery Housing and Administration – The existing residence will be retained. Situated near the main entrance to the facility, this house will allow staff to monitor traffic in and out of the complex. No new residences are proposed.

Administration facilities will consist of offices in the main hatchery building and will include a conference room/break room, mud room, restrooms, lockers and showers, chemical storage, and mechanical and electrical rooms, dry storage, feed storage/cool room.

Cleaning Waste Treatment – As noted above, cleaning wastes from early rearing and juvenile rearing cells will be removed through piped vacuum systems that will convey the concentrated wastes (primarily fish feces and un-eaten feed) to a dual cell off-line settling pond. Each of the two settling pond cells will be sized to treat the peak cleaning waste flow from the facility. This will allow one cell to be dewatered and cleaned without interrupting normal hatchery operations. The settling ponds will be designed to meet guidelines of the US Environmental Protection Agency CFR 40 for aquaculture operations. There is interest in disposing settling pond sludge as fertilizer on adjacent wildlife refuge property. There is also interest in routing hatchery and cleaning waste overflow water to the refuge as well. These options will be explored in more detail during the next design phase.

Preliminary sizing indicates that two side-by-side cells, 15 feet wide by 60 feet long by 4 feet deep, would allow hatchery operators to vacuum clean at least two raceways at a time, with a vacuum flow of 100 gpm each.

4.5.8 Existing Conditions at Sunnyside Dam for Summer/Fall Chinook

There are no fish trapping or sorting facilities at Sunnyside Dam, a US Bureau of Reclamation low head irrigation diversion dam located at RM 103.8 of the Yakima River. Three existing fish ladders operate on the left and right banks and in the center of the river (Figure 4-21), and the canal head works is located on the left bank. The right bank fish ladder is a promising site for adult broodstock capture for the summer/fall Chinook program. The right bank ladder has good fish truck access via a gated gravel and dirt road. Entrances to the other two ladders could be temporarily closed during peak migration periods to increase fish use of the right bank ladder.

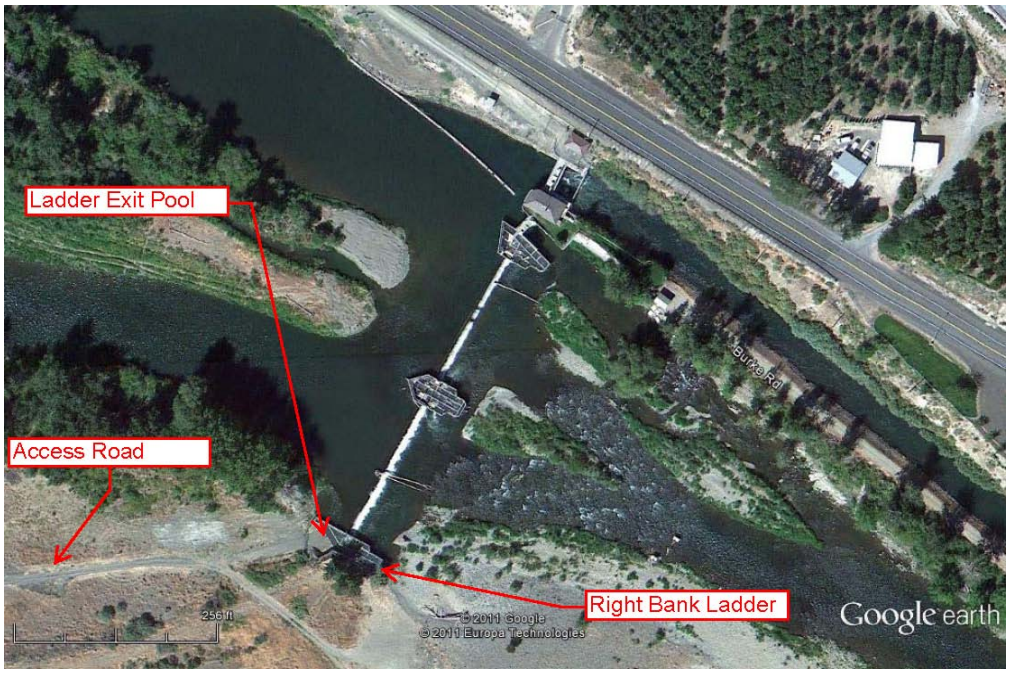


Figure 4-21. Sunnyside Dam – proposed fish trap and sort location

4.5.9 Proposed Facilities at Sunnyside Dam for Summer / Fall Chinook

Several preliminary options were developed to retrofit the right bank ladder to trap and sort upstream migrating adult summer/fall Chinook. Two preferred options were selected for further study and cost comparison. Both options convert the fish ladder exit pool at the upstream end of the ladder to an in-line holding pool. A bar rack would be dropped into the upstream end of this pool to allow the fish to accumulate. One option uses a steep pass fishway to move fish volitionally out of the holding pool up to a sorting deck. The other option is similar to the Roza trap design and uses a fish lock and mechanical brail system to lift the fish up to a sorting deck. These options are illustrated in Appendix G and described below.

Steep Pass Option: Under this option, the upstream end of the holding pool would be modified to provide an entrance for a steep pass fishway. A five cfs booster pump would be activated when operators are ready to sort fish. The pumped flow would upwell via a false weir at the top of the steep pass fishway then cascade down the fishway, resulting in a turbulent flow that would attract fish into the steep pass section. Fish would swim up the fishway, over the false weir and into one of two flumes which then would transport them into anesthesia tanks prior to sorting. The fish would be sorted at an on-grade deck (approximate elevation of 903) and then manually carried up a modular stairway and loaded onto the transport truck.

Fish Lock Option: Under this option, a cast in place concrete fish lock would be constructed adjacent to the upstream end of the holding pool. Manual crowders and sliding bar racks would be used to concentrate the fish from the holding pool into the fish lock without interrupting flow through the existing ladder. The fish lock gate would then be closed and a water supply pump activated to fill the lock as needed to raise the water level to the sorting elevation. An inclined floor brail inside the lock would be raised to force the fish out of the lock and into an anesthesia tank prior to sorting. Under this option, the fish would be sorted on an elevated deck (at elevation 915) so that operators would not have to climb stairs to load the transport truck.

The Tribe has selected the steep pass option as the preferred solution to carry forward into preliminary design.

4.5.10 Production and Operation Schedules

Planning level production and operations schedules for the proposed URB fall Chinook and the Yakima summer/fall Chinook programs have been developed based on the programs described in Sections 2.3 and 4.3.2 and the facilities described above. These schedules demonstrate how the target production goals will be achieved.

The primary biological variables used to prepare the preliminary operations schedule are water temperature (a species-specific condition factor for URB fall and summer/fall Chinook), density and flow indices. Water temperature is the primary determining factor in the development and growth rate of fish. The groundwater supply to be used for all stages of incubation and early fish rearing will provide a relatively constant 56°F year round water temperature at the Prosser and Marion Drain facilities. This relatively warm temperature will accelerate fish growth in relation to natural growth cycles; therefore, chillers will be used to slow growth during the incubation and early rearing phases. Hatchery managers

will put the yearling fish on a maintenance diet to slow the growth during final rearing in order to achieve target release sizes.

A loading density of 0.5 lb./cf and a flow index of 1.0 have been established by Tribal fish culturists. Based on these primary biological variables, specific biocriteria were developed and form the basis of the preliminary operations schedules shown in Appendix C. These schedules depict water use by month, chilling and space requirements for each operational area of the fish culture process, including adult holding, incubation, sub-yearling and yearling rearing.

Each preliminary operations schedule covers a two-year period in order to understand and incorporate overlapping water requirements for juvenile fish (reared to a yearling size) from two brood years on site at one time. A summary schedule of the flow rates proposed at the Prosser and Marion Drain hatcheries are shown in Tables 4-3 and 4-4, respectively.

4.5.10.1 Prosser Hatchery

Development timing for the URB fall Chinook and the fall component of the summer/fall Chinook program at Prosser Hatchery is listed below; associated water requirements are identified in Table 4-3.

- September through November: Adult holding
- October through January: Egg incubation
- Late January through April: In-basin sub-yearling rearing
- January through May: Out-of basin sub-yearling rearing

These sub-yearling programs have a seven to eight month duration, with peak flows of 3,080 gpm (6.85 cfs) occurring at the end of February just before the downstream of Prosser (URB) fish are transferred to a lower river acclimation site (see Appendix J).

Table 4-3. Projected peak monthly flows (in gallons per minute) at Prosser Hatchery by Chinook life stage.

Month	Adult Holding Flow	Incubation Flow	Groundwater Flow to Rearing	River Water Flow to Rearing	Total Flow- (Rounded)
January		204	1,685		1,890
February			3,074		3,080
March				1,310	1,310
April				1,490	1,490
May					
June					
July					
August					
September	875				875
October	875	204			1,080
November	875	204			1,080
December		204			204

4.5.10.2 Marion Drain Hatchery

Development timing for Options 1 and 2 of the summer component of the summer/fall Chinook programs at Marion Drain Hatchery are listed below; water supply requirements for each phase and option are presented in Table 4-4. The options are described in Section 2.3.2.

- August through October: Adult holding
- October through January: Egg incubation
- Late January to mid-February through May: Sub-yearling rearing
- Yearling rearing extends through the following March (Option 1 only)

The summer Chinook program options have peak surface water flow requirements of 1,500 gpm (3.5 cfs) and 526 gpm (1.2 cfs) of groundwater that occur in October at the end of the adult holding period and just before reuse systems are switched to river water make-up.

Table 4-4. Projected peak monthly flows (in gallons per minute) at Marion Drain Hatchery by Chinook life stage for Option 1 and Option 2.

	Adult Holding Flow		Incubation Flow		Make-Up to Rearing GW Flow		Make-Up to Rearing River Flow		Total Flow Through		Reuse Flow	
Month	Option 1	Option 2	Option 1	Option 2	Option 1	Option 2	Option 1	Option 2	Option 1	Option 2	Option 1	Option 2
Jan			43	87			966		1,010	87	2,928	
Feb					203	161	1,288		1,490	161	4,392	488
Mar					203	322	1,449		1,652	322	4,880	976
April					203			644	203	644	732	1,952
May					325				325		1,220	
June					161				161		488	
July					161				161		488	
Aug	875	1,500			322				1,197	1,500	976	
Sept	875	1,500			322				1,197	1,500	976	
Oct	875	1,500	43	87	526				1,444	1,587	1,464	
Nov			43	87			639		682	87	1,938	
Dec			43	87			870		850	87	2,447	

Note: Options are described in Section 2.3.2.

4.6 CONSISTENCY OF THE URB HARVEST PROGRAM AND THE SUMMER/FALL CHINOOK PROGRAM WITH EIGHT SCIENTIFIC PRINCIPLES OF THE NPCC FISH AND WILDLIFE PROGRAM

The Yakama Nation has made every effort to design the proposed project to conform to the NPCC's eight scientific principles and the Major Project Review requirements that flow from them. This section presents the principles and discusses how the proposed Chinook programs are consistent with each.

4.6.1 Principle 1: The abundance, productivity and diversity of organisms are integrally linked to the characteristics of their ecosystems

Language from the NPCC Fish and Wildlife Program further amplifies this principle:

> *"The physical and biological components of ecosystems together produce the diversity, abundance and productivity of plant and animal species, including humans. The combination of suitable habitats and necessary ecological functions forms the ecosystem structure and conditions needed to provide the desired abundance and productivity of specific species."*

The aquatic and terrestrial habitats present within and outside of the Yakima Basin determine the abundance, productivity, and diversity of the basin's fish populations. The quality and quantity of this habitat has been evaluated through field surveys and modeling efforts that have identified habitat factors likely limiting fish production in the basin. The primary limiting factors for early and late run Chinook salmon are high stream temperatures and changes in stream flow volumes, magnitude and timing. Strategies and actions to address habitat limiting factors were developed and incorporated into the Yakima Subbasin Plan (YSFWPB 2004). These actions are being implemented yearly as funds allow and their effectiveness is being tracked over time through monitoring and evaluation.

The biological objectives for the summer/fall Chinook program are based on Ecosystem Diagnosis and Treatment (EDT) and AHA modeling of the entire life cycle of and the ecosystem that may be used by summer/fall Chinook (see Appendix E). This ecosystem includes the Yakima River Basin, Columbia River, Columbia River estuary and the Pacific Ocean. The analysis identified the potential for summer/fall Chinook production in the basin over both the short term (< 25 years) and long term (> 25 years). It also showed that factors outside the basin will play an important role in determining whether the program will be successful. For example, summer/fall Chinook exploitation rates in ocean and freshwater fisheries are greater than 60 percent in most years. This level of harvest, combined with poor in-basin habitat quality, creates a situation where a naturally spawning population cannot be sustainable.

This Master Plan recognizes that humans also rely on the productivity of the ecosystem to provide societal needs, and that many of these needs are in direct conflict with the needs of other species. Treaties and legal agreements dictate that certain actions, for example fish harvest, will continue despite the negative effect fisheries may have on fish abundance. Agriculture in the basin requires large amounts of river water to grow the crops which produce hundreds of millions of dollars in revenue to farmers each year. Much of this water comes at the expense of aquatic species such as summer/fall Chinook that rely on it for all phases of their life-cycle.

Basin stakeholders have been working cooperatively to balance the needs of humans and fish. This balance is being improved by exploring selective fisheries, setting instream flows, guaranteeing water rights to farmers, screening diversions, implementing upland and riparian habitat actions designed to protect the riverine environment, and implementing projects such as this one in a well thought-out and scientifically justifiable manner.

4.6.2 Principle 2: Ecosystems are dynamic, resilient and develop over time

The NPCC Fish and Wildlife Program expands upon this principle by stating:

> *"Although ecosystems have definable structures and characteristics, their behavior is highly dynamic, changing in response to internal and external factors. The system we see today is the product of its biological, human and geological legacy. Natural disturbance and change are normal ecological processes and are essential to the structure and maintenance of habitats."*

Habitat conditions in the Yakima Basin have degraded over time primarily due to human actions (YSFWPB 2004) such as logging, agriculture, and urban development. Each have all contributed to the decline of habitat quality, quantity and fish abundance. These effects influence what is biologically possible to achieve in the short and long term.

The Yakima Subbasin Plan (YSFWPB 2004) identifies limiting factors resulting from habitat degradation and proposes a number of strategies to restore the habitat to a condition closer to its pre-development condition. Implementing these strategies will help protect fish populations from catastrophic events as well as smaller scale disruptions. It is recognized that habitat protection and restoration activities that take into account natural processes as well as human-caused changes require a long-term commitment.

Although the short-term goal of the program is focused on harvest using artificial production, in the long term, it is expected that habitat actions will increase natural fish population productivity, abundance and diversity to the point where they be self-sustaining. The program anticipates and relies on improvements in habitat to achieve long-term program goals. If achieved, this may allow a substantial portion of the hatchery program to be reduced or eliminated.

4.6.3 Principle 3: Biological systems operate on various spatial and time scales that can be organized hierarchically

The NPCC Fish and Wildlife Program language elaborates on this concept as follows:

> *"Ecosystems, landscapes, communities and populations are usefully described as hierarchies of nested components distinguished by their appropriate spatial and time scales. Higher-level ecological patterns and processes constrain, and in turn reflect, localized patterns and processes. There is no single, intrinsically correct description of an ecosystem, only one that is useful to management or scientific research. The hierarchy should clarify the higher-level constraints as well as the localized mechanisms behind the problem."*

The proposed URB harvest program and the summer/fall Chinook program would split the Yakima Basin into two parts. The portion of the basin below Prosser Dam (RM 47) would be managed as a part of the

Upper Columbia URB population to maximize harvest benefits and opportunities. The rest of the basin would be managed as a locally adapting Yakima summer/fall Chinook population over the short term to provide harvest benefits but with a long-term goal of reestablishing a sustainable natural population.

The major constraints limiting goal attainment in the basin result from legal agreements, high harvest rates, mainstem Columbia River hydropower development and human use of basin water and land resources. All of these factors have been taken into consideration in program development. The use of artificial production to achieve identified goals is an indication that these constraints will not soon be eliminated. Humans will always need water, land and power to support an ever increasing population. The challenge is to develop a strategy that balances the needs of both humans and fish.

This Master Plan focuses on implementing actions that are within the control of the Tribe (and basin partners) to meet the harvest and long-term conservation objectives for the summer/fall Chinook program. Actions are designed to protect the population through each of the phases of their life-cycle that occurs in the basin. Habitat improvement actions benefitting summer/fall Chinook are targeting conditions in the mainstem Yakima River, the area where summer/fall Chinook complete all freshwater life stages.

Water is at a premium in the Yakima Basin for both agriculture and municipal purposes, particularly in the summer. Such demands are the primary factors constraining production of most species of anadromous fish. Downstream improvement actions are focused on providing sufficient flows with the proper temperature regime to produce large numbers of healthy smolts and ensure the survival of adult migrants. Water diversions are being screened and the quality of irrigation returns improved to enhance aquatic ecosystem health.

Until habitat quality improves, Treaty harvest rights need to be met through artificial production. Long term, as habitat improves, it may be possible to rely more on natural Chinook production to achieve program objectives. When this occurs, hatchery production may be reduced or eliminated. However, the scale of habitat improvements will be tempered by the growing human population that will continue to place demands on natural resources such as water and land. It is likely that the Tribe will have to rely on artificial production to meet Treaty rights for many decades.

4.6.4 Principle 4: Habitats develop, and are maintained, by physical and biological processes

Elaborating on this, the NPCC Fish and Wildlife Program adds:

> *"Habitats are created, altered and maintained by processes that operate over a range of scales. Locally observed conditions often reflect more expansive or non-local processes and influences, including human actions. The presence of essential habitat features created by these processes determines the abundance, productivity and diversity of species and communities. Habitat restoration actions are most effective when undertaken with an understanding and appreciation of the underlying habitat-forming processes."*

Habitat conditions observed in a particular reach may signal that impacts are occurring elsewhere in the subbasin or at a larger scale. For example, changes in the amount and/or timing of stream flow or sediment input to a channel may be the result of human activity or natural processes in adjacent upland

areas or stream reaches. Habitat actions and strategies proposed in the Yakima Subbasin Plan (YSFWBP 2004) emphasize actions at the watershed (subbasin) level rather than at the habitat unit scale. Strategies include:

- Protecting stream corridor structure and function
- Restoring passage and connectivity between habitat areas
- Restoring floodplain function and channel migration processes
- Restoring riparian condition
- Restoring normative flow regimes
- Restoring degraded water quality, including water temperature

The Subbasin Plan proposes a variety of actions to implement these strategies, taking into account the limited usefulness of some types of habitat actions as well as the acceptability of some actions to members of the public. The Tribe's proposed Chinook programs will not impede efforts to achieve these habitat goals.

4.6.5 Principle 5: Species play key roles in developing and maintaining ecological conditions

The NPCC Fish and Wildlife Program adds that:

> *"Each species has one or more ecological functions that may be key to the development and maintenance of ecological conditions. Species, in effect, have a distinct job or occupation that is essential to the structure, sustainability and productivity of the ecosystem over time. The existence, productivity and abundance of specific species depend on these functions. In turn, loss of species and their functions lessens the ability of the ecosystem to withstand disturbance and change."*

Anadromous fish returning to the Yakima River deliver marine-derived nutrients as their carcasses decompose after spawning in the basin. These nutrients increase stream productivity and provide a food source for both terrestrial and aquatic species (Cederholm et al. 2000).

Past salmon harvest management in the ocean and Columbia River and habitat degradation have contributed to the decreased abundance of some species in the Yakima Basin which has, in turn, decreased the amount of nutrients being delivered. Release of hatchery summer/fall Chinook pursuant to U.S. vs. Oregon agreements helps to mitigate for the loss of marine-derived nutrients in the mainstem Yakima River. Actions proposed in this Master Plan would improve delivery of marine-derived nutrients to the basin from both natural-origin and hatchery summer/fall Chinook salmon. It is expected that summer/fall Chinook abundance, diversity and spatial distribution would increase, helping to restore some lost functionality and increasing the resilience of the overall ecosystem.

The eggs, fry and juveniles produced by hatchery fish spawning naturally will provide food for other species such mountain whitefish, cutthroat trout and rainbow trout. An increase in food supply may increase the abundance, diversity and spatial structure of these native species.

4.6.6 Principle 6: Biological diversity allows ecosystems to persist in the face of environmental variation

Specific language from the NPCC Fish and Wildlife Program states:

> *"The diversity of species, traits and life histories within biological communities contributes to ecological stability in the face of disturbance and environmental change. Loss of species and their ecological functions can decrease ecological stability and resilience. It is not simply that more diversity is always good; introduction of non-native species, for example, can increase diversity but disrupt ecological structure. Diversity within a species presents a greater range of possible solutions to environmental variation and change. Maintaining the ability of the ecosystem to express its own species composition and diversity allows the system to remain productive in the face of environmental variation."*

The diversity of fish populations will be ensured primarily through habitat improvement and protection actions across the Yakima Basin and by re-establishing the summer component of the summer/fall Chinook population (YSFWBP 2004).

Habitat actions implemented throughout the historical range of these summer/fall Chinook will allow the development of spawning aggregates adapted to the current environmental conditions. Spawning aggregates are expected to occur in the lower Naches River, middle Yakima River, Marion Drain, mouths of major tributaries and possibly below Prosser Dam.

Management triggers, based on natural and hatchery fish escapement levels, will be used to adjust the size of the Chinook program above Prosser Dam. When targeted program levels are achieved, hatchery production will be reduced, which should decrease the negative ecological and genetic effects hatchery programs on native fish populations.

4.6.7 Principle 7: Ecological management is adaptive and experimental

Elaborating on the seventh principle, the NPCC Fish and Wildlife Program states:

> *"The dynamic nature, diversity, and complexity of ecological systems routinely disable attempts to command and control the environment. Adaptive management — the use of management experiments to investigate biological problems and to test the efficacy of management programs — provides a model for experimental management of ecosystems. Experimental management does not mean passive "learning by doing," but rather a directed program aimed at understanding key ecosystem dynamics and the impacts of human actions using scientific experimentation and inquiry."*

This Master Plan includes an adaptive management program to track key performance variables over time. The variables act as trigger metrics that drive decisions about program implementation (see Section 3.3). Triggers are used to determine escapement targets, when the program objectives change and when changes in hatchery production are required. In short, fish performance will be used to adaptively manage the Chinook program.

4.6.8 Principle 8: Ecosystem function, habitat structure and biological performance are affected by human actions

The NPCC Fish and Wildlife Program further explains that:

> *"As humans, we often view ourselves as separate and distinct from the natural world. However, we are integral parts of ecosystems. Our actions have a pervasive impact on the structure and function of ecosystems, while at the same time, our health and well-being are tied to these conditions. These actions must be managed in ways that protect and restore ecosystem structures and conditions necessary for the survival and recovery of fish and wildlife in the basin. Success depends on the extent to which we choose to control our impacts so as to balance the various services potentially provided by the Columbia River Basin."*

The common thread running through the discussions of all eight scientific principles is the human effect on anadromous fish and their habitats and the human need for these fish. This Master Plan, in concert with the Yakima Subbasin Plan (YSFWBP 2004), is designed to address both the human-caused degradation of Yakima salmon stocks and the cultural, economic, commercial, and recreational importance of those stocks by restoring and increasing naturally spawning populations and accommodating treaty harvest rights.

Habitat strategies in the Yakima Subbasin Plan address human degradation of stream habitat. It should be noted that this Master Plan does not account for, or assume, any improvements in habitat conditions in the mainstem Columbia or estuary. Subbasin strategies and actions are designed to target the key habitat factors limiting fish abundance, productivity, spatial structure, and life history diversity. A prioritization strategy has been developed to guide the action selection and implementation process.

Strategies under this Master Plan do not target habitat improvements; rather the programs attempt to balance the harvest rights of the Tribe with the impacts hatchery facilities and fisheries have on native fish communities.

Harvest levels and rates will be monitored with in-season adjustments when necessary. Selective sport fisheries that require anglers to release unmarked fish will be maintained throughout the basin. Tribal fisheries will be regulated using traditional time, area, and gear restrictions. The WDFW and other parties are investigating the use of selective fisheries in the ocean and lower Columbia River to reduce harvest impacts on summer/ fall Chinook.

To further reduce human impacts to the ecosystem, these programs propose to:

- Convert to a locally adapted broodstock
- Operate consistent with HSRG guidelines for segregated and integrated harvest programs when adult returns and natural production allow.
- Implement an adaptive management plan that uses attainment of performance indicators to drive hatchery operations and decisions.
- Reduce hatchery production over time as natural early- and late-run fall Chinook production is capable of achieving biological and legal objectives

4.7 INTEGRATED APPROACH TO MEETING LONG-TERM GOALS FOR SUMMER/FALL CHINOOK SALMON IN THE YAKIMA BASIN

4.7.1 Relationship to Other Projects and Activities

In this section, we briefly describe the link of the proposed Chinook programs to other projects and activities in the subbasin intended to achieve desired endstate conditions for the watershed. As shown in Table 4-5, the measures proposed in this Master Plan are but one effort contributing to the protection and restoration of summer/fall Chinook and coho salmon in the Yakima River Basin. Table 4-5 lists fishery and habitat projects in the Yakima Basin that are funded by the BPA. Projects funded by other sources are summarized in Section 6.3.

4.7.1.1 Yakima Klickitat Fisheries Project

The primary umbrella program for fisheries restoration in the Yakima Basin is the Yakima/Klickitat Fisheries Project (YKFP), a joint endeavor of the Yakama Nation and WDFW, sponsored in large part by BPA with oversight and guidance from the NPCC. The YKFP is committed to salmon reintroduction through supplementation and habitat protection and restoration. It is designed to use artificial propagation to maintain or increase natural production while maintaining long-term fitness of the target populations and keeping ecological and genetic impacts to non-target species within specified limits. Species currently being enhanced by the YKFP and the Yakama Nation Fisheries Program include spring, summer and fall Chinook salmon, coho salmon, sockeye salmon, and steelhead trout. The Yakama Nation has been releasing hatchery fall Chinook in the Yakima basin since 1983. Spring Chinook supplementation has been occurring since 1997. Coho supplementation began under this program in 1995 (Dunningan et al. 2002; Hubble et al. 2004); however, the Yakama Nation has been releasing hatchery coho in the basin since the mid-1980s. The Yakama Nation has conducted an interim fish reintroduction program since 2005 at Cle Elum Reservoir. The reintroduction has included coho salmon and sockeye since 2010.

Table 4-5. Other habitat and salmon restoration projects in the Yakima River subbasin.

Contractor	Title/Project No.	Purpose	Summary
Yakama Nation	Yakima River Management, Data and Habitat - Yakima/Klickitat Fisheries Project (YKFP)/ 1988-120-25	Habitat	The Yakima/Klickitat Fisheries Project (YKFP) is split into several sub-projects (Monitoring and Evaluation, Operations and Maintenance, and Construction) under the overall program umbrella. The Management, Data and Habitat Project includes overall management and administration, as well as the data management, and habitat protection and restoration components of the YKFP program.
Yakama Nation	Lower Yakima Valley Riparian Wetlands Restoration/1992-062-00	Habitat	The purpose of this project is to continue implementation of the YN Lower Yakima Valley Wetlands and Riparian Wildlife Mitigation work that began in 1991 (Contract Number 94BI12521). The goals are as follows: 1) To permanently protect 27,000 acres of floodplain lands along the Yakima River, Toppenish and Satus creeks within the agricultural portion of the Yakama Reservation. 2) To enhance those lands to increase native fish and wildlife habitat values. 3) To adaptively manage those lands to ensure permanent fish and wildlife value. 4) To monitor the habitat conditions to ensure the desired habitat value is reached and maintained.
Yakama Nation	Yakima River Monitoring and Evaluation -Yakima/Klickitat Fisheries Project (YKFP)/1995-063-25	Artificial Production	This project funds the monitoring and evaluation activities for the Yakima River Basin assigned to the Yakama Nation fisheries staff.
Yakama Nation	Yakama Reservation Watershed Project/1996-035-01	Habitat	Stream channel, floodplain and vegetation restoration projects addressing habitat related limiting factors (i.e., flow, key habitat quantity, habitat diversity, temperature, sediment load, channel stability) that were identified in the Yakima Subbasin Plan Supplement (pp. 11-13) form the core of this project. This project and the complementary Yakama Nation Riparian/Wetlands Restoration Project (199206200) are the only comprehensive vehicles for recovering two of the four steelhead populations in the Yakima Major Population Grouping. The goal is to restore the natural hydrologic function of the watersheds as much as possible without burdening economic interests (i.e., timber harvest, agriculture) on the

Contractor	Title/Project No.	Purpose	Summary
			Reservation. This in turn will increase steelhead spawning success and juvenile survival to outmigration. In addition to steelhead, restoration work will likely benefit other anadromous and resident fish species (e.g., coho salmon, Chinook salmon, bull trout, and westslope cutthroat trout) and many wildlife species as well. The YRWP conducts comprehensive watershed restoration activities including (1) headwater wetland rehabilitation; (2) adult and juvenile fish passage restoration; (3) stream channel and riparian area restoration including bringing stream channels back to grade, reconnecting side channels and floodplains, planting native vegetation in conjunction with riparian and range fencing; (4) minimum instream flow implementation and modification of irrigation water sources and uses; along with (5) physical monitoring that includes precipitation, groundwater, discharge from streams, canals and drains, temperature, water quality, fish habitat structure and quality according to accepted protocols; and (6) biological monitoring including spawning ground surveys, snorkel surveys and smolt trapping.
Yakama Nation	Yakima River Operations and Maintenance - YKFP/1997-013-25	Artificial Production	The Upper and Lower Yakima Supplementation and Research Facilities are maintained and operated by the Yakama Nation. This project rears and releases 810,000 spring Chinook smolts from three acclimation sites, determines the feasibility of re-establishing a naturally spawning coho population, and tests the application of supplementation principles to the two lower Yakima River fall Chinook stocks, the mainstem and Marion Drain stocks.
Yakama Nation	Yakima Basin Side Channels Land Acquisition/1997-051-00	Habitat	The Yakima Side Channels Project is a fish habitat acquisition program. Habitat acquisition criteria includes a willing seller, land characterized by connection to or a restorable floodplain, prime spawning and/or rearing habitat, and critical habitat for listed Mid-Columbia steelhead. Preference is given to properties that have a water right, and/or are adjacent to protected lands.
Yakama Nation	Coho Nutrient Supplementation/2008-459-00	Habitat	This project uses hatchery carcasses to increase productivity in spawning/rearing tributaries. This will increase egg-to-smolt survival in areas where marine-derived nutrients have been absent for decades.

Contractor	Title/Project No.	Purpose	Summary
Yakama Nation	Coho Production Facility and Marking/2008-465-00	Artificial Production	This project funds construction of a small-scale hatchery to rear 300,000 coho pre-smolts intended to distribute hatchery production to habitats that can support natural spawning. Another component of the project marks hatchery smolts to exclude them from broodstock as returning adults.
Yakama Nation	Prosser Hatchery Reform and Upgrades/2008-466-00	Artificial Production	The goal of this project is to reform and upgrade the infrastructure of the Prosser Hatchery. This included replacing the chiller with a more productive one in order to increase egg viability/survival, allow for synchronization of egg hatch time and increase survival of broodstock. An automated alarm system was installed to monitor water conditions throughout the hatchery. This included flow meters on the river intake system, wells on all fish holding vessels, dissolved oxygen/temperature probes and float meters on all holding vessels. A larger pump was installed in one of the current wells. Lights were installed throughout the hatchery for night time checks and emergencies.
Yakama Nation	Yakama Nation Ceded Lands Lamprey Evaluation and Restoration/2008-470-00	Programmatic	The goal of the lamprey restoration project is to restore natural production of Pacific lamprey in the in the Yakama Nation ceded lands of the Wind, White Salmon, Klickitat, Yakima, Methow, Entiat rivers and streams. Very little information exists about lamprey abundance and distribution throughout the Ceded lands and essentially no information has been collected concerning known or potential limiting factors. One of the primary objectives is to survey key habitats and collect baseline information that will be used to develop a long-term restoration strategy. Other key objectives are to evaluate potential artificial propagation and translocation of adult lampreys. These latter objectives would be used as tools to help jump start natural production in selected watersheds.
Mid-Columbia Fisheries Enhancement Group	Salmon & Steelhead Habitat Restoration and Protection in the Yakima Basin	Habitat	This project will implement a non-regulatory, basin-wide effort to involve landowners in restoration and protection projects in priority areas identified in Yakima Subbasin Plan. Work includes riparian planting, fencing, fish passage, and instream habitat improvements.
Pacific NW National Laboratory	Yakima/Huntsville Screen Evaluation/1985-062-00	Habitat	Assess if sites are properly equipped to provide safe, efficient fish bypass by reviewing design drawings, operating procedures, and components install and in use at 26 facilities in the Yakima River Basin.

Contractor	Title/Project No.	Purpose	Summary
South Central Washington Resource Conservation & Development	Yakima Tributary Access and Habitat Program/2002-025-01	Habitat	The Yakima Tributary Access and Habitat Program (YTAHP) works on Yakima River tributaries to re-establish fish passage, screen diversions, increase in-stream flow and enhance riparian and in-stream habitat. Section 2.1.2 of the Yakima Subbasin Plan Supplement (Nov. 26, 2004. pg.8) speaks to limiting factors in the Yakima Basin and attributes the declines of aquatic species to "low flows; obstruction to fish migration and entrainment; diminished habitat quantity, quality and diversity; high temperatures; altered sediment transport; and degraded channel stability".
S. Central Washington Resource Conservation and Development	Yakima Basin-wide Tributary Passage and Flow/2007-398-00	Habitat	The Manastash Flow Enhancement project is part of a larger restoration project in the Manastash Creek watershed to provide fish screens, remove fish passage barriers and improve in-stream flow.

Source: Columbia Basin Fish & Wildlife Program Projects & Portfolios (available online at http://www.cbfish.org/Portfolio.mvc/Index/).

4.7.2 Relationship to Regional Habitat Strategies

As illustrated in Section 4.7.1, broad-based programs are underway in the Yakima Basin to improve habitat conditions for anadromous and resident fish species. The diversity of entities involved in these habitat efforts is highlighted below. These and other measures are consistent with the NPCC's overall habitat strategies as well as the habitat goals identified in the Yakima Subbasin Plan (YSFWPB 2004).

4.7.2.1 Yakima Tributary Access and Habitat Program

The Yakima Tributary Access and Habitat Program (YTAHP) is a multi-party effort to restore fish passage to Yakima River tributaries that historically supported salmon and to improve habitat in areas where fish access is restored. BPA has funded the program since 2001, with additional funding for individual projects from other sources including the Salmon Recovery Funding Board, the Department of Ecology's Water Infrastructure Program, the Community Salmon Fund, and other local, State, and Federal programs. Funded participants include Kittitas and North Yakima County Conservation Districts, WDFW, Yakama Nation, and the South Central Washington Resource Conservation and Development. Other partners include the Kittitas Conservation Trust, Mid-Columbia Regional Fisheries Enhancement Group and the Benton Conservation District. Projects funded through YTAHP are primarily fish screening and fish passage improvements, but also include riparian plantings, fencing, and irrigation system improvements that improve fish habitat conditions.

4.7.2.2 Yakima Storage Dam Fish Passage Study

The Bureau of Reclamation is leading a cooperative investigation with the Yakama Nation, State and Federal agencies, and others to study the feasibility of providing fish passage at the five large storage dams associated with the Yakima Project. These dams—Bumping Lake, Kachess, Keechelus, Cle Elum, and Tieton—were never equipped with fish passage facilities. Four of the five reservoirs were originally natural lakes and historically supported tribal fisheries for anadromous and resident fish.

4.7.2.3 Salmon Recovery Funding Board Projects

In 1999, the Washington Legislature created the Salmon Recovery Funding Board to administer State and Federal funds to protect and restore salmon habitat in the state. The Yakima Basin Fish and Wildlife Recovery Board (YBFWRB) is the lead entity responsible for coordinating SRFB grant applications in Yakima, Benton, and Kittitas counties. Funding has been used for projects such as fish passage and screening at small irrigation diversions, planting riparian areas, acquiring and protecting land with high-priority fish habitat, restoring natural stream channel functions, and promoting fish-friendly agricultural practices. See YBFWRB (2011) for a summary of projects funded from 1999 through 2011.

4.7.2.4 Yakima County Comprehensive Flood Hazard Management Plans

As part of its Comprehensive Flood Hazard Management Plans, the Yakima County Flood Control Zone District implements habitat restoration projects. These projects are identified in the 2007 Upper Yakima Comprehensive Flood Hazard Management Plan. The plan addresses the floodplain of the mainstem Yakima River from the mouth of Yakima Canyon to Union Gap and the Naches River from its mouth to Twin Bridges. Actions being implemented under this plan include floodplain restoration projects at several locations in the lower Naches River and in the Gap-to-Gap reach of the Yakima River.

4.7.2.5 Washington State Department of Transportation Programs

The Washington State Department of Transportation (WSDOT) has various programs focused on meeting its stewardship goals of avoiding and minimizing environmental and habitat disturbance. In Yakima and Kittitas counties, WSDOT has provided over $2 million for fish passage barrier removal projects. Ongoing projects include wetland mitigation, habitat connectivity and fish passage restoration. The WSDOT 10-year fish passage project funding plan (2007-2019) includes budget for a project at Silver Creek, along Interstate 90 at mile post 70.9. Through its habitat connectivity and wetlands mitigation programs, WSDOT provides funding to various entities (including the YKFP) for land acquisition and conservation easements aimed at maintaining wildlife movement corridors and improving floodplain habitat function.

4.7.2.6 Kittitas Conservation Trust

The Kittitas Conservation Trust implements conservation actions along the mainstem Yakima River and its tributaries. Funded projects include the Swauk Creek Water Storage Study, the Currier Creek Barrier Removal, Taneum Creek Fish Passage Improvements, and North Fork Teanaway River Conservation Easements.

4.7.3 Relationship to Harvest Strategies

Yakima River summer/fall Chinook hatchery and naturally produced fish are affected by fisheries both outside and inside of the basin. Harvest rates and levels in ocean and Columbia River fisheries are established in US vs. Oregon after coordination with agencies such as NMFS, USFWS and the Bureau of Indian Affairs (BIA). Rates are set to meet biological escapement targets and harvest levels as established by law. The primary goals of US vs. Oregon are to rebuild weak runs to full productivity and fairly share the harvest of upper river runs between treaty and non-treaty fisheries in the ocean and Columbia River.

Because Yakima River summer/fall Chinook are captured in the same fisheries as naturally produced fish from the Columbia River, harvest rates are similar. These rates are not meant to protect naturally produced fish from the Yakima River Basin since this population is not viable and therefore not a high management priority at this time. The harvest rates are therefore excessive for the low productivity (recruit per spawner < 1.0) of the Yakima River summer/fall Chinook stock. Harvest rates may need to change in the future if it appears that a self-sustaining population can be established in the basin. The need for such change will be discussed in future updates of the US vs. Oregon management plan.

Although regulations allowing fall season fisheries in the Yakima River are promulgated annually by the Yakama Nation in collaboration with WDFW, Yakima River tribal harvest is typically at or near zero. Tribal fishers generally prefer to fish the Zone 6 Columbia River season fisheries because of the quantity and relatively higher quality of summer/fall Chinook available there. Harvest effort is expected to increase in the Yakima River as run levels increase over time. Season opening and closing dates, as well as fishery locations, would be adaptively managed based on decision triggers provided in Section 3.3.4.

Washington State fishery regulations for fall Chinook vary from year to year and by river location. Fishing regulations for the Yakima River are generally as follows:

The lower Yakima River, from the Highway 240 bridge upstream to 400 feet below Prosser Dam, is generally open to sport fishing from late September through October. Fishing is allowed according to regulations promulgated annually by WDFW.

Harvest rates in the state recreational fisheries ranged from 5 to 24 percent and averaged 16 percent from 2000-2010 (see Table 2-2).

4.8 SUBBASIN-WIDE RISK ASSESSMENT

Because Yakima River summer component of the summer/fall Chinook population has been extirpated and fall component Chinook has been dramatically reduced in abundance and influenced by releases from out-of-basin hatcheries, the risks of using artificial production to increase harvest are deemed low. The fish that remain are of recent hatchery origin. Domestication risks will be reduced by transitioning to local broodstock and eventually by transitioning the summer/fall Chinook program to an integrated one.

A potential program risk to be considered is straying of hatchery fish outside of the target stream. Such colonizing may decrease the productivity of the natural populations inhabiting these areas. Hatchery strays will be minimized by transitioning to locally adapted broodstock. To address the remaining risk, all hatchery fish will be marked with a coded wire-tag. The tag will allow hatchery fish to be identified if harvested or collected during carcass surveys or operations at other hatcheries. Additionally, groups of juveniles will be PIT-tagged prior to release so that upon return as adults, they may be detected as they pass through the FCRPS. If straying exceeds five percent, hatchery operations may be altered in an attempt to improve adult homing.

4.9 CONSISTENCY OF THE URB FALL CHINOOK AND SUMMER/FALL CHINOOK PROGRAMS WITH NPCC ARTIFICIAL PRODUCTION POLICIES

The Council's Artificial Production Review (NPPC 1999) identified necessary reforms of artificial production programs throughout the Columbia Basin and included ten policies to guide the use of artificial production. The Yakama Nation's proposed Chinook programs have been designed to be consistent with these production strategies and other inherent recommendations. The ten artificial production strategies are presented below in bold italics, immediately followed by an assessment of the consistency of the proposed Chinook programs with the strategy.

The purpose and use of artificial production must be considered in the context of the ecological environment in which it will be used.

The Yakima URB fall Chinook and the Yakima summer/fall Chinook programs are designed to provide harvest to meet tribal treaty rights established in law. Artificial production is appropriate for Yakima River URB and summer/fall Chinook because current habitat conditions and harvest rates are such that natural production cannot meet legal obligations or biological objectives.

The Yakama Nation is also investing heavily in habitat improvements throughout the basin. These actions are expected to increase the productivity of naturally produced summer/fall Chinook and other species. As natural fish abundance increases, reliance on hatchery production to meet harvest goals will

decrease. However, the task of improving habitat conditions over time will be complicated due to the increasing need humans have for power, water and land resources. It will require a significant effort to simply maintain status quo habitat conditions in the Yakima Basin. Because of this, it is likely that artificial production will be needed for the foreseeable future.

> ***Artificial production must be implemented within an experimental, adaptive management design that includes an aggressive program to evaluate the risks and benefits and address scientific uncertainties.***

An adaptive management plan is a fundamental component of this program. It uses performance triggers to select when certain management strategies are implemented and stopped (see Section 3.3). An intensive monitoring and evaluation plan is already in place in the basin and will be used to track and determine the causes of program success or failure.

> ***Hatcheries must be operated in a manner that recognizes that they exist within ecological systems whose behavior is constrained by larger-scale basin, regional and global factors.***

The program recognizes that factors outside of the Tribes' control may have a large effect on program success. Harvest levels in ocean and freshwater fisheries may take more than 60 percent of program adults on an annual basis. In addition, summer/fall Chinook migrating to and from the basin are lost in large numbers as they pass through the FCRPS. The effects of these external factors on fish survival are a major reason a 2.7 million fish hatchery program is required to achieve program goals.

Variable ocean conditions will also affect the number of hatchery- and natural-origin adults produced each year. The program accounts for this variability by setting minimum spawning escapement targets and adjusting in-basin harvest rates as needed to achieve these targets. Global climate change may cause stream temperatures in the Yakima River system to increase over time (Section 6.4.6). This change may be sufficient to overwhelm the beneficial actions being undertaken to improve habitat conditions in the basin.

If habitat quality does not increase, then it is unlikely that harvest benefits can be obtained from what will be limited natural Chinook production. Under this scenario, the need for hatchery production to achieve harvest goals will be even greater. Hatchery facilities are designed with sufficient infrastructure expansion capabilities to meet goals under such a future scenario.

> ***Naturally selected populations should provide the model for successful artificially reared populations, in regard to population structure, mating protocol, behavior, growth, morphology, nutrient cycling, and other biological characteristics.***

The morphological, demographic and behavioral characteristics of hatchery summer/fall Chinook will be constantly compared to the natural population to detect changes in these attributes through time. To reduce the chance of divergence in physical and genetic traits between the two components of the population, naturally produced Chinook will be incorporated into the integrated program at ever increasing rates as natural run size increases. The segregated program will prioritize the use of local-origin adults as broodstock to produce fish with traits that have the highest survival potential possible.

The URB fall Chinook program in the lower Yakima will be managed as part of the Hanford Reach/Priest Rapids population. It will be segregated/isolated from the Yakima summer/fall Chinook population spawning upstream of Prosser. The contribution of URB spawners to the summer/fall escapement will be limited to less than five percent. Hatchery operations (such as acclimation) or program size will be altered if the target is not achieved.

Jacks will be incorporated into the integrated broodstock of the summer/fall Chinook program at rates similar to those observed in the natural population. Scale samples will be taken on naturally produced fish to determine size and age relationships for returning fish. This action will establish the size criterion separating adult and jack Chinook.

Summer/fall Chinook smolts will be released at between 70 and 90 fpp. This size range is similar to what has been observed for naturally produced smolts arriving at monitoring facilities in the lower Yakima River.

> ***The entities authorizing or managing an artificial production facility or program should explicitly identify whether the artificial propagation product is intended for the purpose of augmentation, mitigation, restoration, preservation, research, or some combination of those purposes for each population of fish addressed.***

The Yakima URB fall Chinook program downstream of Prosser is strictly a harvest augmentation program. The primary goal of the summer/fall Chinook hatchery program is to provide fish for harvest pursuant to US vs. Oregon. The secondary, more long-term goal is to produce sufficient adults to restore them to self-sustaining levels throughout the basin. Because of degraded habitat conditions, the Tribe recognizes that in all likelihood, this goal will not be met for decades. The purpose of summer/fall Chinook program is both harvest augmentation and conservation/re-colonization.

> ***Decisions on the use of the artificial production tool need to be made in the context of deciding on fish and wildlife goals, objectives and strategies at the subbasin and province levels.***

Hatchery production of URB fall and summer/fall Chinook in the Yakima River Basin is required under US vs. Oregon to achieve tribal fishing rights as defined in law. The US vs. Oregon Columbia River Fish Management Plan (1988) identified a short-term production goal for the Yakima Basin to release 1.7 million URB fall Chinook from the Little White Salmon Hatchery. The long-term production goal for the basin included construction of a Yakima hatchery with capacity to produce 3.0 million URB fall Chinook. The Columbia River Fish Management Plan also supported establishment of a new program under which the production of 200,000 URB fall Chinook would be converted to summer Chinook and identified the construction of a Yakima hatchery for regional (summer Chinook) supplementation as a long-term goal. The URB Chinook program downstream of Prosser is part of these agreements. Annual releases from the existing program have been coordinated with, and agreed to by federal, state and tribal fisheries managers. Summer/fall Chinook reintroduction is also outlined in the Yakima Subbasin Plan that was adopted by the NPCC (http://www.nwcouncil.org/fw/subbasinplanning/yakima/plan/). The reestablishment of extirpated salmon populations is an integral part of the basin planning process.

Appropriate risk management needs to be maintained in using the tool of artificial propagation.

An adaptive management plan is being developed that sets triggers to determine when program changes should be made (Section 3.0). Triggers are used to set escapement levels, reduce harvest and control the proportion of hatchery fish spawning naturally. The programs will be operated consistent with HSRG (2004, 2009) recommendations to reduce genetic and ecological risks that the hatchery may pose to natural populations as conditions allow.

Production for harvest is a legitimate management objective of artificial production, but to minimize adverse impacts on natural populations associated with harvest management of artificially produced populations, harvest rates and practices must be dictated by the requirements to sustain naturally spawning populations.

Harvest rates on Columbia River summer and fall Chinook are set by the terms of US vs. Oregon. Harvest rates are intended to provide sufficient fish to meet treaty rights while at the same time protecting ESA listed salmonids in the Columbia River. Because Yakima River summer and fall Chinook are captured in the same fisheries as naturally produced fish from the Columbia River, harvest rates are similar. These rates are not meant to protect the naturally produced Yakima summer Chinook population. Since this population was extirpated around 1970, pre-terminal fisheries protection of this population as it is reestablished has not yet been a high management priority. The harvest rates are therefore not conducive for the recovery of the low productivity (recruit per spawner < 1.0) Yakima River summer/fall Chinook stock. Harvest rates may need to change in the future if it appears that a self-sustaining population can be established in the basin. The need for such change will be discussed in future updates of the US vs. Oregon management plan.

Federal and other legal mandates and obligations for fish protection, mitigation, and enhancement must be fully addressed.

The Chinook program is required to meet tribal treaty rights. The size of the current program has been agreed to by the parties to US vs. Oregon. The size of the programs proposed in this Master Plan will be sent to the pertinent parties for approval as well. All other relevant legal mandates for fish protection, mitigation and enhancement will be incorporated into the program.

4.10 HATCHERY AND GENETICS MANAGEMENT PLAN

A draft HGMP for the URB fall and summer/fall Chinook artificial production programs is attached as Appendix A.

5.0 PROPOSED COHO PROGRAMS

5.1 PROGRAM NEED AND JUSTIFICATION

The Yakama Nation was guaranteed fishing rights by the Treaty of 1855 (Stat. 951). These rights were confirmed by a federal court in US vs. Oregon in 1969. Since 1977, the parties to U.S. vs. Oregon have been involved in negotiating a series of plans for fisheries management in the Columbia River Basin. These plans have been adopted by the orders of the U.S. District Court for the District of Oregon. The planning process is the principal forum through which issues about anadromous fish harvest, stock restoration, and production are addressed. The 2008-2017 Plan identifies a short-term production goal of 1.0 million coho to be released in the Yakima River Basin.

Historically, the Yakama Tribal members fished for Chinook, coho, steelhead and other species in the Yakima River and throughout the Columbia River Basin. Because of high pre-terminal harvest rates and degraded habitat, the native Yakima coho population was extirpated. To meet treaty obligations, a program is needed that will increase harvest toward historic levels and restore natural production of historic salmon populations in the Yakima Basin. Because it will require decades of work before basin habitat is able to produce coho at sufficient levels to meet harvest and natural production goals, artificial production will be used in the short-term to produce coho for re-colonizing stream habitat and to meet tribal harvest needs.

Hatchery coho production was initiated in the Yakima Basin under a the YKFP program and was expected to progress through four phases: 1) selection and introduction of a donor stock, 2) test and initiate re-colonization of natural habitat, 3) continued colonization and transition to local broodstock, and 4) a local adaptation phase. Phase 1 has been accomplished and Phase 2 ends with the implementation of programs under this Master Plan; therefore, this Master Plan addresses the third and fourth phases of the program.

The hatchery program has two major concurrent components: (1) an integrated coho harvest/re-introduction program in the Yakima River upstream of Prosser Dam at Holmes Ranch Hatchery and (2) a segregated harvest program at Prosser. Each is described below.

Biological objectives for the Phase 3 and 4 hatchery component of the coho program are presented in Table 5-1. The primary objective is to provide an average of 20,000 coho adults for harvest in ocean and freshwater fisheries. Of the 20,000 adults, 40 percent are to be caught in the Zone 6 and Yakima River terminal fishery.

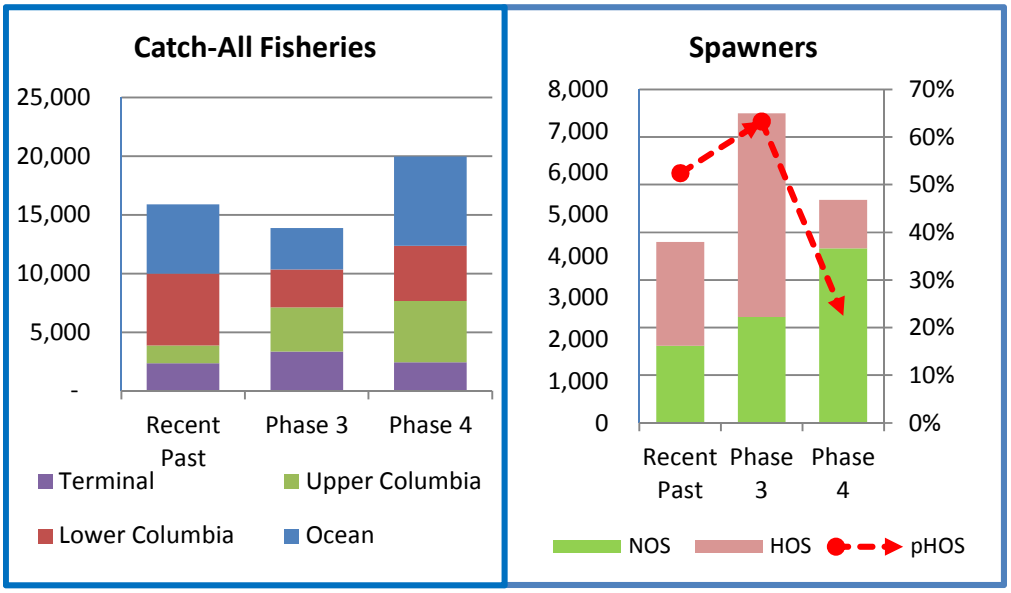
In Phase 4, the program also has an objective to create naturally sustaining populations of coho in the Yakima River. The escapement target for the population is a minimum of 3,500 natural spawners (based on theoretical Yakima spawner escapement as measured at Prosser Dam). Achieving these harvest and escapement targets will require additional improvement in habitat quality and quantity. This improvement will come from the continued implementation of habitat actions in the Yakima River Basin (see Table 4-5 and Section 5.2.1).

Additional biological objectives for Phase 4 are to manage the integrated harvest program to achieve a PNI greater than 0.75 and a pHOS less than 30 percent. The long-term objective is to improve habitat

conditions to the point that the colonization component of the integrated program can be terminated. Expectations in terms of harvest and natural escapement are also illustrated in Figure 5.1.

Table 5-1. Biological objectives and performance indicators for the Yakima River coho program.

Biological Objective	Performance Indicators
Phase 3	
Total Harvest	14,000 adults
Zone 6 Fishery and Yakima River	5,600 adults
Total Spawning Escapement (Natural and Hatchery Origin)	7,000 adults
Trigger to Initiate Phase 4	5,000 natural-origin returns to Prosser (a 3-year running average)
Phase 4	
Total Harvest	20,000 adults
Zone 6 Fishery and Yakima River Terminal Fishery	8,000 adults
PNI	> 0.75
pHOS	< 30 percent
Natural Spawner Abundance	> 3,500 adults



Note: Based on key assumptions listed in Section 3.2.2 and detailed in Appendix E.

Figure 5-1. Expected spawning escapement and catch in all fisheries for the recent past, Phase 3 and Phase 4 Yakima coho.

5.2 PROPOSED STRATEGY

The on-going coho restoration program uses a combination of artificial production and habitat improvements to meet the Tribe's natural production and harvest goals (see Table 2-3). The artificial production component will be altered based on the results of analysis completed in Phase 1 and Phase 2 of the ongoing program (YKFP 2010). The major program changes are that all coho culture activities will now occur within basin and the use of out-of-basin broodstock will be phased out. While the focus of this Master Plan is on the artificial production component of the restoration effort, habitat improvement efforts are critical to program success and are also summarized below.

5.2.1 Habitat Improvement

Because both natural and hatchery produced fish require quality stream habitat to complete their life-cycle, habitat improvement actions will continue to be major components of the coho restoration program for the basin. These actions are being developed and implemented by the Yakama Nation, BPA and other state, city, county and federal agencies working in the basin (see Table 4-5). The results of this work are further described in the YKFP annual reports and other publications.

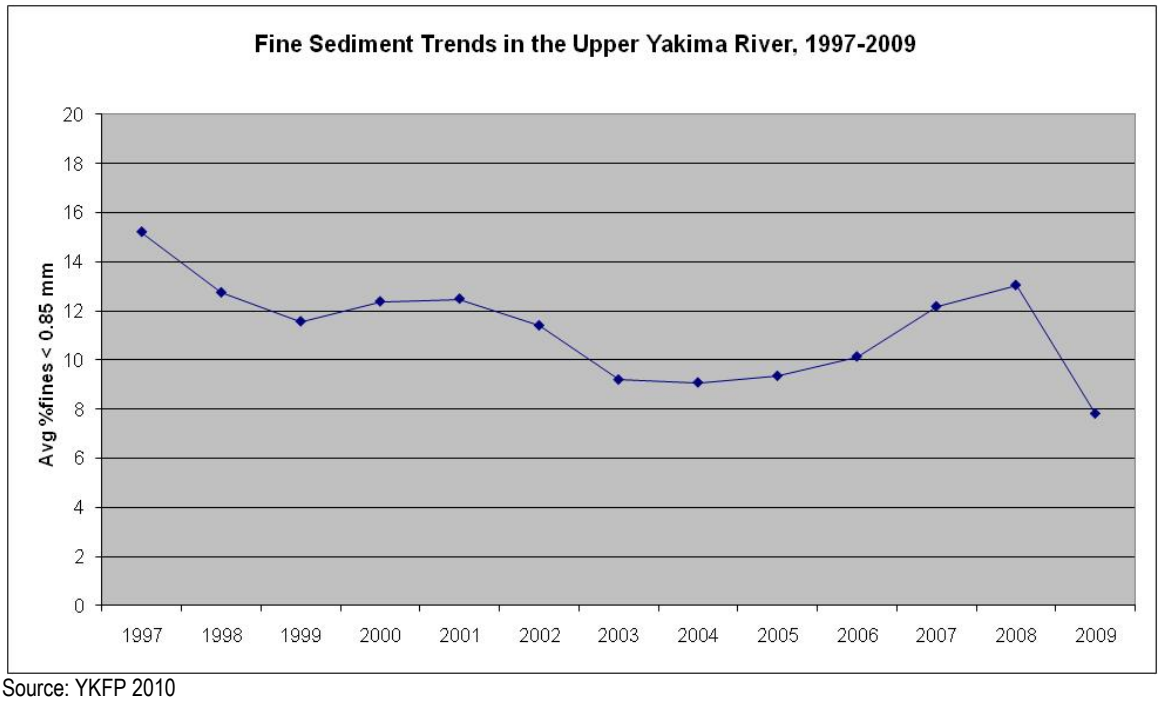
Habitat work has focused on improving floodplain habitat, riparian zones, restoring natural flow and temperature regimes, screening water diversions and providing fish passage at barriers. Some significant habitat improvement actions undertaken in the Yakima River Basin over the last 30 years include:

- 41 major water diversions have been equipped with fish screens (USDI 2008).
- 16 fish passage facilities have been upgraded or built at various locations in the basin (USDI 2008).
- Three of four major irrigation return drains met turbidity and suspended sediment levels established in the TMDL, resulting in considerable improvement in these attributes in the mainstem Yakima River (http://www.ecy.wa.gov/programs/wr/cro/yakimabasin.html).
- Target flows (enacted by Congress) and tribal treaty instream flows (affirmed by the Yakima Superior Court) are in place in the Yakima Basin.
- The Roza-Sunnyside Board of Joint Control implemented a water quality policy, a water quality monitoring program, and used State Revolving Loan Funds to help finance on-farm irrigation upgrades that significantly reduced suspended sediment and DDT loading to the Yakima River (http://www.ecy.wa.gov/programs/wr/cro/yakimabasin.html).
- The North Yakima Conservation District assisted with the conversion of over 8,000 acres of hop fields to drip irrigation systems. This effort, along with much work and investment by Yakima Valley farmers, resulted in significant improvements in water quality for the Yakima River (http://www.ecy.wa.gov/programs/wr/cro/yakimabasin.html).

A comprehensive approach to address water resource and ecosystem issues affecting fish passage and habitat and human water requirements is being developed through the Yakima River Basin Integrated Water Resource Management Plan described in the Draft Programmatic EIS (USDI and WDOE 2011).

This plan includes seven elements: reservoir fish passage, structural and operational changes to existing facilities, surface water storage, groundwater storage, habitat/watershed protection, enhanced water conservation and market reallocation. EDT modeling results indicate that implementation of this program has the potential to increase Yakima River coho production by 26 percent.

To quantify the success of habitat restoration efforts in the basin, Yakama Nation biologists track key environmental attributes through time (YKFP 2010). For example, fine sediment levels are tracked throughout the basin (Figure 5-2). This data is entered into the EDT model to estimate theoretical change in salmon abundance and to prioritize habitat actions by stream and environmental attribute.



Source: YKFP 2010

Figure 5-2. Overall average percent fine sediment (< 0.85 mm) in spawning gravels of the Upper Yakima River, 1997-2009.

Additional information on habitat conditions and actions designed to improve this habitat can be found in Section 6.1 and Table 4-5.

5.2.2 Artificial Production Program

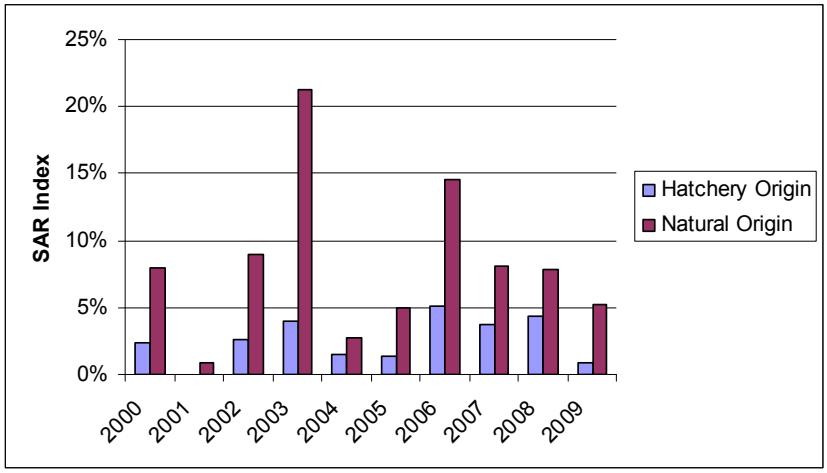
Artificial production of coho was initiated in the basin as part of the U.S. v Oregon Columbia River Fish Management Plan with a stated purpose of providing "a directed tribal harvest within the Yakima River system". Through the mid-1980s and early 1990s, approximately 700,000 coho were imported from out-of-basin hatcheries and released annually as pre-smolts in the Yakima River below the Wapato Irrigation Diversion Dam. In 1996, the scope of the project was expanded under the YKFP, "to determine the feasibility of re-establishing a naturally spawning population and a significant fall fishery for coho in the Yakima River Basin" (BPA 1996). Hatchery broodstock since 1997 has primarily relied on out-of-basin fish from Eagle Creek National Fish Hatchery and the Washougal Fish Hatchery. The

program has gone through two distinct phases. This master plan establishes two separate coho programs in the Yakima subbasin: a segregated harvest augmentation program in the lower Yakima (at Prosser) and an integrated harvest and re-colonization program (at Holmes Ranch) upstream of Prosser. The initial completed phases, as well as the proposed Phase 3 and Phase 4 are described below.

5.2.2.1 Yakima Coho Program Phase 1

The first phase of the effort was aimed at (1) moving existing coho hatchery releases to locations above the confluence of the Yakima and Naches rivers, and (2) evaluating the extent and feasibility of restoring naturally spawning coho to the Yakima River Basin. This effort was considered successfully completed in 2003 and results are published in Bosch et al (2007). Key findings of Phase 1 work[8] were:

- Indices of smolt-to-adult survival for natural-origin fish were 3.5 to 17.0 times the survival indices of hatchery-origin fish (Figure 5-3). Smolt-to-adult returns (SARs) (index) from 2000 to 2009 averaged 1.9 percent for hatchery-origin coho and 7.1 percent for natural-origin coho.

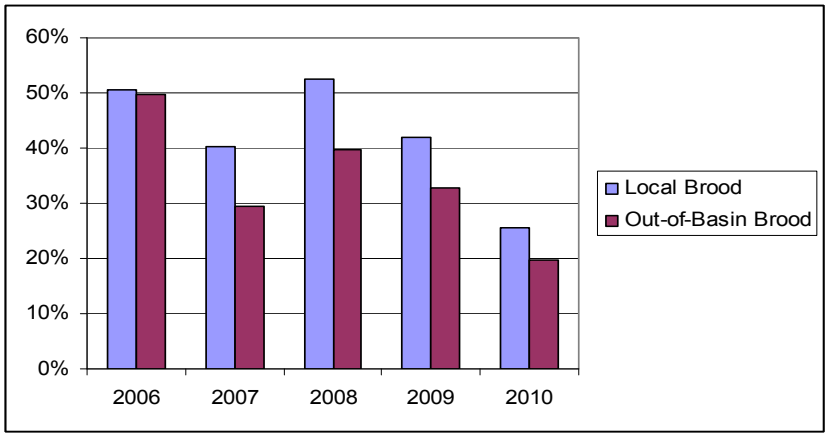


Source: Bosch et al. 2007, updated through 2010 by Yakama Nation staff

Figure 5-3. SAR index for hatchery-origin and natural-origin Yakima River coho.

- Hatchery releases from the local brood source (Yakima River returns) had significantly higher smolt-to-smolt survival than releases from out-of-basin (non-Yakima River origin) hatchery broodstock (Figure 5-4).

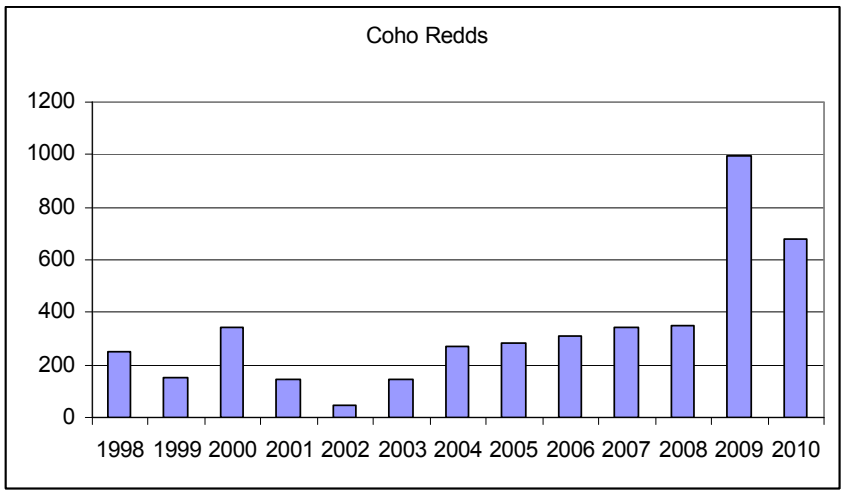
[8] Graphs have been updated to the most recent period available.



Source: Bosch et al. 2007, updated through 2010 by Yakama Nation staff

Figure 5-4. Smolt-to-smolt survival rate for local and out-of-basin hatchery broodstock 2006-2010 (data pooled for all release sites).

- The number of adult coho returns to the historical spawning habitats in upriver areas generally increased (Figure 5-5).



Source: Bosch et al. 2007; updated by Yakama Nation staff (2011)

Figure 5-5. Total number of coho redds observed in the Naches and Yakima river systems for brood years 1998-2010.

Studies of hatchery coho juvenile residualism and predation rates on other species were also undertaken in Phase 1 (Dunnigan 1999, Dunnigan 2001). Major findings of this work included:

- Approximately 1.7 percent of a 500,000 coho release may have residualized in the river section between Cle Elum and Roza Dam through the summer of 1999. Studies were repeated in both the Naches River and Upper Yakima River in 2000 and 2001; results confirmed that residualism rates for coho were quite low (Dunnigan 2001).

- Studies of coho predation rates on fall Chinook and spring Chinook were conducted in 1997 and 1998 (Dunnigan and Hubble 1998). Less than 0.5 percent of all juvenile coho stomach samples contained salmonids in both years.

- Biologists investigating coho competition with rainbow and cutthroat trout (Dunnigan 1999) found no evidence that coho influenced the abundance of each species in allopatry and sympatry with coho salmon. Tests repeated after removing the effects of elevation on trout abundance revealed no difference between allopatric and sympatric mean densities of resident trout. Similarly, no evidence was found that coho affected the growth of cutthroat or rainbow trout when the condition factor of each species in allopatry and sympatry was compared with coho salmon.

These findings are consistent with Pearsons and Temple (2007) who studied ecological impacts of spring Chinook and coho supplementation in the upper Yakima Basin and concluded that they were generally within containment objectives, or impacts that were outside of containment objectives were not caused by supplementation activities.

5.2.2.2 Yakima Coho Program Phase 2

Phase 1 results provided the baseline data needed to demonstrate that coho reintroduction was possible, and that their reestablishment in the basin would not substantially affect other species of concern (Chinook, steelhead, and cutthroat trout).

Phase II goals were to:

- Increase coho spawning in tributaries

- Phase out imported releases of coho in the Yakima Basin, replacing them with fish reared from locally collected broodstock

- Test and monitor new acclimation techniques

Summer parr plants have been the primary method for increasing fish production in upper basin tributaries. These fish have either been released into tributaries or acclimated using ponds or the newly developed (experimental) mobile acclimation system. Parr survival rates to McNary Dam have ranged from an average of 7 percent to 29 percent over a three year period (Figure 5-6).

The mobile acclimation units are portable aluminum raceways that are 20 feet long, 4 feet wide and 5 feet tall. These units are installed near a stream in an area that has existing disturbance (such as spur roads, USBR screening areas), and are plumbed into creeks. The units hold up to 10,000 coho smolts for approximately 4 weeks. Portions of the fish are PIT-tagged so that survival rate and behavior data can be collected at each site. Initial results show that the system produces fish that have high survival rates to McNary Dam (e.g., 47 percent in 2010); however, like any remote system, problems with debris plugging intakes and disease have resulted in fish loss.

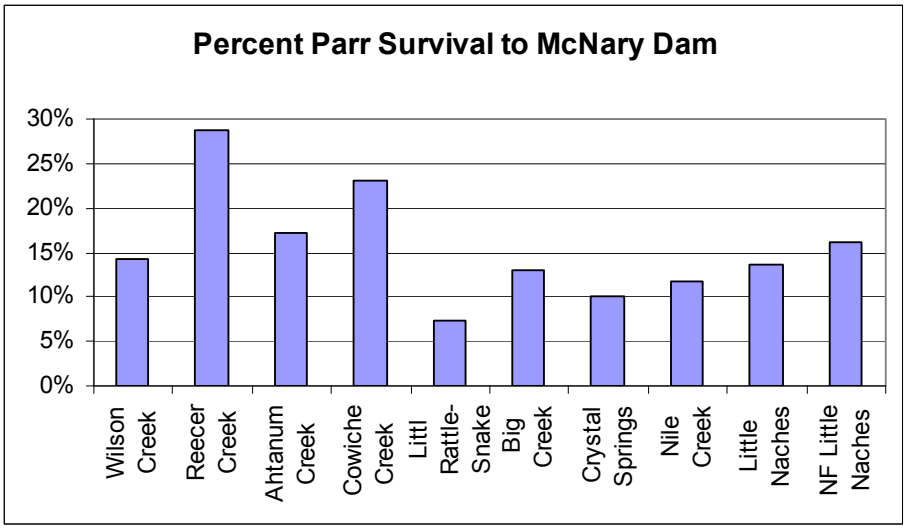


Figure 5-6. Average parr survival rate (percent) to McNary Dam for multiple release locations in the Yakima River Basin (2008-2011).

Adult coho plants have also been used to increase fish abundance in multiple tributaries. In 2007 and 2008, adult coho were planted into Taneum Creek to determine spawning success and effects on resident trout. Initial results of this on-going work indicate that coho spawned successfully and produced large numbers of offspring. The total biomass of all salmonids in the stream increased and there were no discernable impacts to resident trout (Temple et al. 2009).

Parr and smolt plants in the tributaries have resulted in a substantial increase (69 percent) in the number of redds observed in tributaries since 1998. The number of redds observed in the mainstem Yakima and Naches rivers since 1998 has also increased over time, with the Naches River showing the largest gain (Figure 5-7).

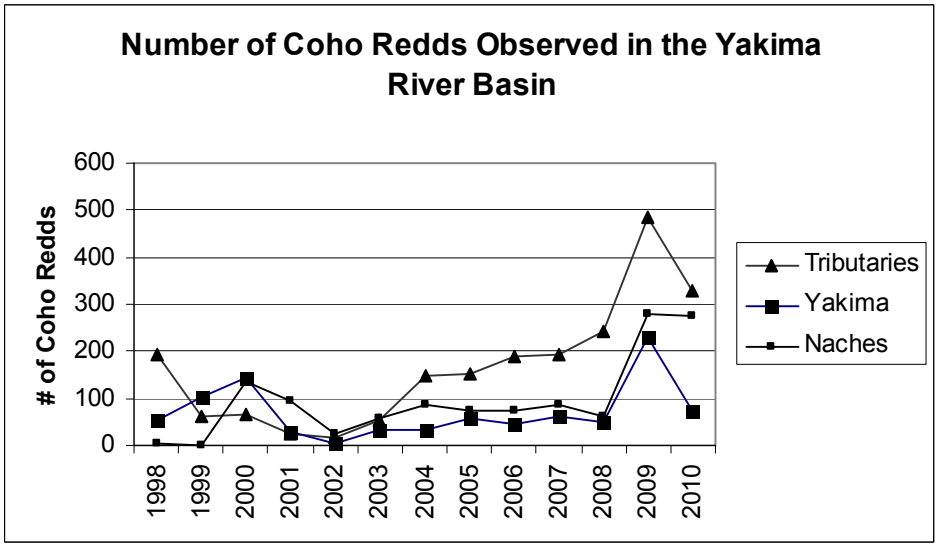
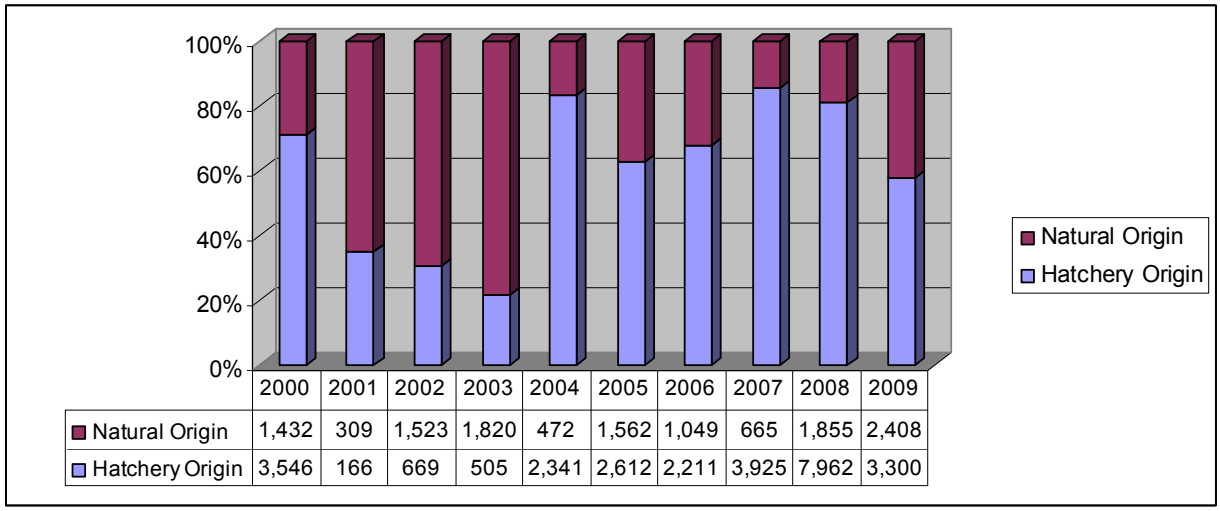


Figure 5-7. Number of coho redds observed in mainstem Yakima River, Naches River and tributaries from 1998-2010.

Total adult coho returns by year have ranged from a low of 818 in 2001 to a high of 10,674 in 2009. Over this time frame, natural-origin adults have averaged approximately 30 percent of the total adults produced in the basin (Figure 5-8).



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Natural Origin	1,432	309	1,523	1,820	472	1,562	1,049	665	1,855	2,408
Hatchery Origin	3,546	166	669	505	2,341	2,612	2,211	3,925	7,962	3,300

Figure 5-8. The number and percent composition of hatchery- and natural-origin coho adults returning to Prosser Dam from 2000 to 2009.

Phase 2 studies are on-going and will be considered completed with the implementation of Phase 3 under this Master Plan.

5.2.2.3 Yakima Coho Program Phase 3

The primary goal of Phase 3 of the artificial production program is to provide fish for harvest. This goal will be accomplished by implementing both segregated and integrated hatchery programs in the basin. The segregated program component will be located at Prosser Hatchery on the lower Yakima River and integrated program will be located at Holmes Ranch Hatchery on the Upper Yakima River. The segregated program will release 500,000 smolts (at 15 fpp) downstream of Prosser Dam using broodstock collected at Prosser. The integrated program will rear and release 500,000 parr (at 100 fpp) and 200,000 smolts (at 20 fpp) in the upper Yakima and Naches rivers using broodstock collected at Roza and Sunnyside. Fish will be 100percent coded wire-tagged but not adipose fin-clipped. Different coded wire tag codes will be used to distinguish release locations.

Major changes in the program from what has occurred historically are (1) all fish culture activities will occur in-basin and (2) the program will transition to locally adapted broodstock at ever increasing rates as natural-origin fish become available. No more than 20 percent of the natural run (to be measured at Prosser) will be taken for broodstock in any year.

The results from Phases I and 2 were used to formulate the Phase 3 program. A description of the key findings from these phases and how each was used to develop the proposed Phase 3 activities and facilities follows:

- **Residualism and predation studies indicate that the coho program will have an acceptable level of impact on Chinook and steelhead populations**

These results, plus the need to meet legal mandates (US v Oregon), justify continuing coho releases to the basin. To reduce ecological effects even further, the segregated program will release all 500,000 coho smolts (15 fpp) below Prosser Dam in the lower Yakima River. This release site is downstream of major rearing areas for spring Chinook and ESA listed steelhead.

- **Hatchery releases from the local brood source (Yakima River returns) had significantly higher smolt-to-smolt survival than releases from out-of-basin (non-Yakima River origin) hatchery broodstock.**

The higher return rate for the local broodstock supports the need to convert the program to a locally adapted broodstock and to conduct all fish culture activities in-basin. During the initial years of the segregated program, broodstock will come from hatchery fish returning to the basin at either Prosser or Roza; in later years, surplus adults from the integrated program will be used as broodstock and may be collected at Sunnyside. This type of broodstock interchange is referred to as a stepping stone program.

- **Hatchery-origin coho SARs (index) from 2000 to 2010 averaged 2.6 percent.**

Although an index, the SAR for hatchery-origin smolts released into the Naches and Upper Yakima are more than sufficient to return broodstock and provide substantial harvest benefits. To increase survival even further, a segregated hatchery program using locally adapted broodstock will be initiated at Prosser. Juveniles from this program will be released below Prosser Dam with returning adults intended to provide harvest benefits to the tribal and sport fishery. By using locally adapted fish for broodstock and releasing fish lower in the river, average hatchery fish survival is expected to increase by approximately 25 percent (based on data presented in Figure 5-3).

- **Indices of smolt-to-adult survival for natural-origin fish were 3.5 to 17.0 times the survival indices of hatchery-origin fish.**

Phase 3 of the program will build upon this natural-origin coho survival advantage. These fish will contribute broodstock for the integrated harvest program and will contribute to harvest. Incorporating natural-origin fish into the broodstock is expected to increase the productivity of the hatchery component of the population.

- **Parr and smolt plants in the tributaries using acclimation has resulted in a substantial increase (69 percent) in the number of redds observed in tributaries since 1998.**

Because the parr program has been successful, this approach will continue and be expanded as part of the Phase 3 integrated program. The program will be operated at the new Holmes Ranch Hatchery described in this Master Plan. Parr plants will occur for six consecutive years into each tributary selected for stocking. At the end of this period, parr plants will be discontinued and the stream monitored for juvenile and adult production and habitat conditions. Hatchery fish may again be stocked in the stream if no adult production is observed for three consecutive brood years. This approach allows biologists to continually probe the ability of the system to produce naturally sustainable coho without hatchery intervention.

- **Initial results of adult coho plants indicated that coho spawned successfully and produced large numbers of offspring.**

Unless new data indicate this strategy is not effective in the next two years, the adult planting strategy will be continued in Phase 3. Stocking and evaluations will be similar to the protocol described above for the parr plants.

During Phase 3, all fish from the integrated program will be coded wire-tagged, but not adipose fin-clipped. All segregated program fish will be adipose fin-clipped and a subsample coded wire-tagged. These actions are designed to reduce harvest of coho from the integrated program in pre-terminal fisheries and to distinguish them from adult returns from the Prosser segregated program.

5.2.2.4 Yakima Coho Program Phase 4

Phase 4 will begin when the number of natural-origin coho exceeds hatchery-origin coho at Prosser Dam for three consecutive brood years. The three year period was selected as the criterion because it corresponds to the three year life cycle of coho. When the adult criterion is achieved, the program will operate as follows:

- The segregated program will continue to produce and release 500,000 smolts at Prosser Hatchery.

- The integrated program will be operated to achieve a PNI of 0.75 and pHOS of no more than 30 percent. Thus, the focus of the integrated program will shift to one that equally emphasizes harvest and conservation.

- The size of the program will be set at the level needed to produce sufficient parr to seed newly opened or restored stream habitat and the adults needed for broodstock to operate the segregated program.

- The 300,000 smolts from the integrated program may be acclimated and released at Prosser in order to increase their juvenile to adult survival rate and thus provide greater harvest benefits. Fish from the segregated program will be 100 percent ad-clipped with no coded-wire tag, while the integrated program will be 100 percent ad-clipped and coded wire-tagged.

As the program transitions to Phases 3 and 4, the expected outcomes in spawning escapement (spawners) and harvest (Catch-All Fisheries) may be as presented in Figure 5-1. The long-term goal (Phase 4) is to have an average NOR run of 10,000, providing 20,000 adult coho.

5.3 ALTERNATIVES CONSIDERED TO MEET BIOLOGICAL OBJECTIVES

As described in Section 5.1, both legal requirements and the results of data collection efforts over the last 15 years were used to select the preferred alternative for the artificial component of the coho program. Other alternatives were considered but rejected because they do not meet legal requirements, failed to achieve biological objectives or were inconsistent with study findings from Phase

I and Phase 2. A brief description of the alternatives not carried forward, along with the rationale for their elimination, is presented below.

5.3.1 Alternative A: Maintain Existing Program

The ongoing coho program is operated as follows:

- The majority of broodstock is imported from out of basin.
- Up to 500,000 smolt equivalents are reared at Prosser Hatchery.
- Summer parr are released in tributaries or acclimated in accessible tributaries.
- Smolts are acclimated at earthen pond sites on mainstem reaches of Yakima and Naches rivers.
- Pre-spawn adult coho are planted in accessible tributaries to jump start NOR juveniles in uninhabited streams.

The current program rears an insufficient number of smolts to meet the requirements of US vs. Oregon. Program size is limited because Prosser Hatchery has been prioritized for the propagation of late-run fall Chinook. The coho program relies on out-of-basin broodstock, which have lower survival rates than local broodstock, and require that the program depend on outside facilities for propagation. For these reasons, this alternative was eliminated from further consideration.

5.3.2 Alternative B: Eliminate Hatchery Production and Improve Habitat

Under this alternative, production of hatchery coho would be eliminated. Actions would continue to be implemented in the basin to increase habitat quantity, which in turn would increase the productivity of local fish populations. The program would rely on the natural colonization of habitat by adult coho strays from other basins or hatchery programs.

This action would mean that treaty obligations to provide coho for tribal harvest would not be met for decades, if ever. Depending on strays from other streams to colonize compromised habitat in the basin would also delay achieving the long-term objective of creating sustainable runs of coho for decades, if not tens of decades. Given the long lead times to achieve even the harvest objective, this alternative was not selected for advancement.

5.3.3 Alternative C: Implement a One Million Smolt Segregated Program at Prosser

This program would be operated as follows:

- Produce one million smolts at the Prosser Hatchery.
- Broodstock would come from locally adapted hatchery-origin adults returning to the facility.
- All smolts would be released below Prosser Dam.
- No fish would be released into the Upper Yakima or Naches rivers.

This alternative would meet treaty harvest obligations for coho but would not achieve the long-term conservation objective of restoring natural production to the Naches and Upper Yakima rivers. Implementing this alternative would require doubling the water chilling capacity, doubling the groundwater withdrawals and taking an additional 25 cfs of river water just before releasing juvenile

fish. Costs associated with these improvements were deemed excessive compared to the small increase in harvest that would occur.

5.4 CONCEPTUAL DESIGN OF COHO PROGRAM FACILITIES

5.4.1 Overview of Facilities

The Yakama Nation has conducted a coho salmon artificial fish production program in the basin since 1983. This Master Plan describes proposed modernization and major upgrades to the Prosser Hatchery as well as a new coho hatchery at Holmes Ranch near Ellensburg. The following sections describe the existing conditions and proposed improvements at both locations.

5.4.2 Existing Coho Facilities at Prosser Hatchery

The coho program at Prosser Hatchery shares water supply and drain systems, utilities, adult holding, incubation building, early rearing troughs, final rearing raceways, and related supporting infrastructure with the fall Chinook program described in Section 4 above. Please refer to Section 4.5.2 for a detailed description of these existing facilities.

5.4.3 Proposed Coho Facilities at Prosser Hatchery

The Yakama Nation proposes to modernize the Prosser Hatchery with a variety of improvements to water supplies, fish culture incubators and rearing units, power and control systems, and support buildings in order to achieve the coho production goals outlined in the preceding sections. These improvements will be shared with the Prosser late-run fall Chinook program and have been described in detail in Section 4.5.3. The only major improvements at Prosser specific to the coho program will be the increased well water production, 13 double stack incubation trays in the remodeled incubation building, and 31 new concrete raceways (3,250 cubic feet each) to replace and expand upon the capacity of the existing plastic lined steel raceways. These improvements are illustrated in the concept design drawings in Appendix G.

As with the fall Chinook program, the Tribe has indicated that construction of these improvements cannot interrupt the existing fish production programs at Prosser Hatchery.

5.4.4 Existing Facilities at Holmes Ranch

The Holmes Ranch property consists of three contiguous parcels of land, totaling 50 acres, owned by Yakama Nation, approximately 0.8 miles north of the intersection of Highway 10 and Highway 97. The site is bordered by Interstate Highway 90 to the south, Klocke Road to the east, John Wayne Trail (a trans-Cascade recreation trail) to the north and private property to the west. Portions of the site are in a conservation easement reserved to provide habitat value. The 10-acre developable portion of the site is in the southeast corner of the ranch. Figure 5-9 is an aerial image showing the approximate site boundaries.

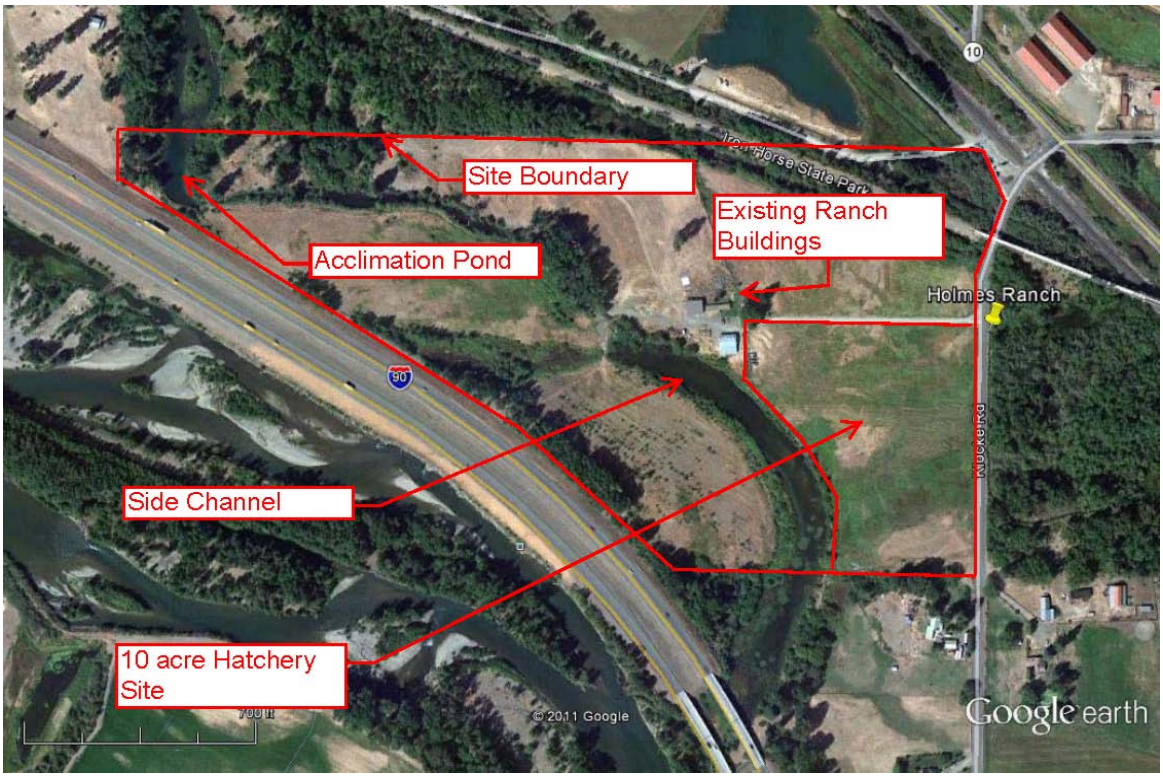


Figure 5-9. Holmes Ranch - approximate site boundaries.

Site Access and Security – The site has a single access via a gravel drive off of Klocke Road, a short distance to the south of Highway 10. There is a metal gate at the site entrance, and some perimeter barbed wire fencing.

Topography – An historic side channel of the Yakima River occupies the southwest edge of the developable site. The side channel is supplied with water from an irrigation fish screen bypass system. A pond on the bypass stream is used seasonally by the Tribe to acclimate coho (Figure 5-9). Because the survival rate of fish from this pond is lower than other release sites, the Tribe plans to eventually discontinue its use. Just south of the ranch house are several rectangular fiberglass tanks that the Tribe is using for a beaver rehabilitation program.

The developable site is a relatively flat field, sloping gently from elevation 1,587 at the northwest corner to 1,582 near the southeast corner. Drawing GH-2 in Appendix G shows the existing site plan and surveyed topography. A 100-foot-wide shoreline buffer zone extends into the site from the edge of water in the side channel. The east edge of the side channel is bermed and has been mapped as the boundary of the 100-year floodplain. Restrictions associated with this buffer will be verified and mitigated as needed during Step 2 environmental compliance and preliminary design phases.

Utilities – Utilities available on site include a potable water well, single phase power and communications lines serving the ranch house. Three phase power is available a short distance north of the property boundary. A small concrete lined irrigation canal flows along the west side of the ranch house and north edge of the side channel. There is an existing surface water right of 4.6 cfs for irrigation associated with the parcel.

Support Facilities – Existing support facilities to be retained include a barn with hay cover, equipment shed, garage, and shop buildings. The existing ranch house is in poor condition and will be demolished and replaced as part of the planned improvements.

5.4.5 Proposed Coho Facilities at Holmes Ranch

Improvements proposed at Holmes Ranch are very similar to those planned for the Marion Drain Hatchery described in Section 4.5.7. The Holmes Ranch site has limited groundwater and surface water. Water re-use technology is proposed to supply the rearing phase of the fish culture operation, an approach that will enable the Tribe to achieve the established production goals for the program.

The proposed improvements are shown in Figure 5-10 and include the following major elements:

- New intake screens and a surface water pump station will provide water to the hatchery from the upstream entrance to the side channel.
- Stop log supports to be installed in the Cascade Irrigation District's screen structure will allow surface water to be diverted into the side channel.
- Three new wells will supply groundwater and provide redundancy.
- A new centralized degassing head box will be installed for groundwater treatment and supply
- A new 28,000-square-foot hatchery and administration building will be designed for the coho incubation and rearing program. Water re-use systems will provide a 25 percent make-up flow for the program to produce high quality fish using the limited available water supply.
- New adult holding and spawning facility
- New cleaning waste treatment pond
- Two new 2,000-square-foot residences, one located in the general footprint of the existing ranch house, and the other located near the site entrance.

Surface Water Supply – The hatchery will use up to 3 to 4 cfs of pumped surface water for fish culture from late fall through early spring. Surface water will be diverted into the existing irrigation bypass stream that feeds into the historic Yakima River side channel just upstream of the hatchery site. From November through April, the canal headgate is closed and only seepage flow is present. The Tribe proposes to route approximately 8 cfs through the canal head gate from November through April (the non-irrigation period) to supply the hatchery and provide necessary sweeping flows at the proposed hatchery intake screens. The existing Cascade Irrigation District screening structure (Figure 5-11) will be modified to include a concrete stem wall in front of the screen bays (see Drawing SH-5). The wall will protect the screen bays and downstream canal from sediment-laden water during the winter and channel the diversion of 8 cfs to the hatchery. The conceptual design, shown in Appendix G, includes a micro-strainer and UV disinfection on the surface water supply system.

Groundwater Supply – A groundwater test well was drilled and test pumped in September 2011 during the irrigation season. The well was test pumped again during the non-irrigation season in February 2012

to study the effects of irrigation canals on the aquifer. These preliminary investigations indicate that there is a shallow aquifer containing high quality groundwater sufficient to meet the proposed hatchery groundwater demand. Based on water temperature variations of approximately 10° F, it appears that the aquifer is surface water influenced. The 8-inch test well will likely produce up to 110 gpm of supply flow. Two to three larger diameter additional wells are planned to provide up to 975 gpm of continuous groundwater supply. The wells will be sized and locations finalized after geophysical modeling is completed.

Degassing Headbox – A new degassing headbox will be provided in the new hatchery building for treating the incoming well water to reduce nitrogen levels and increase dissolved oxygen prior to use in the incubation process. The headbox will be a fabricated aluminum structure with degassing columns mounted on top. It will have separate compartments for ambient and chilled groundwater.

Hatchery Building – The proposed hatchery building will have a rectangular footprint, approximately 218 feet long and 130 feet wide. It will house multiple critical functions with square footage assignments very similar to those shown in Table 4-2 for the Marion Drain Hatchery. The building is configured with a central drive-through along its long axis to provide truck and trailer access for transfer and marking of fish.

The building is situated with the long axis in the east-west orientation to maximize solar gain in the winter and the ability to control direct sun penetration during the hot summer months. The design offers extended overhangs over south facing exterior windows to control solar gain during the summer. Clerestory openings will allow natural light deep into the fish production area to minimize the dependence on artificial lighting, thus reducing energy consumption.

The proposed exterior materials include steel siding with a concrete or masonry base to prevent potential damage by equipment or trucks. Metal roofing and trim are also envisioned. Insulated translucent sandwich panels will provide natural daylight into the production area. The exterior color palette is proposed to be earth tones.

These facilities will be configured similar to those proposed at Marion Drain and illustrated on Figure 4-20.

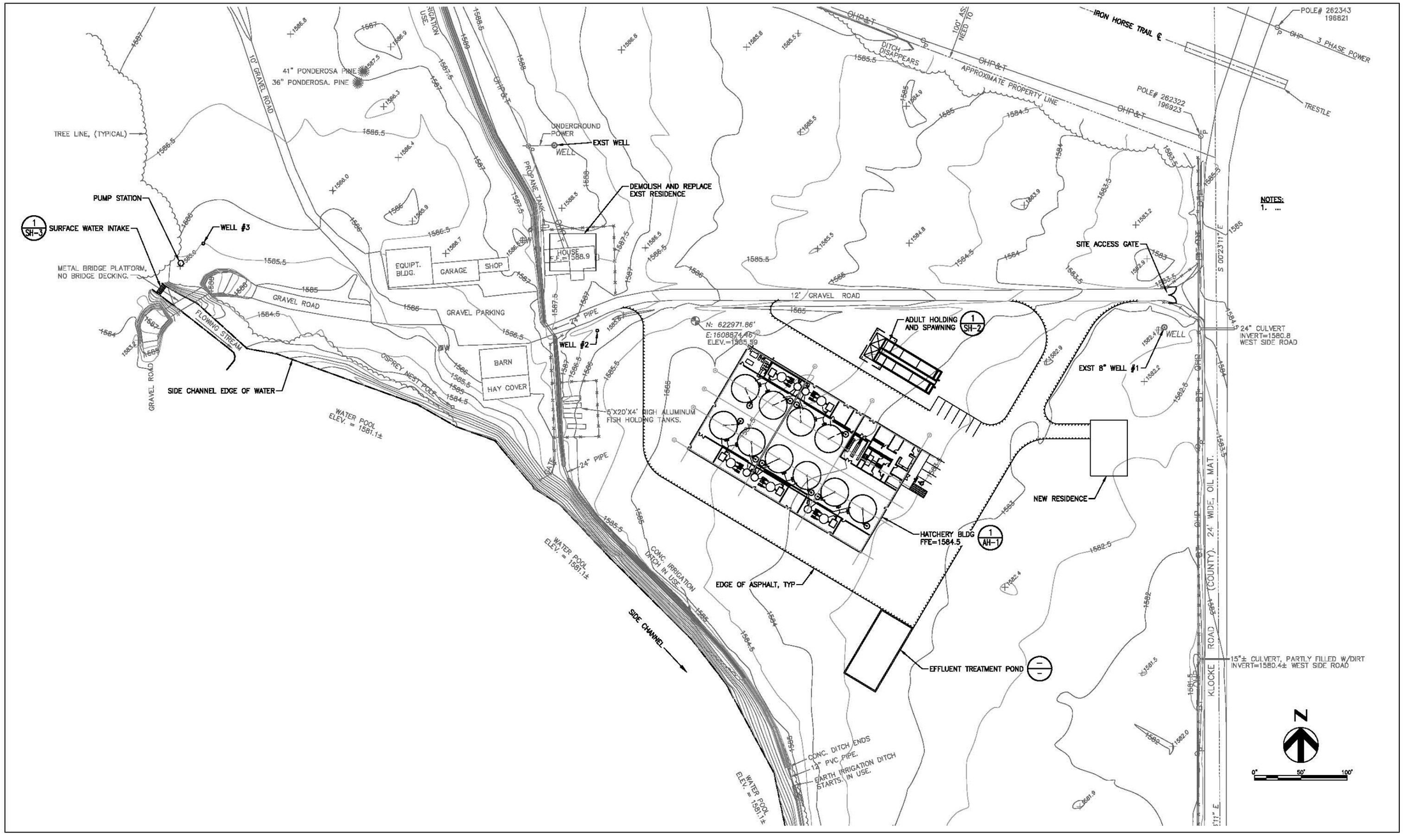


Figure 5-10. Proposed Holmes Ranch site improvements

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Figure 5-11. Proposed Holmes Ranch Hatchery surface water diversion site at irrigation canal.

Utility Systems – Improvements to utility systems will be needed as described below.

- Power: Overhead three-phase power will be brought in from the northeast, with a short overhead offsite extension. A new three-phase transformer and upgraded service will be provided to the new hatchery building and the new residence. A standby diesel generator will be incorporated into the facility design to provide power to critical functions via an automatic transfer switch.

- Communications: Phone and data services are available to the project site and will be extended to the new hatchery building and residences.

- Potable water: Potable water via a domestic well is available to the project site and will be extended to the hatchery building and residences.

- Fire Protection: A fire sprinkler system will be required for the occupied portion of the building. The supply will be provided by a ULFM listed fire pump located at the surface water pump station. Yard hydrants with hose stations will also be provided.

- Domestic Wastewater: A new onsite waste disposal systems, including septic tanks and drainfields will be constructed adjacent to the hatchery building. Due to shallow groundwater, mound systems may be required.

- Stormwater: Run-off from the newly developed portions of the site will be directed into filter strips and/or bio-swales for treatment prior to leaving the site.

Adult Holding and Spawning Facility – Adult coho to be used as broodstock will be collected at the proposed Sunnyside Dam trap (see Section 4.5.9), or at existing traps at Prosser Dam or Roza Dam and transported to Holmes Ranch Hatchery for holding and spawning. The broodstock goal is to collect 1,000 fish that will be processed over a 4 month period. No more than 400 fish will be held on station at any given time. The fish will be held onsite for two to three months, from October through January.

The adult holding ponds will consist of two post-sort pools with three partitions each to allow for segregation of new, green, ripe, almost ripe, males, and fish to be scatter planted. The adult fish will be held initially on chilled groundwater in October, transitioning to surface water in November, at maximum densities of 5 cubic feet per fish, and upwelling water supply flows of 2.0 to 2.5 gallons per minute (gpm) per fish. The holding ponds will have 4 to 5 feet of freeboard plus jump panels to contain the fish as shown on the concept design drawings. At the head end of the ponds, a concrete pad with an open-sided roof covering will provide a spawning area for collecting eggs as the fish ripen. The concrete pad will be sloped to floor drains which will route the spawning wastes to a buried holding tank that will be pumped out at the end of each season.

Incubation Facilities – Green eggs will be processed in an egg prep room inside the hatchery building. They will be loaded into bulk troughs in the incubation room until eye-up, when they will be transferred into adjacent heath trays at 4,000 eggs per tray for the duration of the incubation period. Chilled and ambient groundwater will be routed to each incubation trough and tray stack unit. The target incubation water temperature is 42°F, with 6 gpm of supply flow to each stack of incubators. Eight double stacks will be required, with a total single pass flow-through rate of 48 gpm.

A hard-piped chemical feed system will be used to deliver argentine or formalin treatments to the water supply as needed to prevent fungus growth on the eggs. Overflow water from the troughs and trays will be collected in floor trenches and conveyed into the hatchery drain system. Adequate dilution flow will be maintained through the drain system to avoid exceeding chemical concentration limits in the hatchery outfall.

Rearing Facilities – Beginning in late February, swim up fry will be transferred from the incubators into the 30-foot-diameter fiberglass rearing tanks. Water reuse technology in these tanks will reduce overall water demand at this facility by 75 percent. The rearing tanks will be configured in rows, with each pair of tanks connected to a common reuse system module. Water to be reused will overflow from each tank via an overflow in the tank sidewall. It will then flow by gravity through a micro-strainer drum screen that removes suspended particulates, and then into a pump sump. Booster pumps will then lift the water through a UV unit and into a degassing and oxygenation tower to remove the carbon dioxide byproduct from fish respiration and increase dissolved oxygen to near saturation before the water is returned to the rearing tanks. The 25 percent make-up water flow will be introduced via a metered connection at the top of the tower to improve water quality before it enters the rearing tanks.

For the early life stages, chilled groundwater, transitioning to ambient groundwater will be used as the make-up water source. In November, the make-up water will be switched to surface water pumped from the side channel. Peak make-up water flow rates to each reuse system module will be 325 gpm, or 25 percent of the total recirculated flow rate.

Each tank will have a center bottom drain that collects solids in the water and conveys it along with about 15 percent of the total flow to a radial flow separator. The separator overflow line will route clarified drain water to the hatchery outfall. The separator purge line will route the concentrated feces

and un-eaten food along with the micro-strainer backwash drain to an offline cleaning waste settling pond.

Each tank will have screens for segregating and retaining batches of fish, and a weir in the overflow box for water level control. A grated floor trench will run the length of the room at the downstream end of the tanks to collect overflow/drain water and route it into the hatchery drain pipe system. Two to three extra tanks will be provided to allow operational flexibility for marking and segregating batches of fish and to allow for experiments with larger fish sizes at release.

Hatchery Housing and Administration – The existing residence is in poor condition and will be replaced with a new one in the same footprint. A second new residence will be located near the main entrance to the facility, enabling staff to monitor traffic in and out of the complex.

Administration facilities will consist of offices within the main hatchery building. Support facilities, also in the main hatchery building, will include a conference /break room, mud room, restrooms, lockers and showers, chemical storage, and mechanical and electrical rooms, dry storage, and feed storage/cool room.

Cleaning Waste Treatment – As noted above, cleaning wastes from early rearing and juvenile rearing cells will be removed using piped vacuum systems that will convey the concentrated wastes (primarily fish feces and un-eaten food), to a dual cell off-line settling pond. Each of the two settling pond cells will be sized to treat the peak cleaning waste flow from the facility. This will allow one cell to be dewatered and cleaned out without interrupting normal hatchery operations. The settling ponds will be designed to meet guidelines of the US Environmental Protection Agency CFR 40 for aquaculture operations.

Preliminary sizing indicates that two side-by-side cells, 15 feet wide by 60 feet long by 4 feet deep, would allow hatchery operators to vacuum clean at least two raceways at a time, with a vacuum flow of 100 gpm each.

5.4.6 Production and Operation Schedules

Planning level production and operations schedules for the proposed coho programs have been developed based on the program described in Sections 2.2 and 5.2.2 and the facilities described above. These schedules demonstrate how the target production goals will be achieved.

The primary biological variables used to prepare the preliminary coho operations schedule are water temperature, loading density and flow indices. Water temperature is the primary determining factor in the development and growth rate of fish. River water is too warm from June through October but will be used beginning in November of each year. The groundwater supply to be used for incubation and early fish rearing will provide relatively constant year round water temperatures of about 56°F at both the Prosser and Holmes Ranch facilities. This relatively warm temperature will accelerate fish growth in relation to natural growth cycles; therefore, chillers will be used to slow growth during the incubation and early rearing phases. Hatchery managers will put the yearling fish on a maintenance diet to slow the growth during final rearing in order to achieve target release sizes.

A loading density of 0.5 lb./cf and a flow index of 1.0 have been established by Tribal fish culturists. Based on these primary biological variables, specific biocriteria were developed and form the basis of the preliminary operations schedules shown in Appendix C. These schedules depict water use by month,

chilling, and space requirements for each operational area of the fish culture process, including adult holding, incubation, sub-yearling and yearling rearing.

Each preliminary operations schedule covers a two-year period in order to understand and incorporate overlapping water requirements for juvenile fish (reared to a yearling size) from two brood years on site at one time. Summary schedules of the flow rates proposed at the Prosser and Holmes Ranch hatcheries are shown in Tables 5-2 and 5-3, respectively.

5.4.6.1 Prosser Hatchery Coho Development

The yearling coho development cycle at Prosser will be as follows:

- October through November: Adult holding
- October through February: Egg incubation
- Late February through March: Early rearing in troughs
- April through the following March: Outdoor juvenile rearing in raceways

Table 5-2. Projected peak monthly flows (in gallons per minute) for the Prosser coho program by life stage.

Month	Adult Holding Flow	Incubation Flow	Groundwater Flow to Rearing	River Water Flow to Rearing	Total Flow- (Rounded)
January		77		4,970	5,050
February		77	307	8,213	8,600
March			466	8,895	9,360
April				965	965
May				1162	1,160
June			1608		1,610
July			2,192		2,200
August			2,879		2,880
September			3,445		3,450
October	225	23	4,172		4,420
November	495	77		4,856	5,430
December		77		4,794	4,870

Peak flow requirements at Prosser for this program are 8,895 gpm (18.8 cfs) of surface water in March and approximately 4,200 gpm (9.3 cfs) of groundwater in October.

5.4.6.2 Holmes Ranch Hatchery Coho Development

Coho development at Holmes Ranch will occur as follows:

- October through January: Adult holding
- October through February: Egg incubation

- March through July: Sub-yearling rearing
- Extending through the following March: Yearling rearing

Table 5-3. Projected peak monthly flows (in gallons per minute) for the Holmes Ranch coho program by life stage.

Month	Adult Holding Flow	Incubation Flow	Ground Water Make-Up to Rearing Flow	River Water Make-Up to Rearing Flow	Total Flow Through	Re-use Rearing Flow
January	300	102		644	1,046	1,950
February		102		805	907	3,416
March			322	966	1,288	4,392
April				322	322	976
May				483	483	1,464
June			483		483	1,464
July			805		805	2928
August			325		325	976
September			483		483	1,464
October	300	25	483		808	1,464,
November	800	60		644	1,504	1,950
December	600	80		644	1,324	1,950

This program will require a peak flow of 1,444 gpm (3.2 cfs) of surface water in November and approximately 820 gpm (1.8 cfs) of groundwater in July and October.

5.5 CONSISTENCY WITH NPCC EIGHT SCIENTIFIC PRINCIPLES

The Yakama Nation has made every effort to design the proposed project to conform to the NPCC's eight scientific principles and the Major Project Review requirements that flow from them. This section presents the principles and discusses how the proposed programs accommodate them.

5.5.1 Principle 1: The abundance, productivity and diversity of organisms are integrally linked to the characteristics of their ecosystems.

Language from the NPCC Fish and Wildlife Program further amplifies Principle 1:

> *"The physical and biological components of ecosystems together produce the diversity, abundance and productivity of plant and animal species, including humans. The combination of suitable habitats and necessary ecological functions forms the ecosystem structure and conditions needed to provide the desired abundance and productivity of specific species."*

This Master Plan recognizes that the aquatic and terrestrial habitats present within and outside of the Yakima Basin determine the abundance, productivity, and diversity of the basin's fish populations. The quality and quantity of habitat within the basin has been evaluated through field surveys and modeling which identified habitat factors that are likely limiting fish production in the basin. Strategies and actions to address habitat limiting factors were developed and incorporated into the Yakima Subbasin Plan (YSFWPB 2004). These actions are being implemented yearly as funds allow and their effectiveness tracked over time through monitoring and evaluation efforts (see Table 4-5).

The biological objectives for the coho program are based on Ecosystem Diagnosis and Treatment (EDT) and AHA modeling of the entire life cycle of and ecosystem inhabited by Yakima River coho. This ecosystem includes the Yakima River Basin, Columbia River, Columbia River estuary and the Pacific Ocean. The analysis identified what is possible for coho in the basin over both the short and long term. It also showed that factors outside the basin will play an important role in determining whether the program will be successful. For example, adult and juvenile migration success through the FCRPS reduces the number of coho returning to the basin each year. Fewer adult returns equates to a reduction in the probability of achieving program objectives.

The Master Plan recognizes that humans also rely on the productivity of the ecosystem to provide societal needs, and that many of these needs are in direct conflict with the needs of other species. Agriculture in the basin requires large amounts of river water to grow the crops which produce hundreds of millions of dollars in revenue to farmers each year. Much of this water comes at the expense of aquatic species such as coho that rely on it for all phases of their life-cycle. Basin stakeholders have been working cooperatively to balance the needs of humans and fish. This balance is being achieved by setting instream flows, guaranteeing water rights to farmers, screening diversions and implementing upland and riparian habitat actions designed to protect the riverine environment.

5.5.2 Principle 2: Ecosystems are dynamic, resilient and develop over time

The NPCC Fish and Wildlife Program states the following:

> *"Although ecosystems have definable structures and characteristics, their behavior is highly dynamic, changing in response to internal and external factors. The system we see today is the product of its biological, human and geological legacy. Natural disturbance and change are normal ecological processes and are essential to the structure and maintenance of habitats."*

Habitat conditions in the Yakima Subbasin have degraded over time (YSFWPB 2004). Human activities such as logging, agriculture, and rural development have all resulted in a decrease in both habitat quality and quantity. The Yakima Subbasin Plan identifies limiting factors resulting from habitat degradation and proposes a number of strategies to return subbasin habitat more closely to the pre-development condition. Implementation of these strategies will help protect fish populations from catastrophic events as well as smaller scale disruptions. It is recognized that habitat protection and restoration activities that take into account natural processes as well as man-caused changes require a long-term commitment.

Although the short-term goal of the program is focused on harvest using artificial production, in the long term, it is expected that habitat actions will increase natural fish population productivity, abundance

and diversity to the point where they are self-sustaining. This may allow a substantial portion of the hatchery program to be reduced or eliminated.

An active monitoring and evaluation program will be used to detect trends in habitat condition and fish abundance. This information is used to determine the need for, and location of, habitat actions to be implemented. Fish population monitoring will occur directly through implementation of this Master Plan and other YKFP activities while habitat effectiveness monitoring will occur coincident with implementation of Yakima Subbasin and Recovery Plans. Information gathered through monitoring and evaluation will be used to make changes to the Master Plan (Principle 7 below and Section 3.4).

5.5.3 Principle 3: Biological systems operate on various spatial and time scales that can be organized hierarchically

The NPCC Fish and Wildlife Program language elaborates on this concept as follows:

> *"Ecosystems, landscapes, communities and populations are usefully described as hierarchies of nested components distinguished by their appropriate spatial and time scales. Higher-level ecological patterns and processes constrain, and in turn reflect, localized patterns and processes. There is no single, intrinsically correct description of an ecosystem, only one that is useful to management or scientific research. The hierarchy should clarify the higher-level constraints as well as the localized mechanisms behind the problem."*

The ability to implement a successful coho program is constrained by factors occurring both within and outside of the Yakima River Basin. Human-induced factors outside of the basin have an ongoing effect on Yakima coho populations. Human impacts to their migration corridor and ocean and freshwater harvest continue to reduce the number of fish that return to the basin each year. Because these factors and their effect on fish survival are not in the direct control of the Yakama Nation, they are not explicitly addressed in the Master Plan. The Tribe will continue to work through other forums to implement actions to reduce the effect of out-of-basin activities on anadromous fish populations in the Yakima Subbasin.

This Master Plan focuses on implementing actions that are within the control of the Tribe (and basin partners) to meet the harvest and long-term conservation objectives for the coho program. Actions are designed to protect coho through each phase of their life-cycle that occurs in the basin.

Coho habitat improvement actions target tributaries in the upper portion of the basin where coho spawn and rear as fry (Naches River and Upper Yakima River above Roza Dam). These tributaries were affected historically by farming and logging practices.

Water is at a premium in the Yakima Basin for both agriculture and municipal purposes, particularly in the summer. Such demands are the primary factors constraining production of most anadromous species in the basin. Downstream improvement actions are focused on providing sufficient flows with the proper temperature regime to produce large numbers of healthy smolts and ensure the survival of adult migrants. Water diversions are being screened and the quality of irrigation returns improved to protect aquatic ecosystem health.

Until habitat quality improves, Treaty harvest rights need to be met through artificial production. Long term, as habitat improves, it may be possible to rely more on natural coho production to achieve program objectives. When this occurs, coho hatchery production may be reduced or eliminated. However, the scale of habitat improvements may be tempered by the growing human population that places demands on natural resources such as water and land. It is likely that the Tribe will have to rely on artificial production to meet Treaty rights for many decades.

5.5.4 Principle 4: Habitats develop, and are maintained, by physical and biological processes

The NPCC Fish and Wildlife Program states that:

> *"Habitats are created, altered and maintained by processes that operate over a range of scales. Locally observed conditions often reflect more expansive or non-local processes and influences, including human actions. The presence of essential habitat features created by these processes determines the abundance, productivity and diversity of species and communities. Habitat restoration actions are most effective when undertaken with an understanding and appreciation of the underlying habitat-forming processes."*

Habitat conditions observed in a particular reach may signal that impacts are occurring elsewhere in the basin or at a larger scale. For example, changes in the amount and/or timing of stream flow or sediment input to a channel may be the result of human activity or natural processes in adjacent upland areas or stream reaches. Habitat actions and strategies proposed in the Yakima Subbasin Plan emphasize actions at the watershed (subbasin) level rather than at the habitat unit scale. Strategies include:

- Protecting stream corridor structure and function
- Restoring passage and connectivity between habitat areas
- Restoring floodplain function and channel migration processes
- Restoring riparian condition
- Restoring normative flow regimes
- Restoring degraded water quality, including water temperature

The Yakima Subbasin Plan (YSFWBP 2004) proposes a variety of actions to implement these strategies, taking into account the limited usefulness of some types of habitat actions as well as the acceptability of some actions to members of the public.

5.5.5 Principle 5: Species play key roles in developing and maintaining ecological conditions

This principle is elaborated in the NPCC Fish and Wildlife Program:

> *"Each species has one or more ecological functions that may be key to the development and maintenance of ecological conditions. Species, in effect, have a distinct job or occupation that is essential to the structure, sustainability and productivity of the ecosystem over time. The existence, productivity and abundance of specific species*

depend on these functions. In turn, loss of species and their functions lessens the ability of the ecosystem to withstand disturbance and change."

Anadromous fish returning to the Yakima River deliver marine-derived nutrients as their carcasses decompose after spawning. These nutrients increase stream productivity and provide a food source for both terrestrial and aquatic species (Cederholm et al. 2000).

Past salmon harvest management in the ocean and Columbia River and habitat degradation have contributed to the decreased abundance of some species in the Yakima Basin. This has decreased the amount of nutrients delivered to portions of the Basin. Release of hatchery coho pursuant to U.S. v Oregon agreements helps to mitigate for the loss of marine-derived nutrients in the mainstem Yakima River. Actions proposed in this Master Plan would improve delivery of marine-derived nutrients from both natural-origin and hatchery coho salmon. It is expected that coho abundance, diversity and spatial distribution would increase, restoring some lost functionality and increasing the resilience of the overall ecosystem.

5.5.6 Principle 6: Biological diversity allows ecosystems to persist in the face of environmental variation

Specific language from the NPCC Fish and Wildlife Program states:

"The diversity of species, traits and life histories within biological communities contributes to ecological stability in the face of disturbance and environmental change. Loss of species and their ecological functions can decrease ecological stability and resilience. It is not simply that more diversity is always good; introduction of non-native species, for example, can increase diversity but disrupt ecological structure. Diversity within a species presents a greater range of possible solutions to environmental variation and change. Maintaining the ability of the ecosystem to express its own species composition and diversity allows the system to remain productive in the face of environmental variation."

The diversity of fish populations will be ensured primarily through habitat improvement and protection actions across the basin (YSFWBP 2004). Should environmental conditions, for example, result in the failure of a spawning aggregate in one portion of the subbasin, the presence of healthy populations in other parts of the basin would enable the species to persist.

The Tribe recognizes that while hatchery programs may provide substantial harvest and conservation benefits, they also pose risks to native fish communities. Hatchery strategies have the potential to prevent fish from taking advantage of favorable habitat conditions, decreasing population productivity, and increasing competition, predation and disease. To help alleviate these problems, hatchery releases will be discontinued in streams after six years of stocking. Eliminating hatchery plants (parr) will halt on-going hatchery effects and allow the population to express a life-history that can be successful for that stream.

5.5.7 Principle 7: Ecological management is adaptive and experimental

Expanding on this, the NPCC Fish and Wildlife Program states:

> *"The dynamic nature, diversity, and complexity of ecological systems routinely disable attempts to command and control the environment. Adaptive management — the use of management experiments to investigate biological problems and to test the efficacy of management programs — provides a model for experimental management of ecosystems. Experimental management does not mean passive "learning by doing," but rather a directed program aimed at understanding key ecosystem dynamics and the impacts of human actions using scientific experimentation and inquiry."*

This Master Plan includes an adaptive management program to track key coho performance variables over time. The variables act as trigger metrics that drive decisions regarding program implementation (see Section 3.1). Triggers are used to determine escapement targets, when the program shifts from a harvest to conservation objective, and a change in hatchery production level. In short, fish performance is used to adaptively manage the program.

In addition, releases of hatchery fish will be turned on and off over six year periods as a means to probe the ability of the habitat to support natural coho production. This action is designed to provide feedback on habitat quality and the need to continue hatchery production in specific portions of the basin.

5.5.8 Principle 8: Ecosystem function, habitat structure and biological performance are affected by human actions

The NPCC Fish and Wildlife Program elaborates this fundamental observation as follows:

> *"As humans, we often view ourselves as separate and distinct from the natural world. However, we are integral parts of ecosystems. Our actions have a pervasive impact on the structure and function of ecosystems, while at the same time, our health and well-being are tied to these conditions. These actions must be managed in ways that protect and restore ecosystem structures and conditions necessary for the survival and recovery of fish and wildlife in the basin. Success depends on the extent to which we choose to control our impacts so as to balance the various services potentially provided by the Columbia River Basin."*

The common thread running through the discussions of all eight scientific principles is the human effect on anadromous fish and their habitats and the human need for these fish. This Master Plan, in concert with the Yakima Subbasin Plan (YSFWBP 2004), is designed to address both the human-caused degradation of Yakima Subbasin salmon stocks and the cultural, economic, commercial, and recreational importance of those stocks by restoring and increasing naturally spawning populations and accommodating treaty harvest rights.

Habitat strategies in the Yakima Basin Plan address human degradation of stream habitat. This Master Plan does not account for, or assume, any improvements in habitat conditions in the mainstem Columbia or estuary. Strategies and actions are designed to target the key habitat factors limiting fish

abundance, productivity, spatial structure, and life history diversity. A prioritization strategy has been developed to guide the action selection and implementation process.

Strategies under this Master Plan do not target habitat improvements; rather the programs attempt to balance the harvest rights of the Tribe with the impacts hatchery facilities and fisheries have on native fish communities. Prior to submitting this Master Plan, extensive work was performed to determine the effects (predation and competition) the coho program would have on natural populations of Chinook and steelhead. These effects have been documented to be low, and along with Tribal treaty rights, provide strong justification for the program.

Harvest levels and rates will be monitored with in-season adjustments made when necessary. Selective sport fisheries that require release of unmarked fish will be maintained throughout the basin. Tribal fisheries will be regulated using traditional time, area, and gear restrictions. Harvest management strategies may be altered based on monitoring and evaluation results.

To further reduce human impacts to the ecosystem, this program proposes to:

- Convert to a locally adapted broodstock.
- Eliminate hatchery production in tributaries after six years of stocking to determine if the run can sustain itself naturally.
- Operate the hatchery programs consistent with HSRG guidelines for segregated and integrated harvest programs.
- Implement an adaptive management plan that uses attainment of performance indicators to drive hatchery operations and decisions.
- Reduce hatchery production over time as natural coho production increases.

5.6 INTEGRATED APPROACH TO MEETING LONG-TERM GOALS FOR COHO SALMON IN THE YAKIMA BASIN

Although this program focuses on hatcheries to achieve identified coho goals, habitat, harvest and hydropower strategies are also in place to assist in this effort. The habitat strategy for the basin is described in Yakima River Subbasin Plan (YSFWBP 2004). The plan calls for protecting existing high quality habitat and restoring degraded habitat as a means to increase the abundance, productivity and diversity of anadromous fish populations in the basin.

Management strategies identified in the Subbasin Plan to improve and protect aquatic habitat include:

- Implementing riparian projects such as replanting, fencing and purchase of riparian properties
- Implementing passage improvements at diversion dams, screens, culverts and other barriers
- Implementing water quality projects, e.g., those devoted to control of toxics, sediment, fecal coliform/bacteria and temperature
- Implementing stream flow projects such as water conservation, purchases, transfers, or leases

- Developing flow/temperature benchmarks, then funding and implementing projects that move the hydrograph toward the benchmark
- Reducing net water use
- Developing out-of-basin sources for new water
- Managing the system differently in good/excellent water years
- Setting Total Water Supply Available targets to reduce or eliminate flip-flop
- Reconnecting side channels as strategies to restore temperature regimes
- Increasing environmental attributes that favor anadromous fish.
- Studying the effect of altered temperatures on life histories and ecosystems in general

Habitat actions have been on-going in the basin since the early 1980s. A list of the major habitat protection and improvement accomplishments is presented in Sections 5.2.1 and 4.7.2.

The harvest strategy for coho relies on marking (or tagging) all hatchery fish released in the basin. Marking enables biologists to distinguish hatchery fish from naturally produced fish in the hatchery brood, on the spawning grounds and in fisheries.

Coho produced in the integrated program will be 100 percent coded wire-tagged but not adipose fin-clipped to distinguish them from segregated program coho which will be 100 percent adipose fin-clipped and a portion coded wire-tagged. The tagging strategy for the integrated program is designed to reduce the harvest rate on these integrated fish in ocean and freshwater fisheries, resulting in more fish returning to the basin. Tagging protocols will change in Phase 4 when all hatchery fish will receive similar marks and tags.

Tribal fisheries in Zone 6 and within the Yakima River Basin will be regulated using traditional time, area, and gear restrictions. These regulations will be designed to ensure that adult escapement targets for hatchery broodstock and natural spawning are achieved yearly.

In regards to a hydropower strategy, the Yakama Nation will continue to work with the Corps of Engineers, NOAA Fisheries and other parties to implement the Biological Opinion for the Federal Columbia River Power System (BiOP), as amended (NOAA 2008). Actions proposed in the 2008 BiOP are expected to improve adult and juvenile fish survival through the FCRPS over time. Additionally, the Yakama Nation continues to implement improvements at Roza Dam and the Chandler facility to improve fish passage survival.

5.6.1 Relationship to Other Projects and Activities

The relationship of the coho program to other ongoing and proposed fisheries activities is consistent with those described in Section 4.7.1.

5.6.2 Relationship to Regional Habitat Strategies

The relationship of the coho program to other ongoing and proposed habitat strategies is consistent with those described in Section 4.7.2.

5.6.3 Relationship to Harvest Strategies

The State of Washington is expected to continue mark-selective harvest practices for coho in marine and most recreational fisheries in the Columbia River below McNary Dam. Above McNary Dam, where relatively minor harvest levels occur, state recreational fisheries may not be mark-selective. The marking program for coho included in this Master Plan takes advantage of the selective fishery policy of the state to increase the number of integrated program fish returning to the basin. The integrated fish will be 100 percent coded wire-tagged but not adipose fin-clipped. The combination of marks will ensure that fish are harvested at low rates in fisheries yet can be distinguished as hatchery-origin fish when they return to the basin.

5.7 SUBBASIN-WIDE RISK ASSESSMENT

Risks associated with the proposed Yakima River coho program are considered quite low. Alterations to the historical habitat and flow regime extirpated natural coho population in the 1980s. Hatchery releases to the system benefit coho by using artificial production to increase population abundance. Potential program risks will be reduced by transitioning to local broodstock and operating the program consistent with HSRG principles.

A potential risk to be considered is that hatchery-origin fish may stray and spawn in areas outside of the Yakima River. Such colonizing may decrease the productivity of the natural populations inhabiting these areas. Hatchery strays will be minimized by transitioning to broodstock locally adapted to the Yakima River. Juvenile hatchery fish will be released relatively high in the watershed, or acclimated in ponds prior to release so that they imprint on the water signature of their natal stream. Also, some returning adults will be placed in tributaries high in the basin in an attempt to re-colonize its upper extent.

5.8 CONSISTENCY WITH THE NPCC ARTIFICIAL PRODUCTION POLICIES

Program operation has been designed to be consistent with the NPCC's artificial production strategy and inherent recommendations. The ten artificial production strategies are presented below in bold italics, immediately followed by an assessment of the consistency of the proposed coho program with the strategy.

> ***The purpose and use of artificial production must be considered in the context of the ecological environment in which it will be used.***

The coho program is designed to provide harvest to meet tribal treaty rights established in law. Artificial production is appropriate for Yakima coho because the species was extirpated in the Yakima River Basin due to habitat degradation from activities such as agriculture, forestry, and urban development. Because habitat conditions are not likely to improve to levels capable of supporting large scale natural coho production for many decades, artificial production is required to meet treaty obligations in the near term.

Although the size of the program was set in a legal process (US v Oregon), the Yakama Nation has conducted studies to determine the effect the program may have on other species. Studies on

predation and competitive interactions between hatchery coho and Chinook and steelhead found little evidence of substantial negative effects (Dunnigan 1999, Dunnigan 2001, Dunnigan and Hubble 1998).

The Yakama Nation is also investing heavily in habitat improvements throughout the basin. These actions are expected to increase the productivity of naturally produced coho. As natural coho abundance increases, reliance on hatchery production to meet harvest goals will decrease.

Artificial production must be implemented within an experimental, adaptive management design that includes an aggressive program to evaluate the risks and benefits and address scientific uncertainties.

The coho program has already gone through two phases wherein the risks and benefits of the program have been evaluated. Studies on coho predation and competition with other species have been estimated and found acceptable. Biologists have shown that hatchery coho will successfully spawn, produce offspring and these offspring will contribute to fisheries in large numbers. Adults readily find and use spawning habitat located throughout the basin.

An adaptive management plan is a fundamental component of this program (Section 3.1). It uses performance triggers to select when certain management strategies are implemented. The plan also calls for testing the success of using parr or adult coho to recolonize vacant habitat (Section 5.2). An intensive monitoring and evaluation plan is already in place in the basin and will be used to track and determine the causes of program success or failure.

Hatcheries must be operated in a manner that recognizes that they exist within ecological systems whose behavior is constrained by larger-scale basin, regional and global factors.

The program recognizes that factors outside of the Tribes' control may have a large effect on program success. Harvest levels in ocean and freshwater fisheries may take more than 30 percent of program adults on an annual basis. Also, the selective nature of these fisheries creates conditions where upwards of 50 percent of all hatchery fish are harvested prior to entering the Yakima River. These losses are some of the reasons why the size of the program is so large to achieve harvest goals.

Variable ocean conditions will also affect the number of hatchery- and natural-origin adults produced each year. The program accounts for this variability by setting minimum spawning escapement targets and adjusting harvest rates as needed to achieve these targets.

Global climate change may cause stream temperatures in the Yakima River system to increase over time. This change may be sufficient to overwhelm the beneficial actions being undertaken to improve habitat conditions in the basin.

If habitat quality does not increase, then it is unlikely that harvest benefits can be obtained from what will be limited natural coho production. Under this scenario, the need for hatchery production to achieve harvest goals will be even higher. Hatchery facilities are designed with sufficient rearing space to meet goals under such a future scenario.

Naturally selected populations should provide the model for successful artificially reared populations, in regard to population structure, mating protocol, behavior, growth, morphology, nutrient cycling, and other biological characteristics.

The morphological, demographic and behavioral characteristics of hatchery coho will be constantly compared to the natural population to detect changes in these attributes through time. To reduce the chance of divergence in physical and genetic traits between the two components of the population, naturally produced coho will be incorporated into broodstock at ever increasing rates as the natural run size increases.

Because the segregated program component will not include natural-origin coho as broodstock, the program will enforce strict controls on the proportion of hatchery fish spawning naturally (pHOS) upstream of Prosser Dam. pHOS will be limited to less than five percent.

Coho jacks will be incorporated into the broodstock at rates similar to those observed in the natural population. Scale samples will be taken on naturally produced fish to determine size and age relationships for returning fish. This action will establish the size criterion separating adult and jack coho.

Coho smolts will be released at between 15-20 fpp. This size range is similar to what has been observed for naturally produced smolts arriving at Roza Dam and the Chandler Facility.

The entities authorizing or managing an artificial production facility or program should explicitly identify whether the artificial propagation product is intended for the purpose of augmentation, mitigation, restoration, preservation, research, or some combination of those purposes for each population of fish addressed.

The primary goal of the coho hatchery program is to provide fish for harvest pursuant to US v Oregon. The secondary goal is to produce sufficient coho to restore them to historical habitats in the basin. Because of degraded habitat conditions, the Tribe recognizes that attaining this goal may not be met for decades, in all likelihood.

Decisions on the use of the artificial production tool need to be made in the context of deciding on fish and wildlife goals, objectives and strategies at the subbasin and province levels.

Hatchery coho production in the Yakima River Basin is required under US v Oregon to achieve tribal fishing rights as defined in law. Annual releases from the program have been coordinated with, and agreed to by federal, state and tribal fisheries managers. Coho reintroduction is also outlined in the Yakima Subbasin Plan (http://www.nwcouncil.org/fw/subbasinplanning/yakima/plan/).

Appropriate risk management needs to be maintained in using the tool of artificial propagation.

Since its inception, the coho program has strived to quantify and mitigate the risks the program may have on other aquatic species. Competition and predation studies were undertaken in Phase 1 and Phase 2 to ensure that impacts to Chinook and rainbow trout (steelhead) were at acceptable levels. These studies will be repeated in the future as natural coho production increases. The results of these studies will be used to determine the need for changes in program release locations or numbers. An

adaptive management plan has been put in place for Phase 3 and Phase 4 that sets triggers to determine when program changes should be made. Triggers are used to set escapement levels, reduce harvest and control the proportion of hatchery fish spawning naturally. The programs will be operated consistent with HSRG recommendations (HSRG 2004, 2009) to reduce genetic and ecological risks that the hatchery may pose to natural populations.

> ***Production for harvest is a legitimate management objective of artificial production, but to minimize adverse impacts on natural populations associated with harvest management of artificially produced populations, harvest rates and practices must be dictated by the requirements to sustain naturally spawning populations.***

Harvest rates on Yakima River coho are set by the terms of US v Oregon and rates are intended to provide sufficient fish to meet treaty rights while at the same time protecting ESA listed coho in the lower Columbia River. Because Yakima River coho are captured in the same fisheries as naturally produced coho from the lower Columbia, harvest rates are deemed protective. The implementation of mark-selective fisheries in the ocean and mainstem Columbia River (below McNary) for coho will decrease harvest rates on naturally produced adults while at the same time allowing higher harvest rates on marked hatchery fish.

> ***Federal and other legal mandates and obligations for fish protection, mitigation, and enhancement must be fully addressed.***

The program is required to meet tribal treaty rights. The size of the program has been agreed to by the parties to US v Oregon. All other relevant legal mandates for fish protection, mitigation and enhancement will be incorporated into the program.

5.9 HATCHERY AND GENETICS MANAGEMENT PLAN

The draft HGMP for the coho program is presented in Appendix B.

6.0 LOCAL AND REGIONAL CONTEXT FOR THE YAKIMA CHINOOK AND COHO PROGRAMS

6.1 GEOGRAPHIC AND ENVIRONMENTAL CONTEXT

6.1.1 Location

The Yakima River Basin is located in south central Washington. The 6,100 square mile area is bordered by the Cascade Mountains to the west, the Columbia River to the east, the Wenatchee Mountains to the north, and by the Simcoe Mountains and Horse Heaven Hills to the south. Major cities in the Yakima Basin include Ellensburg, Yakima, Prosser, and Toppenish.

The Yakima River bisects the basin from north to south. Most major tributaries enter from the west down the slopes of the Cascade Mountains. Primary project facilities are in the lower portion of the

subbasin (Figure 4-4). Prosser Hatchery is on the mainstem Yakima River at RM 47. Marion Drain Hatchery is 6.7 miles upstream of the mouth of an 18-mile-long irrigation drain which enters the Yakima River at RM 77. Much further upstream in the watershed to the north of Ellensburg, Holmes Ranch Hatchery is proposed at RM 158 of the mainstem Yakima River.

6.1.2 Climate

The climate of the Yakima Basin is highly variable with elevation. Near the Cascade crest, annual precipitation ranges from 80 to 140 inches, while the lower elevations in the valleys to the east receive 10 inches or less. This sharp precipitation gradient in the basin falls off in a southeasterly direction. Moist maritime air passing over the Cascade Range results in precipitation in the western part of the subbasin and a rain shadow in the east. The rainy season in the valleys occurs from November through January, when approximately half the annual precipitation falls. Cascade Mountain snowpack contributes most of the river flow and water for irrigated agriculture; virtually all of the streams in the basin originate at higher elevations where the annual precipitation exceeds 30 inches.

Summer temperatures average 55˚F in the mountains and up to 82˚F in the valleys. Average maximum winter temperatures range from 25˚ to 40˚F, while average minimum winter temperatures range from 15˚ to 25˚F. Minimum temperatures of -20˚ to -25˚F have been recorded in most areas.

6.1.3 Geology, Soils and Land Types

The Yakima Basin contains two very different geographic regions. The western third of the basin contains the Cascade Range geologic province. This area is a thick sequence of volcanic rocks resting on older metamorphic, intrusive, and sedimentary rock. The volcanic rocks include lavas and pyroclastic materials that originated from numerous volcanic centers. Younger rocks are exposed where uplift and erosion has occurred. These areas are typically metamorphosed oceanic crust, granitic intrusions. The upper mainstem Yakima and Naches rivers and several tributaries occupy valleys excavated by glaciers. Along the sides and bottom of most of these valleys, younger materials such as glacial deposits, mudflows, landslides, and stream alluvium are often present.

The remainder of the Yakima Basin lies in the Columbia Basin province where the dominant geologic materials are basalts and sedimentary interbeds of the Columbia River Basalt Group (CRBG). The CRBG consists of a thick sequence of basalt lavas, interspersed with sedimentary layers. The CRBG includes three main units: Saddle Mountains Unit, Wanapum Unit, and the Grande Ronde Unit. Each of these units may consist of many individual flows. The thickness of the basalt in the lower and middle Yakima River Basin ranges from 9,000-12,000 feet, growing thicker in the downstream direction. Individual flows typically have volumes of two to seven cubic miles (TCWR 2001). The basalt plateau of the eastern basin was folded and faulted into a series of west-east trending ridges and valleys. Outflow from glaciers along the Cascade crest delivered glacial outwash to the basins, resulting in the partial filling of Cle Elum, Kittitas, and upper and lower Yakima valleys with sand, gravel, and silt over the basalt.

6.1.4 Hydrology

The Yakima Basin has approximately 1,900 miles of streams that have been mapped by the US Geological Survey. The Yakima River originates at the outlet of Lake Keechelus and flows for 214 miles in a southeasterly direction to its confluence with the Columbia River at Richland, Washington. With its

tributaries, the Yakima River drains about 6,150 square miles, or 4 million acres (YSFWPB 2004). Primary tributaries include Naches River (Little Naches, Bumping, and Tieton rivers), Sqauk, Taneum, Umtanum, Manastash, and Wenas creeks, and Ahtanu, Toppenish and Satus creeks.

The hydrologic features of the basin vary along with topography. In the higher elevations, steeply-dropping streams form waterfalls, pools, and rapids. In the lower portions of the valley, the Yakima River alternates from narrow canyon sections to broad meandering stretches with floodplains and terrace features. The Yakima Basin can be broken into five distinct channel types that are very apparent along the altitudinal gradient from source to mouth: 1) high gradient, largely constrained headwaters; 2) expansive braided alluvial floodplains; 3) constrained canyons; 4) meanders with expansive floodplains containing oxbows; and 5) deltaic floodplain at the confluence with the Columbia River.

Six major reservoirs are located in the basin and form the storage component of the federal Yakima Project, managed by the US Bureau of Reclamation (USBR). The Yakima Project irrigates a narrow strip of fertile land that extends for 175 miles on both sides of the Yakima River and totals approximately 464,000 acres. These reservoirs are the Keechelus, Kachess, and Cle Elum lakes on the upper Yakima River; Rimrock and Clear lakes on the Tieton River; and Bumping Lake on the Bumping River. The Tieton and Bumping rivers are tributaries to the Naches River. Total storage capacity of all reservoirs is approximately 1.07 million acre/feet. The construction and operation of irrigation reservoirs has significantly altered the natural, seasonal hydrograph of all downstream reaches (Eitemiller et al. 2000).

Groundwater in the Yakima Basin is controlled by a variety of factors such as structural folds and faults, and characteristics of the rock fabric or unconsolidated sediments. The basalt folds of the Yakima Basin produced a series of groundwater basins that influence the hydrologic cycle. For example, Marion Drain is an irrigation runoff ditch that intercepts alluvial gravels and collects and distributes large quantities of groundwater (HSRG 2009).

6.1.5 Water Quality

The Washington Department of Ecology has rated the Yakima River from the confluence with the Cle Elum River (RM 185.6) to the mouth as having Class A, or “excellent” water quality. The American, Bumping, upper Naches and upper Yakima rivers were classified as AA or “exceptional”. However, there are some specific water quality parameters that do not conform to this classification.

The extensive irrigation water delivery and drainage system in the Yakima River Basin exerts a significant effect on water quality conditions and aquatic health in agricultural streams, drains, and the Yakima River. Chemicals and other agricultural byproducts are the most common contaminants in the Yakima River system. Nitrate and orthophosphate were the dominant forms of nitrogen and phosphorus found in the Yakima River and its agricultural tributaries. These forms of nitrogen and phosphorus are highly water soluble, and concentrations in some agricultural drains were high enough to support nuisance-level growths of algae (Fuhrer et al. 2004).

Historically, organochlorine insecticides were frequently detected in agricultural streams in the Yakima River Basin. DDT, DDE, dieldrin, and heptachlor epoxide exceeded the USEPA chronic water quality criteria for the protection of aquatic life, but concentrations of total DDT in water are decreasing over time (Fuhrer et al. 2004).

6.1.6 Habitat and Biota

6.1.6.1 Fish

The abundance of salmon, steelhead and resident fish in the Yakima Subbasin have been an important cultural and subsistence resource for the Yakama Nation as well as for sport anglers. Currently, the basin is known to support 38 species of fish, of which 24 are native and 14 nonnative (Table 6-1; Tri-County Water Resource Agency 2001). Populations of anadromous fish have declined sharply during the 20th Century, and some native populations have been extirpated. Bull trout (*Salvelinus confluentus*) were listed as threatened in the Columbia River Basin by the US Fish and Wildlife Service in June 1997. Steelhead (*Oncorhynchus mykiss)* were listed as threatened species in the mid-Columbia River watershed by the National Marine Fisheries Service in March 1999. Key species are described in the sections that follow.

Table 6-1. Fish species found in the Yakima River System.

Fish Species	Scientific Name
Western brook lamprey	*Lampetra richardsoni*
Pacific lamprey	*Entosphenus tridentatus*
Mountain whitefish	*Prosopium williamsoni*
Brown Trout[1]	*Salmo trutta*
Cutthroat trout	*Salmo clarki*
Brook trout[1]	*Salvelinus fontinallis*
Bull trout	*Salvelinus confluentus*
Coho	*Oncorhynchus kisutch*
Rainbow trout	*Oncorhynchus mykiss*
Steelhead	*Oncorhynchus mykiss*
Chinook	*Oncorhynchus tshawytscha*
Kokanee	*Oncorhynchus nerka*
Carp[1]	*Cyprinus carpio*
Chiselmouth	*Axcrocheilus alutaceus*
Redside shiner	*Richarsonius balteatus*
Longnose dace	*Rhinichthys cataractae*
Leopard dace	*Rhinichthys falcatus*
Speckled dace	*Rhinichthys osculus*
Northern pike minnow	*Ptychocheilus oregonensis*
Peamouth	*Mylocheilus caurinus*
Largescale sucker	*Catostomus macrocheilus*
Mountain sucker	*Catostomus platyrhynchus*
Bridgelip sucker	*Catostomus columbianus*
Channel catfish[1]	*Ictalurus punctatus*
Brown bullhead[1]	*Ictalurus nebulosus*
Black bullhead[1]	*Ictalurus melas*

Fish Species	Scientific Name
Mosquitofish[1]	*Gambusia affinis*
Three-spine stickleback	*Gasterosteus aculeatus*
Largemouth bass[1]	*Micropterus salmoides*
Smallmouth bass[1]	*Micropterus dolomieui*
Black crappie[1]	*Pomoxis nigromaculatus*
Bluegill[1]	*Lepomis macrochirus*
Pumpkinseed[1]	*Lepomis gibbosus*
Walleye[1]	*Stizostedion vitreum*
Yellow perch[1]	*Iperca flavescens*
Piute sculpin	*Cottus beldingi*
Torrent sculpin	*Cottus rhotheus*
Mottled sculpin	*Cottus bairdi*

[1] Species introduced to the basin.
Source: Tri-County Water Resource Agency 2001.

Summer/Fall Chinook Population Components

Summer/fall Chinook salmon were once abundant in the Yakima River Basin. Naturally propagated returns may have been as high as 250,000 fish prior to the mid-19th century. As a result of historical land and water development and fisheries management practices, the summer run component was extirpated by 1970.

Fall Chinook salmon are known to spawn in the Yakima mainstem from Sunnyside Dam (RM 103.8) downstream almost to the confluence with the Columbia River (Figure 2-2). Redds are distributed patchily throughout the river, depending on the amount of submerged aquatic vegetation. Spawn timing upstream of Prosser Dam (RM 47) begins about the middle of October, peaking in the first week of November, and ending by the third week of November. Spawning in the lower mainstem includes some fish that spawn much later; spawning has been observed as late as early January. Fry emergence does not occur in the mainstem before late March and extends into the third week of April.

Historically, the Yakima Basin may have had an abundance of fall Chinook ranging from about 38,000 to 100,000 fish (HSRG 2009). The population has declined since the 19th century due to unscreened diversions, logging, channelization, and overharvesting. Subsequent losses occurred in the early 20th century with construction of unladdered dams, high harvest in the ocean fishery, dewatered spawning and rearing habitats, and altered natural summer flow regimes. The mean adult fall Chinook spawning escapement in the mainstem Yakima River from 1998 to 2006 can be roughly estimated at 5,700 fish, with a range of 1,940 to 13,846 (HSRG 2009).

Since 1999, terminal harvests have ranged from 34 to 2,300 fall Chinook. Prior to 1999, in-basin harvest of fall Chinook was negligible.

Yakima fall Chinook are part of the Upper Columbia River summer/fall Chinook ESU, which is not listed under the ESA.

Spring Chinook Salmon

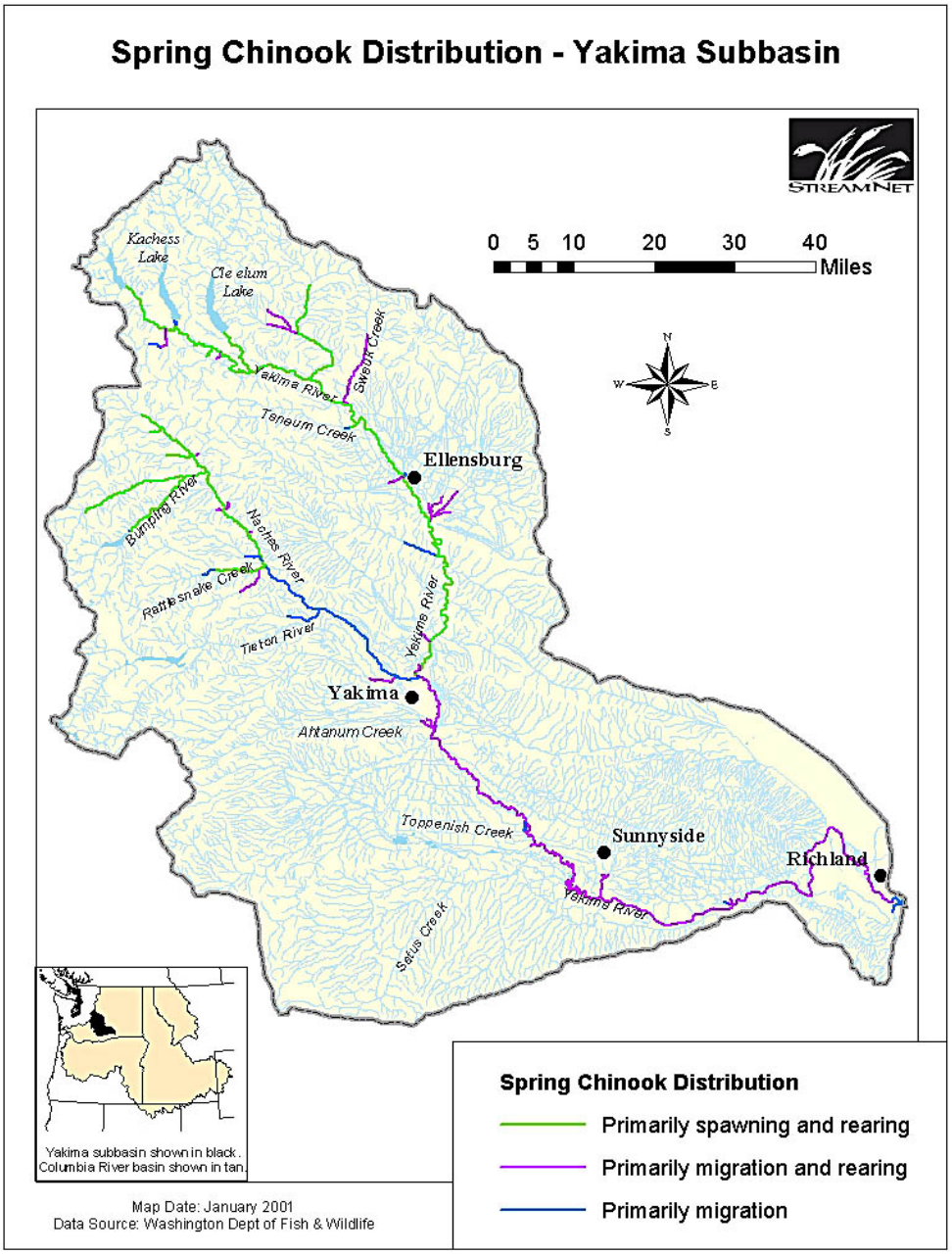
Spring Chinook avoid high water temperatures by migrating through the lower river during spring, and spawn and rear in the upper watershed (Figures 2-1 and 6-1) where the water temperatures are not normally a concern. In the Yakima Basin, spring Chinook spawning generally occurs from early September through early October. Fry emergence occurs from late March to early May, depending on water temperature. Juvenile spring Chinook spend one year in freshwater and then migrate to the ocean.

The Yakima River Basin supports three genetically distinct stocks of spring Chinook: the American River stock, the Naches River stock, and the upper Yakima stock. The Yakima River stock of spring Chinook spawn in the mainstem Yakima from just below Roza Dam (RM 128) to Keechelus Dam (RM 214), but are concentrated between the Cle Elum River confluence (RM 186) and Easton Dam (RM 202) (Figure 6-1). Spawning also occurs in the Teanaway River and the Cle Elum River. The Naches stock spawns in the mainstem Naches River from the confluence of the Tieton River (RM 17.5) to the confluence of the Little Naches and Bumping Rivers (RM 44.6), as well as in Rattlesnake Creek, the Little Naches River, and in the Bumping River downstream of Bumping Lake Reservoir. The American River stock spawns almost exclusively in the American River itself (a tributary of the Naches River) and is concentrated between RM 1 and RM 15.

Historic spawner escapement to the Yakima Basin may have ranged from 50,000 to 200,000 spring Chinook (YSFWPB 2004). Mean escapement of the upper Yakima stock from 2000 to 2007 was 4,126 fish. From 2000 to 2007, escapement to the Naches River averaged 2,037 fish. Escapement to the American River averaged 869 from 2001 to 2007.

From 1982 to 2007, the number of natural-origin spring Chinook harvested in the Yakima Basin ranged from 25 to 2,806 adults; since 2001, harvest of hatchery-origin spring Chinook ranged from 12 to 1,865 fish. Sport harvest in the Yakima River is mark selective, but tribal harvest is not.

Yakima spring Chinook are part of the Mid-Columbia River spring-run Chinook ESU which includes all naturally spawned populations of spring-run Chinook salmon in Columbia River tributaries from the Klickitat River upstream to and including the Yakima River (excluding the Snake River Basin). Listing of this ESU was determined to be not warranted by NOAA in 1998.



Source: WDFW 2001.

Figure 6-1. Spring Chinook distribution in the Yakima Basin.

Coho Salmon

Coho salmon were extirpated from the Yakima Basin in the early 1980s. Today, natural reproduction of hatchery-planted coho smolts is occurring in both the Yakima and Naches rivers. Historically, spawning occurred in the upper Yakima above the Cle Elum confluence as well as in the lower alluvial reaches of the Naches below the Tieton confluence (HSRG 2009) (see Figures 2-4 and 2-5). The current run spawns

in reaches downstream of historic production areas, presumably due to hatchery smolt acclimation and/or release sites that are downstream of historic spawning areas. Over time, the major spawning area has moved from in or below the Granger Drain (RM 83) to Sunnyside Dam (RM 103.8), to the middle and upper Yakima, much closer to historic spawning grounds.

Coho return to the Yakima Basin from September to November. Spawning occurs in riffles or where groundwater seepages occur. Coho salmon generally spend one season in freshwater before migrating to the ocean, and return as 3-year old adults to spawn in their natal streams.

Historic runs of coho to the Yakima River Basin are estimated to have been between 44,000 and 100,000 fish (HSRG 2009). Since regular outplanting of hatchery smolts began in 1985, coho returns have steadily increased. From 2001 through 2005, coho escapement into the Yakima Basin averaged approximately 2,570. Beginning in 2005 through 2010, average coho escapement has risen to 6,286.

The Tribal terminal coho fishery is negligible and estimated to be one percent by Yakama Nation biologists.

Bull Trout

Bull trout, a species of char, are found in the cold, pristine stream and lake habitats of Washington, Oregon, Idaho, Montana, Nevada, and western Canada. Once found in about 60 percent of the Columbia River Basin, bull trout are now limited to less than half of their range. Bull trout are patchily distributed and due to their decreasing abundance, were listed as threatened throughout their range in 1999. On October 18, 2010, the USFWS revised critical habitat designations for bull trout. Under the revision, 557.3 miles of the Yakima River were designated as critical bull trout habitat.

The Yakima River Critical Habitat Unit supports adfluvial, fluvial and resident life history forms of bull trout. The designated habitat includes the mainstem Yakima River and tributaries from its confluence with the Columbia River upstream to the uppermost point of bull trout distribution. The USFWS (2002) identified 13 “local” populations within the Yakima Subbasin: the mainstem Yakima River (Keechelus to Easton Reach), Ahtanum Creek (North, South, and Middle Forks), Naches River tributaries (American River, Rattlesnake Creek, and Crow Creek), Rimrock Lake tributaries (South Fork Tieton River and Indian Creek), Bumping Lake (Deep Creek), North Fork Teanaway River, Kachess Lake tributaries (Box Canyon Creek and the upper Kachess River), Keechelus Lake (Gold Creek), and the Cle Elum River. The South Fork Tieton River population, one of the largest populations of bull trout in central Washington, is located above the Tieton Dam and supports the core area. There are no estimates of historical abundance or productivity in the Yakima River area, but it is reasonable to assume that bull trout historically maintained stable trends over time.

Bull trout are piscivorous and require an abundant supply of forage fish to maintain healthy populations. They require cool water, with 44-46°F appearing optimal, and 59°F maximum. Spawning in the Yakima Subbasin occurs in cooler water below 48°F, from August through November. Eggs hatch in late winter or early spring.

Steelhead

The Yakima Basin supports four genetically distinct stocks of summer steelhead: the Satus Creek stock, the Toppenish Creek stock, the Naches River stock, and the upper Yakima stock. A radio tagging study

performed over brood years 1990 to 1992 showed that the mean percent of fish spawned in the following locations: Satus Creek (48 percent), the Naches River watershed (32 percent), Toppenish Creek (13 percent), and the upper Yakima (7 percent).

Estimates of the historical steelhead run size range from 20,800 to 100,000 fish (HSRG 2009). Production in the Yakima subbasin has dramatically declined in the 20th century. Factors in the decline include damming of spawning tributaries, closing the fish ladder at Roza Dam during much of the steelhead spawning run from 1941 through 1959, and the large diversion dams downstream of Roza Dam, which each pose a significant mortality risk for outmigrating smolts. All populations of Yakima steelhead have grown somewhat since 2000. The mean abundance from 2001 through 2007 was as follows: Satus Creek stock -929 fish, Naches River stock - 861 fish, Toppenish Creek stock -669 fish, and upper Yakima stock -161 fish.

Summer steelhead spawn in most of the accessible tributaries in the upper Yakima, but especially in the Teanaway River and its tributaries, Taneum Creek, Swauk Creek and Umtanum Creek. With the exception of the Tieton River and probably the American River, summer steelhead spawn in virtually all of the accessible tributaries in the Naches watershed, particularly the Little Naches River, Rattlesnake Creek, and the Bumping River. Steelhead spawning in Toppenish Creek is currently restricted to the upper watershed due to habitat degradation in the lower reaches. Spawning occurs in upper Simcoe Creek and in Toppenish Creek above the Simcoe confluence. Satus Creek steelhead spawn in almost all reaches and tributaries of Satus Creek, including intermittent tributaries.

Spawn timing, with the exception of the Satus Creek stock, varies throughout the basin with elevation and seasonal water temperatures in the watershed. At the lowest elevations, spawning begins in early March, while at the higher elevations, spawning can continue into June (YSFWPB 2004). Satus Creek steelhead differ from other Yakima steelhead stocks in a number of respects. Satus Creek is the lowest and warmest watershed in the basin, so spawning begins in February. Fry generally emerge in May and the growth rate is more rapid.

Although the entire Yakima Basin was closed to steelhead fishing in 1994, considerable illegal and/or inadvertent steelhead harvest is believed to occur during the winter whitefish fishery. A terminal harvest rate has been estimated at eight percent (HSRG 2009).

Westslope Cutthroat Trout

Westslope cutthroat trout have a known native range in Washington that includes the Lake Chelan and Methow basins in the mid-Columbia River and the headwaters of the Pend Oreille River. Surveys during the 1990s determined that naturally reproducing populations of westslope cutthroat trout occur in virtually all subbasins above 3,000 feet in elevation. In eastern Washington, westslope cutthroat trout occur in 1,509 miles of 493 streams and 311 lakes in the Yakima, Wenatchee, Entiat and Methow rivers, and the Lake Chelan and Pend Oreille River drainages. Ten populations of westslope cutthroat trout have been identified in the Upper Yakima River Basin (Wydoski and Whitney 2003).

Hybridization with other introduced cutthroat species and with introduced rainbow trout has caused a drastic loss of genetically pure populations. Combined with degraded habitat, loss of genetic integrity has led to a classification of “vulnerable” for westslope cutthroat trout.

The westslope subspecies of cutthroat trout are known to exhibit three life history forms: adfluvial, fluvial, and resident. Adfluvial trout spend from 1 to 4 years as juveniles in tributary streams before moving into lakes where they spawn between March and July. They remain in the lakes after spawning. Fluvial cutthroat trout spawn in small upstream tributaries and move downstream to larger river reaches as they grow. The resident form of westslope cutthroat is found in headwater streams and for the most part, exhibit little movement. Generally they inhabit shoreline areas of streams during the summer and move into pools during the winter. Sexual maturation typically occurs at age 4 or 5. Adfluvial and fluvial stocks can reach lengths of 12 to 15 inches, while resident forms are generally smaller.

Sockeye Salmon

Four nursery lakes In the Yakima River Basin historically produced an estimated annual return of about 200,000 sockeye. These lakes became unproductive in the early 1900s when irrigation storage dams were constructed without fish passage. Work conducted by the NMFS from 1987 to 1993 in Lake Cle Elum returned from 4 to 20 sockeye adults to the base of Cle Elum Dam, demonstrating that restoration of sockeye was feasible with sufficient passage modifications.

As part of water storage improvements under Section 1206 of the 1994 Yakima River Basin Water Enhancement Project Act, the Yakama Nation, with the cooperation of the U.S. Bureau of Reclamation (USBR), is actively pursuing the restoration of anadromous fish passage above Cle Elum Dam. The USBR estimated a sockeye smolt production potential of 400,000 to 1.6 million fish in the Cle Elum Lake watershed, with a projected return of 30,000 to 50,000 adult spawners (assuming average survival and median pool elevation) (Grabowski 2007). Based on this and other feasibility work, a temporary juvenile fish passage flume was constructed at Cle Elum Dam in 2006. The Yakama Nation tested passage through this flume in 2006-07 using coho salmon as surrogates. Approximately 10,000 coho smolts were released annually and PIT-tags were used to evaluate survival. Over 25 percent of the smolts released into Lake Cle Elum in 2006-07 successfully migrated using the flume and 1.5 percent of the known 2006 outmigrants returned as adults to Prosser Dam in 2007.

Pacific Lamprey

Pacific lamprey in Washington are found in most large coastal and Puget Sound rivers as well as distances inland in the Columbia, Snake, and Yakima River systems. Occasionally a few adults were counted at Prosser Dam through the 1990s. Since 2002, counts at Prosser Dam have ranged from 2 in 2005 to 87 in 2003 (YN, unpublished data). The Pacific lamprey is considered a Species of Concern by the U.S. Fish and Wildlife Service, and is a monitored species in the State of Washington.

Pacific lamprey have larvae called ammocoetes that are filter feeders that inhabit fine silt and mud substrates in backwaters and quiet eddies of cold water streams. Ammocoetes live in freshwater for 4 to 7 years before metamorphosing and migrating from their parent stream to the Pacific Ocean. Migration occurs during March to July of the year following their metamorphosis. Young adults migrate at night by drifting downstream with the stream current during periods of high stream flow, rather than actively swimming. After metamorphosing into the adult parasitic phase, Pacific lamprey feed on the body fluids of other fish. Adult Pacific lamprey migrate to freshwater between March and October, overwinter in deep pools, and spawn the following spring. Adults can pass barriers such as rocks forming waterfalls or the walls of dams by clinging to and slowly ascending them using their sucker-like

mouths. Spawning occurs from April through July in nests made in gravel substrates containing some fine gravel and sand. Adults may reach a length of 30 inches and a weight of about 1 pound.

Other Fish Species

Important resident fish species present in the upper Yakima Basin include rainbow trout, cutthroat trout, whitefish, and several species of dace, sculpins, and suckers. In the lower system, species present include rainbow trout, whitefish, carp, northern pike minnow, redside shiner, chiselmouth and peamouth chubs, largescale, bridgelip and longnose suckers and several species of sculpins and dace.

Three salmonid species (brook trout, lake trout, and brown trout) have been introduced, along with a variety of sunfish, perch, catfish, and minnow species. Before the introduction of exotics, northern pikeminnow, sculpin, bull trout, rainbow trout, cutthroat trout, and burbot were the primary piscivores in the subbasin.

6.1.6.2 Wildlife

Because of its diverse vegetative and geologic features, the Yakima Basin supports a variety of wildlife species, including 22 species of reptiles, 23 species of amphibians, 98 species of mammals, and 241 species of birds. Several species of big game live in the basin, including black bear, black-tailed deer, mule deer, Rocky Mountain elk, bighorn sheep, mountain goats, and cougar. Big horn sheep were reintroduced over 40 years ago and inhabit areas between Naches and Ellensburg. A small population of mountain goats can be found at high elevations along the western fringe of the subbasin, and wolverines have also been reported in the higher elevations. Federal and state listed species are identified in Table 6-2.

Table 6-2. Federal and State listed species of the Yakima Basin.

Common name	Scientific name	Federal status[1]	State status[2]
Amphibians			
Cascade Torrent Salamander	*Rhyacotriton cascadae*	_	SC
Cascades Frog	*Rana cascadae*	FCo	_
Columbia Spotted Frog	*Rana luteiventris*	_	SC
Columbia Torrent Salamander	*Rhyacotriton kezeri*	FCo	_
Dunn's Salamander	*Plethodon dunni*	_	SC
Larch Mountain Salamander	*Plethodon larselli*	FCo	SS
Oregon Spotted Frog	*Rana pretiosa*	FC	SE
Red-Legged Frog	*Rana aurora*	FCo	_
Van Dyke's Salamander	*Plethodon vandykei*	FCo	SC
Western Toad	*Bufo boreas*	FCo	SC
Birds			
American White Pelican	*Pelecanus erythrorhynchos*	_	SE
Bald Eagle	*Haliaeetus leucocephalus*	FCo	SS
Black Tern	*Chlidonias niger*	FCo	_
Black-Backed Woodpecker	*Picoides arcticus*	_	SC

Common name	Scientific name	Federal status[1]	State status[2]
Burrowing Owl	*Athene cunicularia*	FCo	SC
Common Loon	*Gavia immer*	_	SS
Ferruginous Hawk	*Buteo regalis*	FCo	ST
Flammulated Owl	*Otus flammeolus*	_	SC
Golden Eagle	*Aquila chrysaetos*	_	SC
Harlequin Duck	*Histrionicus histrionicus*	FCo	_
Lewis' Woodpecker	*Melanerpes lewis*	_	SC
Loggerhead Shrike	*Lanius ludovicianus*	FCo	SC
Marbled Murrelet	*Brachyramphus marmoratus*	FT	ST
Northern Goshawk	*Accipiter gentilis*	FCo	SC
Olive-Sided Flycatcher	*Contopus borealis*	FCo	_
Pileated Woodpecker	*Dryocopus pileatus*	_	SC
Purple Martin	*Progne subis*	_	SC
Sage Sparrow	*Amphispiza belli*	_	SC
Sage Thrasher	*Oreoscoptes montanus*	_	SC
Sage-Grouse	*Centrocercus urophasianus*	FC	ST
Sandhill Crane	*Grus canadensis*	_	SE
Spotted Owl	*Strix occidentalis*	FT	SE
Vaux's Swift	*Chaetura vauxi*	_	SC
Western Grebe	*Aechmophorus occidentalis*	_	SC
White-Headed Woodpecker	*Picoides albolarvatus*	_	SC
Willow Flycatcher	*Empidonax traillii*	FCo	_
Mammals			
Fisher	Martes pennant	FC	SE
Fringed Myotis	*Myotis thysanodes*	FCo	_
Gray Wolf	*Canis lupus*	FE	SE
Grizzly Bear	*Ursus arctos*	FT	SE
Keen's Myotis	*Myotis evotis*	FCo	_
Long-Legged Myotis	*Myotis volans*	FCo	_
Lynx	*Lynx canadensis*	FT	ST
Merriam's Shrew	*Sorex merriami*	_	SC
Townsend's Big-Eared Bat	*Coryhorhinus townsendii*	FCo	SC
Washington Ground Squirrel	*Spermophilus washingtoni*	FC	SC
Western Gray Squirrel	*Sciurus griseus*	FCo	ST
White-tailed Jackrabbit	*Lepus townsendii*	_	SC
Wolverine	*Gulo gulo*	FCo	SC
Yuma Myotis	*Myotis yumanensis*	FCo	_

Common name	Scientific name	Federal status[1]	State status[2]
Reptiles			
California Mountain Kingsnake	*Lampropeltis zonata*	_	SC
Night Snake	*Sceloporus graciosus*	FCo	SC
Sharptail Snake	*Contia tenuis*	FCo	SC
Striped Whipsnake	*Masticophis taeniatus*	_	SC
Western Pond Turtle	*Clemmys marmorata*	FCo	SE

[1] FE: Federally Endangered, FC: Federal Candidate Species, FT: Federally Threatened, FCo: Federal Species of Concern.
[2] SE: State Endangered, ST: State Threatened, SS: State Sensitive, SC: State Candidate.
Source: YSFWPB 2004.

The Yakima Basin is an important stop in the migratory route for many avian species that traverse the region during the spring and fall migratory period. These species may include warblers, flycatchers, finches, and shorebirds.

Because of the large number of wildlife species and habitats in the area, the Yakima Subbasin Plan assessed specific focal habitats as well as focal species (Table 6-3). Focal habitats were selected based on the amount of decline and sensitivity of the habitat to alteration, and those that were ecologically important for healthy fish and wildlife populations. Focal species were selected because of their status as listed as threatened and endangered at either the federal or state level, their cultural significance, and their value and indicator species.

Table 6-3. Focal wildlife species identified in the Yakima Subbasin Plan.

Common Name	Focal Habitat	Status[1]		Native Species	Priority Habitat Species	Game Species
		Federal	State			
Western Toad	Montane Coniferous Wetlands	SC	C	X	X	
Sandhill Crane			E	X	X	
White-headed Woodpecker	Ponderosa Pine / Oregon White Oak		C	X	X	
Lewis' Woodpecker			C	X	X	
Western Gray Squirrel		SC	T	X	X	
Mule Deer	Interior (Eastside) Grassland			X	X	X
Sage Grouse		C	T	X	X	
Brewer's Sparrow	Shrub Steppe			X		
Yellow Warbler	Eastside (Interior) Riparian Wetland			X		
Mallard				X		X
American Beaver	Numerous Habitats			X		X

[1] C = Candidate, SC = Species of Concern, T = Threatened, E = Endangered.
Source: YSFWPB 2004

6.1.6.3 Vegetation

Vegetation across the Yakima Basin is a diverse mix of forest, grassland, and cropland, typically associated with geological and precipitation patterns. In general, the western third of the basin is forested. Forested areas typically have a mix of species, mostly of grand fir, Douglas fir, lodgepole pine, ponderosa pine, and Western larch. Along the eastern edge of the forested zone where precipitation has decreased, a band of Oregon white oak can be found intermingled with ponderosa pine and Douglas fir.

As precipitation and elevation decrease, forested areas meld into shrub/steppe, which occupies the eastern two-thirds of the basin. Due to conversion to cropland and grazing, only five percent of the historical shrub/steppe habitat has been left in relatively undisturbed condition (YSFWPB 2004). Moderately disturbed shrub-steppe communities, those affected by grazing, invasive plant species, and other disturbances, are fairly common. Approximately 26 percent of the undisturbed shrub-steppe habitat is dominated by native grasses and sagebrush, with a thin groundcover layer of moss and lichen. Damaged habitat still provides cover, food, and nesting habitat for many species of wildlife and is particularly important during winter months when cultivated fields provide no vegetative cover.

6.2 SOCIOECONOMIC CONTEXT

The Yakima Basin lies mainly within Yakima County (population 234,564 in 2008), with smaller sections in Kittitas County (population 38,951 in 2008), and Benton County (population 163,058 in 2008). Yakima County covers 4,296.1 square miles, and in second largest in land area and seventh largest population area in Washington State. The largest community in the basin is the City of Yakima, with a population of 85,040 in 2010.

Private ownership totals 32 percent or over 1.2 million acres of the 4 million acres in the Yakima Subbasin. The single largest landowner is the US government with 1.5 million acres or 38 percent of the land area largely within the Wenatchee National Forest. Other large federal land holdings include the US Army Yakima Training Center, the Hanford Nuclear Reservation, and Bureau of Land Management lands. State, county, and local government ownership totals over 400,000 acres. The Yakama Reservation covers 1,573 square miles (1,371,918 acres) in southern Yakima County and a smaller part of Klickitat County. The Yakama Nation and its members have over 880,000 acres held in trust; only a small portion is deeded land.

Nearly 40 percent of the basin is forested, 40 percent is rangeland, and 15 percent is cropland. The remaining acreage includes other land uses and water bodies. Major land uses include grazing (2,900 square miles), timber harvest (2,200 square miles), irrigated agriculture (1,000 square miles), and urbanization (50 square miles).

The 2,900 square miles of rangelands are primarily used and managed for grazing, military training, wildlife habitat, and tribal cultural activities. The 2,200 square miles of forested areas in the northern and western portions of the basin are primarily used and managed for timber harvest, water quality, fish and wildlife habitat, grazing, tribal cultural activities, and recreation. About one-fourth of the forested area is designated as wilderness. The 1,000 square miles of irrigated agriculture includes pasture, orchards, grapes, hops, and field crops. Diverse recreation activities, including hunting, fishing, and

camping, occur across much of the subbasin. Major urban areas have developed in Yakima and Richland.

The people of the Yakama Nation have lived on the central Washington plateau and along the Columbia River since the beginning of time (www.yakamanation-nsn.gov). The Cascade Mountains and the Yakima River form the eastern and western borders of the Yakama's historic territory. The Yakama people spent the coldest months in villages generally located on the valley floor, where the climate was relatively moderate. This area provided reliable sources of wood and water and protection from the cold winds. Villages were located near waterways where resources could be obtained, including deer, elk, fish, riparian and desert plants, and animal resources. In springtime, tribal people moved across the countryside for fresh food resources. Edible roots were collected as they matured. Some tribal people would remain along rivers to fish, while others followed maturing plans upslope, ending with huckleberry harvest in the fall in the mountains. At that time, food would either be stored or transported back to the winter village to be used until fresh food was available the next spring.

In the Treaty of 1855, the federal government ceded more than 12 million acres of land to the Yakama Nation, with 1,130,000 acres declared reservation land. Fourteen tribes and bands were confederated in the Yakama Nation at the signing of the treaty: Kah-miltpah, Palouse, Klickitat, See-ap-Cat, Klinquit, Sk'in-pah, Li-ay-was, Oche-Chotes, Wenatchapam, Pesquose, Yakama, Shyiks, Kow-was-say-ee, and Wish-ham. Tribal leaders reserved the right to fish, hunt and gather all of the tribe's traditional foods on the reservation as well as the more expansive ceded area. One month after the treaty was signed, the territorial governor declared that all ceded lands were open and available for white settlement.

The Tribe's aboriginal territory was a diverse ecosystem with abundant fish and wildlife that were relied upon by the Yakama people for subsistence and cultural uses. Over the last century, those once abundant resources have declined as the complex ecosystem has been altered. The social and economic benefits of harvesting salmon are significant to Tribal members, as well as to the commercial and recreational fisheries that have evolved. The proposed Chinook and coho programs would contribute substantial numbers of salmon to marine, Columbia River and Yakima River fisheries. The Independent Economic Analysis Board (IEAB 2005) estimated annual income from existing Columbia Basin harvest and production strategies, stating that "economic impact can be significant in some communities with close ties to the fishing industry". Although the IEAB made no estimate of the economic value of ceremonial or substance use, such harvests are of immeasurable cultural importance to the Tribe and the social fabric of the Yakama Nation.

6.3 RELATIONSHIP OF THE FALL CHINOOK AND COHO PROGRAMS TO REGIONAL PLANS AND PROGRAMS

6.3.1 Yakima/Klickitat Fisheries Project

The Yakima/Klickitat Fisheries Project (YKFP) is an adaptive management and research project designed to restore anadromous fish and the habitats that support them in the Yakima and Klickitat subbasins. The stated purpose of the YKFP is to "test the hypothesis that new supplementation techniques can be used in the Yakima River Basin to increase natural production and to improve harvest opportunities, while maintaining the long-term genetic fitness of the wild and native salmonid populations and keeping

adverse ecological interactions within acceptable limits" (BPA 1996). The project was designed as an "all stocks" initiative with initial emphasis on spring Chinook and coho salmon in the Yakima Subbasin.

The YKFP is conducted by fishery managers, biologists and technicians from the Yakama Nation and WDFW. An adaptive management framework guides the planning, implementation, and evaluation of the YKFP. The YKFP is sponsored in large part by the BPA with oversight and guidance from the NPCC.

The YKFP has four biological objectives:

1. **Ecological interactions:** Monitor and evaluate ecological impacts of supplementation on non-target species, and impacts of interacting species on productivity of targeted stocks;

2. **Genetics:** Monitor and evaluate genetic change due to domestication and potential genetic change due to in-basin and out-of-basin stray rates;

3. **Harvest:** Monitor and evaluate changes in harvest of YKFP targeted stocks; and

4. **Natural production:** Determine if supplementation and habitat actions increase natural production. Evaluate changes in natural production with specified statistical power.

The approach outlined for the summer/fall Chinook and coho programs would contribute to meeting a number of these biological objectives. Specifically, the programs would be consistent with the genetic objective by transitioning the current programs to local broodstock. The use of local broodstock may decrease the number of strays out of the basin in the long term. The intent of the three proposed programs include both harvest and conservation elements. Hatchery-produced adults returning to the basin will be available for harvest and hatchery broodstock, and the remainder will be allowed to spawn naturally in the Yakima subbasin. By monitoring these stocks, the proposed plan will be consistent with the harvest and natural production biological objectives of the YKFP.

The YKFP is an integral part of the Yakima Subbasin and Recovery Plans. The strategies presented in this Master Plan are an essential component of the intent and vision of the YKFP. Additional information is contained in NPCC project proposal documents for YKFP projects[9].

6.3.2 Yakima Subbasin Plan

The Yakima Subbasin Plan was part of the NPCC's process to guide the selection of projects funded by BPA for the protection, restoration, and enhancement of fish and wildlife affected by the Federal hydropower system. The plan was submitted to the NPCC in 2004 and further clarified later that year (YSFWPB 2004) before it was adopted into the Fish and Wildlife Program. The supplement identifies the key factors limiting the biological potential of representative ("focal") species, the biological objectives to address each limiting factor, and management strategies to achieve success for each objective. The Yakima Subbasin Plan and Supplement was adopted by NPCC into its Fish and Wildlife Program. The plan's vision for the year 2020 is as follows:

> *Yakima River Basin communities have restored the Yakima River basin sufficiently to support self-sustaining and harvestable populations of indigenous fish and wildlife while*

[9] http://www.cbfish.org/Project.mvc/Display/1988-120-25, http://www.cbfish.org/Project.mvc/Display/1995-063-25 and http://www.cbfish.org/Project.mvc/Display/1997-013-25

> *enhancing the existing customs, cultures, and economies within the basin. Decisions that continuously improve the river basin ecosystem are made in an open and cooperative process that respects different points of view and varied statutory responsibilities, and benefits current and future generations. (YSFWPB 2004).*

Its stated mission is to:

> *Restore sustainable and harvestable populations of salmon, steelhead, and other at-risk species through collaborative, economically sensitive efforts, combined resources, and wise resource management of the Yakima Basin. (YSFWPB 2004).*

The strategies for the summer/fall Chinook program presented in this Master Plan are designed to complement and further both the broad and specific goals stated in the Subbasin Plan. The Subbasin Plan promotes hatchery supplementation for fall Chinook populations with reduced abundance levels, and recommends continued hatchery releases to increase Tribal and sport harvest opportunities. The proposed programs intend to reintroduce the summer component of the summer/fall Chinook life history that has been extirpated in the Yakima Basin. This reintroduction will reestablish traditional harvest opportunities in the Yakima Basin, while rebuilding and spatially and temporally diversifying the natural production of summer/fall Chinook.

The proposed coho program also is consistent with the objectives of the Yakima Subbasin Plan which recommends continued coho reintroduction efforts wherever it is determined that passage, habitat, and potential habitat productivity are sufficient to support viable populations over the long term. The proposed coho program will provide meaningful harvest opportunities, and transitioning to local broodstock that will minimize ecological impacts.

6.3.3 Yakima River Salmon Recovery Plan

The Yakima Basin Fish & Wildlife Recovery Board developed these plans to guide salmon and steelhead recovery efforts in the Yakima Basin. The Board is a locally based organization governed by representatives of Yakima, Benton, and Kittitas counties, the Yakama Nation, and cities in the basin. The Board's mission is "to restore sustainable and harvestable populations of salmon, steelhead, bull trout, and other at-risk fish and wildlife species through the collaborative, economically sensitive efforts, combined resources, and wise resource management of the Yakima River Basin." It is recognized by the State of Washington as one of the regional organizations at the heart of the state's salmon recovery efforts.

The Board and its partners followed guidance from NOAA Fisheries, WDFW and the Washington Governor's Salmon Recovery Office in developing this plan. Local planners also provided information and feedback to the Interior Columbia Technical Recovery Team (ICTRT) that NOAA Fisheries convened to develop science-based assessments of the status of steelhead populations.

The salmon and steelhead recovery plans were built on the belief that healthy salmon and steelhead populations can be rebuilt in a manner that coexists with vibrant human communities and the local economies that support them. The plans emphasize that salmon and steelhead recovery should build on existing fish and wildlife recovery programs and should rely on voluntary, non-regulatory approaches to habitat improvement. While the plan focuses on recovery efforts in the Yakima Basin, it

acknowledges the need for ongoing recovery actions in the Columbia River, its estuary, and the Pacific Ocean.

Recovery of Chinook and coho in the Yakima Basin will not occur in a vacuum. Strategies in the Yakima Subbasin Salmon Recovery Plan are expected to complement goals stated in this Master Plan. Implementation of the measures proposed in the plan, including improving flow conditions and restoring habitat quality and quantity, will also benefit coho salmon. Additionally, the Plan identifies restoring allied populations and species as one of the recommended subbasin actions.

6.3.4 Wy-Kan-Ush-Mi Wa-Kish-Wit

Wy-Kan-Ush-Mi Wa-Kish-Wit is the Columbia River Anadromous Fish Restoration Plan of the Nez Perce, Umatilla, Warm Springs and Yakama Tribes that provides a framework to restore the Columbia River salmon stocks. This tribal salmon restoration plan outlines the cultural, biological, legal, institution and economic context within which the region's salmon restoration efforts are taking place. The long-term plan addresses virtually all causes of salmon decline and roadblocks to salmon restoration for all anadromous fish stocks.

Wy-Kan-Ush-Mi Wa-Kish-Wit has four goals:

- Restore anadromous fishes to the rivers and streams that support the historical cultural and economic practices of the tribes.
- Emphasize strategies that rely on natural production and healthy river systems to achieve this goal.
- Protect tribal sovereignty and treaty rights.
- Reclaim the anadromous fish resource and the environment on which it depends for future generations.

The Wy-Kan-Ush-Mi Wa-Kish-Wit Plan provides recommended actions for the Yakima River system. These actions include restoring riparian areas, proving smolt flushing flows and summer and winter rearing flows though storage releases, retaining woody debris, restoring riparian vegetation, eliminate or restrict logging, grazing and riparian development, constructing passage facilities on tributary irrigation diversions, implementing water conservation programs to reduce silt and pesticides, providing instream flows, and implementing new broodstock programs, release programs, and production programs for anadromous salmonids and lamprey. The plan developed an adult return goal of 12,000 summer Chinook, 4,700 fall Chinook, and 5,000 coho.

The proposed summer/fall Chinook and coho production programs fulfill the recommended action of implementing new broodstock programs for Chinook and coho, and are one of the steps toward meeting the adult return goals presented in the Wy-Kan-Ush-Mi Wa-Kish-Wit Plan.

6.3.5 FCRPS Biological Opinion and 2008 Yakama Nation Columbia Basin Fish Accords

The proposed Prosser, Marion Drain and Holmes Ranch programs will be consistent with the 2008 Columbia Basin Fish Accords, Memorandum of Agreement between the Yakama Nation and other Lower Columbia River treaty tribes and the FCRPS Action Agencies (BPA, USACE and USBR 2008). Specifically,

the Accords state that over a ten year period, BPA and the other action agencies will make funds available for projects that benefit fisheries affected by the FCRPS. The focus is on habitat and artificial production initiatives that benefit ESA-listed populations and other target resident fish species. The Accords target improvements to existing hatchery facilities such as proposed in this Master Plan at Marion Drain and Prosser as well as measures to restore coho. In addition, under the Accords, the Yakama Nation is improving tributary habitat where Chinook spawn and rear. A new coho production facility is specifically identified in the Accords to distribute hatchery production to reaches of the upper Yakima system to increase adult returns to underutilized areas.

Several conditions are associated with this funding: (1) biological benefits are to be confirmed by experts; (2) NOAA must determine that the hatchery programs will not impede recovery; and (3) all necessary permits must be obtained for hatchery construction and operation. This Master Plan will seek to confirm conditions (1) and (2).

6.4 RELATIONSHIP OF PROGRAMS WITHIN THE LOCAL AND REGIONAL HABITAT MANAGEMENT CONTEXT

6.4.1 Fish Management and Recovery

Yakima summer/fall Chinook and coho populations are not listed in the Endangered Species Act and therefore, recovery goals have not been established. Currently, neither population is capable of self-sustaining without hatchery releases. In their 2009 review of Columbia River, the HSRG provided recommendations that would benefit both salmon populations.

For Yakima summer/fall Chinook, the HSRG (2009) recommended developing the capability to collect local broodstock and mark all juveniles. As described in this Master Plan, fall Chinook from out of basin will no longer be used as broodstock. The program will transition to adults collected locally at Prosser Dam and adults transferred to the Prosser Hatchery from Priest Rapids Hatchery (an in-basin stock). Also, all juveniles will be marked with an adipose fin clip, a CWT, or both. Following the HSRG recommendations will increase the likelihood of meeting harvest and conservation goals, make it possible to identify and manage the origin of broodstock, and to monitor the natural-origin population.

HSRG recommendations for Yakima coho include developing local broodstocks within the basin for both conservation and harvest programs, and developing in-basin facilities for incubation and rearing. The facility improvements and program modifications included in the proposed program will meet both of these recommendations. Once the Master Plan is approved, the Prosser Hatchery and Marion Drain Hatchery will be retrofitted to accommodate the new fall Chinook and coho programs, and a new hatchery will be developed at Holmes Ranch. The proposed program will also follow the HSRG's recommended coho marking strategy: conservation fish will be marked with a CWT but not adipose fin-clipped to relieve fishing pressure on the population and to distinguish it from the natural population. Fish from the segregated program will be 100 percent adipose clipped, with a portion receiving a CWT to maximize harvest so that broodstock separation can be achieved and straying into the natural population can be evaluated.

6.4.2 Habitat

The Yakima River Basin encompasses over 6,100 square miles, bordered on the west by the crest of the Cascade Mountains, on the north by the Wenatchee Mountains, on the east by the breaks of the Columbia River, and on the south by the Simcoe Mountains and the Horse Heaven Hills. A multitude of landforms exist in the basin. The glaciated Cascade Mountains have peaks exceeding 8,000 feet and deep valleys. Moving east and south from the crest of the Cascades, elevation decreases, opening onto the broad valleys and lowlands of the Columbia Plateau. The lowest elevation in the basin is 340 feet at the confluence of the Yakima and Columbia rivers at Richland.

As described in Section 6.1.2, precipitation is highly variable across the basin, ranging from approximately 7 inches per year in the eastern portion to over 140 inches per year along the western border near the crest of the Cascades. Total runoff averages approximately 3.4 million acre/feet per year, ranging from a low of 1.5 to a high of 5.6 million acre/feet.

The basin contains a variety of aquatic habitats associated with the mainstem of the Yakima River and its primary tributaries, the upper Yakima, Cle Elum, and Naches rivers as well as by many smaller tributaries such as the Little Naches River, Satus, Ahtanum, and Taneum creeks.

Private ownership totals 32 percent or over 1.2 million acres of the 4 million acres in the Yakima Basin. The single largest landowner is the U.S government with 1.5 million acres or 38 percent of the land area. Most of the federal land is within the Wenatchee National Forest. Other large federal land holding include the U.S. Army Yakima Training Center, the Hanford Nuclear Reservation, and Bureau of Land Management lands (BLM). Other public ownership (state, county, and local governments) totals over 400,000 acres. The Yakama Nation's Reservation covers 1,573 square miles (1,371,918 acres) in southern Yakima County and a smaller part of Klickitat County. The Yakama Nation and its members have over 880,000 acres held in trust; only a small portion is deeded land.

Nearly 40 percent of the basin is forested, another 40 percent is rangeland, 15 percent cropland, and the remaining acreage includes other land uses and water bodies. The predominant land uses in the Basin are grazing (2,900 square miles), timber harvesting (2,200 square miles), irrigated agriculture (1,000 square miles), and urbanization (50 square miles).

The 2,900 square miles of rangelands are primarily used and managed for grazing, military training, wildlife habitat, and tribal cultural activities. The 2,200 square miles of forested areas in the northern and western portions of the basin are primarily managed for timber harvest, water quality, fish and wildlife habitat, grazing, tribal cultural activities, and recreation. About one-fourth of the forested area is designated as wilderness. The 1,000 square miles of irrigated agriculture includes pasture, orchards, grapes, hops, and field crops. Diverse recreational activities such as hunting, fishing, and camping, occur across much of the basin. Major urban areas include the cities of Yakima and Richland.

The Yakima River originates at the outlet of Lake Keechelus and flows for 214 miles in a southeasterly direction to its confluence with the Columbia River at Richland (Figure 4-4). With its tributaries, the Yakima River drains about 6,150 square miles or 4 million acres. The headwaters originate in the high Cascade Mountains, with numerous tributaries draining subalpine regions within the Snoqualmie National Forest and the Alpine Lakes, Norse Peak, and William O. Douglas Wilderness areas. Major tributaries include the Kachess, Cle Elum and Teanaway rivers in the northern part of the subbasin. The Swauk, Taneum, Umtanum, Manastash, and Wenas creeks drain into the upper and middle Yakima

River. The Naches River in the west is formed by the confluence of the Bumping and Little Naches rivers at RM 44.6. Tributaries of the Naches include the Tieton River and Rattlesnake and Cowiche creeks. Ahtanum, Toppenish, and Satus creeks join the Yakima in the lower subbasin from the west.

Six major reservoirs are located in the basin and form the storage component of the federal Yakima Project, managed by the USBR: Keechelus Lake (157,800 acre feet); Kachess Lake (239,000 acre feet); Cle Elum Lake (436,900 acre feet); Rimrock Lake (198,000 acre feet); Bumping Lake (33,700 acre feet); and Clear Lake (5,300 acre feet). Total storage capacity of all reservoirs is approximately 1.07 million acre/feet. With the exception of Rimrock and Clear Lake, all reservoirs were natural lakes prior to the construction of dams near their respective outlets. The non-federal Wenas Dam, located on Wenas Creek, stores irrigation water for use in the lower Wenas Valley. The construction and operation of irrigation reservoirs altered the natural seasonal hydrograph of all downstream reaches (Eitemiller et al. 2000).

The Washington Department of Ecology (WDOE) placed 72 stream and river segments throughout the Yakima Basin on the 303(d) list of threatened and impaired water bodies (DOE 1996, candidate list for 1998, Federal Clean Water Act 1977). Of these segments, 83 percent were cited as exceeding temperature standards. Specifically, temperatures exceeded 70°F in the Yakima River and tributaries from the Columbia River confluence to the Cle Elum River, and 61°F in the upper Yakima, American, and Bumping rivers.

A summary of existing habitat limiting factors in the basin (by reach) from the Yakima River Subbasin Plan (YSFWPB 2004) is summarized Table 6-4. Additional detail regarding the Yakima Basin's geography, topography, hydrology, habitat, and land use is available in Chapter 1 of the Yakima Subbasin Plan (YSFWPB 2004).

Table 6-4. Aquatic habitat limiting factors in the Yakima River Basin.

Floodplain Habitat	The loss of floodplain habitat, especially side channels and springs adjacent to the mainstem Naches and Yakima rivers, is a significant limiting factor for the productivity of aquatic habitat in the subbasin. Actions recommended in the Yakima Subbasin Plan to reverse this habitat loss are to relocate infrastructure (where possible) to allow natural processes to operate and to reconnect side channels by removing obstructions.
Riparian Habitat	Riparian zone degradation includes a lack of shade and large woody debris (LWD), bank instability, and the inability of black cottonwood to reproduce under existing flow regimes. The Yakima Subbasin Plan calls for restoration of riparian zones and reduction of chronic bed instability through revegetation, introduction of LWD, protection of riparian areas by purchase or easement, improved riparian area management, and restoration of natural flow regimes.
Channel Confinement	Channel confinement by levees, bridges and roads alters floodplain functions and causes habitat loss. Multi-jurisdictional floodplain restoration and flood hazard reduction projects are necessary to reconnect floodplain side channels and to restore "unmanaged" or natural floodplain habitats.
Flow Regime	The presence of reservoirs in the system has reduced peak flows and may have either increased or decreased energy available for sediment transport. Altered flows and changes in the sediment transport and water temperature regimes (mostly summer increases) severely reduce the quantity and quality of aquatic habitats.

Predation	There is a high predation risk for juvenile salmonids in the Basin. To reduce the effect of elevated predation, the Subbasin Plan recommends increasing the number of spawning fish, reducing populations of smallmouth bass in the lower Yakima River, improving cover and off-channel habitats, and implementing further control on predator populations in mainstem reservoirs.
Fish Passage	Passage barriers and unscreened diversions and pumps have significant negative effects on salmon productivity. Related objectives of the plan are to improve passage and design of irrigation diversions to allow fish and sediment to pass through diversion points.

6.4.3 Hatchery Programs

As described in Section 6.3.1, the Yakima-Klickitat Fisheries Project is co-managed by the Yakama Nation and the WDFW. The project includes collection of salmonid broodstock, incubation of eggs and rearing of fry in hatcheries, the acclimation and release of smolts, and related ecological studies of natural production. Currently, there are five primary hatchery facilities operating in the basin producing Chinook, and coho, and reconditioning steelhead kelts. Each of these facilities is described below.

6.4.3.1 Prosser Hatchery

Prosser Hatchery is located on the left bank of the Yakima River at RM 46.8. Currently, Prosser is used to incubate, rear, and hold Yakima fall Chinook as well as coho and to recondition hatchery steelhead kelts. In the past, coho were received from the Little White Salmon/Willard NFH Complex but this program was discontinued due to funding cuts. Currently out-of-basin coho salmon come from Washougal Hatchery and the Eagle Creek NFH.

Existing facilities at Prosser are described in Section 4.4.2; how they would be modified is described in Section 4.4.3 and 5.5.3. The intent of the facility and program modifications is to increase production of URB fall Chinook, the late component of Yakima summer/fall Chinook and Yakima coho and to make changes needed to improve fish health and disease containment.

The Prosser Hatchery kelt reconditioning program is the only steelhead artificial production program in the basin. It will be unaffected by the proposed facility modification. The Yakima Basin Steelhead Reconditioning Project HGMP (2005) summarized the program as follows. Steelhead kelts are collected at the Chandler smolt trap at Prosser Dam (RM 47) and subjected to short- and long-term reconditioning and release. Because Prosser Dam is downstream of all four steelhead populations, the kelts collected and reconditioned presumably represent a sample of all of the stocks in the basin. Under long-term reconditioning, kelts are captured at the Chandler smolt trap between March and June, reconditioned on-site for 6 to 8 months, and released back into the Yakima River at Prosser Dam the following December.

6.4.3.2 Marion Drain Hatchery

The Marion Drain Hatchery is a part of the Yakima/Klickitat Fisheries Project and operates under the Lower Yakima River Supplementation and Research Project. One of the goals of the current project is to increase the number of Marion Drain fall Chinook through supplementation. Artificial production programs using naturally-spawned Yakima fish as broodstock began in 1997, both at Marion Drain and

at the Prosser Hatchery. The Marion Drain program is an integrated program that uses a fish wheel to collect broodstock approximately 6.7 miles inside Marion Drain. Any un-clipped fish collected are assumed to be of Marion Drain stock (HSRG 2009).

Under this Master Plan, the facilities and program at Marion Drain would be upgraded to support expanded production of the early component of locally-adapted Yakima summer/fall Chinook.

6.4.3.3 Cle Elum Supplementation and Research Facility

The YKFP began a spring Chinook (*O. tshawytscha*) salmon hatchery program at the Cle Elum Supplementation Research Facility (CESRF) near Cle Elum on the upper Yakima River (river mile 184.7, measuring from the confluence with the Columbia River) in 1997. The CESRF has multiple goals including harvest augmentation, mitigation, restoration, research, and education/outreach. This program is a supplementation effort targeting the upper Yakima River spring Chinook population and is designed to test whether artificial propagation can be used to increase natural production and harvest opportunities while limiting ecological and genetic impacts (RASP 1992). It is an integrated hatchery program (Mobrand et al. 2005) because only natural-origin broodstock are used and returning hatchery-origin adults are allowed to spawn in the wild. The program employs "best practice" hatchery management principles (see Cuenco et al. 1993, Mobrand et al. 2005) including reduced pond densities, strict disease management protocols, random broodstock selection, and factorial mating (Busack and Knudsen 2007) to maximize effective population size. Fish are reared at the central facility, but released from three acclimation sites located near the central facility at: Easton, approximately 15.5 miles upstream of the central facility; Clark Flat, about 15 miles downstream of the central facility; and Jack Creek, about 7 miles upstream from the Teanaway River's confluence with the Yakima River. The CESRF collected its first spring Chinook broodstock in 1997, released its first fish in 1999, and age-4 adults have been returning since 2001. The first generation of offspring of CESRF and wild fish spawning in the wild returned as adults in 2005. The program uses the adjacent, un-supplemented Naches River population as an environmental and wild control system.

6.4.4 Hydropower

Three small federal hydroelectric projects are located on the Yakima and Naches rivers: the Roza and Chandler power plants and the Naches Drop project on Wapato Canal. Roza Powerplant is on Roza Canal northeast of the City of Yakima (Figure 2-1). Water is diverted into the canal at Roza Dam (RM 127.9) about 10 miles north of the city and returns to the river below the power plant (RM 113.3). The power plant has an 11,250 kilowatt (kW) capacity. Chandler Powerplant (RM 35.8) diverts water from the Chandler Power Canal which has a capacity of 1,500 cfs. Flows are diverted at Prosser Dam (RM 47.1) and conveyed across the Yakima River into the Kennewick Main Canal for irrigation purposes. The residual capacity remaining from irrigation needs, including when the pumps are not run for irrigation, is used for power production. Wapato Power Plant is located on the Naches River (RM 9.7) has been purchased by the Bureau of Reclamation for the purpose of returning up to 450 cfs previously used for power generation to instream flows in the Naches River.

In addition to the above hydroelectric projects, the Bureau of Reclamation owns and operates six reservoirs (Bumping, Rimrock, Kachess, Keechelus, and Cle Elum) located in the headwaters of the Yakima Basin as part of the Yakima Reclamation Project, with a combined storage capacity of 1.07 million acre/feet. These reservoirs exert a fundamental influence on the floodplains and riparian zones downstream. In general, flows are lower in the fall, winter, and spring, and higher in the summer and

early fall than they would be without the reservoirs. Most importantly, the reservoirs significantly reduce flood flows during flood events (YSFWPB 2004).

One of the most significant factors contributing to the abundance of anadromous salmonids in the Yakima River Basin is the number of dams in the mainstem Columbia River that smolts and returning adults must pass to complete their life cycle. The construction of Bonneville (1938), The Dalles (1957), John Day (1968), and McNary (1953) dams all reduced the number of adults returning to the Yakima Basin and the number of smolts successfully migrating to the ocean. Since the completion of the federal hydropower system, the Corps of Engineers constructed fish passage facilities at all dams, which has increased both upstream and downstream passage survival (NOAA Fisheries 2008). The Biological Opinion (NOAA 2008) for the FCRPS identified operational trade-offs with survival improvements and also noted that mortality rates vary by facility. The BiOp includes potential biological triggers for conservation measures if listed populations fail to reach benchmark levels. System improvements will continue over time, but it is uncertain how successful they may be in continuing to reduce dam-related mortality on Chinook, coho and steelhead. The proposed hatchery programs will help mitigate dam effects on populations by increasing the number of juvenile fish leaving the system. It should be noted that one of the YKFP's primary objectives is to increase knowledge about hatchery supplementation to resource managers and scientists throughout the Columbia River Basin, to determine if it may be used to mitigate effects of hydroelectric operations on anadromous fisheries.

6.4.5 Harvest

6.4.5.1 Yakima River URB Fall Chinook and Yakima Summer/Fall Chinook

The primary purpose of the proposed URB harvest program below Prosser and the summer/fall Chinook program above Prosser is harvest augmentation, reestablishing traditional harvest opportunities in the Yakima Basin. The proposed program is sized to consistently meet or exceed treaty harvest obligations on a sustainable basis, and to maintain or increase recreational fisheries consistent with US vs. Oregon agreements.

The total number of URB fall Chinook returning to the basin has averaged about 5,000 adults (hatchery and natural origin) from 2001 - 2010 (Table 2-1)[10]. Recreational fishers harvest about 16 percent of the annual Chinook returns to the basin each year. Because of the quantity and relatively higher quality of summer and fall Chinook available to tribal fishers in Zone 6 Columbia River fisheries, historical Yakima River Tribal harvest is typically less than 2 percent of the total run each year. Releasing hatchery URB fall Chinook juveniles at RM 10 is expected to improve fish quality and increase in-river tribal fishing effort and success substantially.

This program will contribute URB fall Chinook and Yakima summer/fall Chinook salmon to fisheries in the Pacific Ocean and Columbia River before the adults return to the Yakima River (Table 6-5). Modeling the proposed program using the All-H Analyzer indicates that in the long term, all fisheries could harvest an average of 18,000 Chinook, while terminal and Zone 6 harvest rates could average about 5,000 fall Chinook. The interim goal for Yakima URB and summer/fall Chinook is a sustainable harvest of more than 6,000 fall Chinook in all fisheries. Terminal and Zone 6 harvest is estimated to be 1,800 adults by Yakama Nation biologists.

[10] Because hatchery fish are not 100% marked, it has not been possible to determine the proportion of the run that is of natural origin.

Table 6-5. Estimated long-term harvest rates of hatchery-origin Yakima summer and fall Chinook salmon under the proposed programs.

Fishery	Below Prosser URB	Above Prosser Yakima Summer/Fall Chinook	
	URB Fall- Run	Summer Component	Fall Component
Ocean Harvest Rate	35%	43%	35%
Lower Columbia Harvest Rate	8%	9%	8%
Upper Columbia Harvest Rate	16%	30%	16%
Terminal Harvest Rate	11%	11%	11%

State recreational fishery regulations for the Yakima River vary from year to year and by river location, but generally require that all salmon caught with an intact adipose fin must be released. Typically, the Yakima River regulation states:

> "The lower Yakima River, from the Highway 240 bridge upstream to 400 feet below Prosser Dam, is generally open to sport fishing from late September through October. Fishing is allowed according to regulations promulgated annually by WDFW. "

Tribal fisheries are regulated using traditional time, area, and gear restrictions. Yakima River tribal harvest is typically at or near zero due to the general preference of tribal fishers to fish in Zone 6 Columbia River fall season fisheries. Fall Chinook typically are numerous and relatively higher quality at this location. Tribal harvest will be monitored by sampling fisheries below Bonneville Dam and at Cascade Locks, The Dalles Dam, John Day Dam, and McNary Dam on the mainstem Columbia River. Tribal fisheries in the Yakima River will also be sampled.

Tribal harvest will be subject to a hatchery broodstock objective of 300 adults and a minimum natural escapement objective of 5,000 adult during the transition period and 10,000 adults in the long term. The long-term harvest goal for the Chinook program is an average annual harvest of 18,000 Chinook salmon in all fisheries, of which 5,000 adults would be harvested in Zone 6 and terminal fisheries.

6.4.5.2 Yakima River Coho

One of the goals of the proposed coho program is to reestablish traditional harvest opportunities for coho in the Yakima Basin. Because hatchery fish provide most of the harvestable fish throughout the Columbia River system, the proposed program is structured to balance potential hatchery impacts to the species with the harvest benefits they provide. This program will contribute coho salmon to fisheries in the Pacific Ocean and Columbia River before the adults return to the Yakima River (Table 6-6). Modeling the proposed program using the All-H Analyzer indicates these pre-terminal ocean and freshwater fisheries should harvest an average of 20,000 coho, while Zone 6 and Yakima River harvest by the Yakama Nation could average about 8,000 coho. Terminal sport harvest is considered negligible by Yakama Nation biologists.

Table 6-6. Estimated harvest rates of Yakima River coho salmon under the proposed integrated and segregated programs.

Fishery	Integrated Program	Segregated Program
Phase 3		
Ocean Harvest Rate	8%	33%
Lower Columbia Harvest Rate	8%	29%
Upper Columbia Harvest Rate	10%	10%
Terminal Harvest Rate	10%	10%
Phase 4		
Ocean Harvest Rate	8%	33%
Lower Columbia Harvest Rate	8%	29%
Upper Columbia Harvest Rate	10%	10%
Terminal Harvest Rate	10%	10%

The State of Washington is expected to continue mark-selective harvest practices for coho in marine and most recreational fisheries in the Columbia River below McNary Dam. Above McNary Dam where relatively minor harvest levels occur, state recreational fisheries may not be mark-selective. Tribal fisheries will be regulated using traditional time, area, and gear restrictions. The Yakama Nation may encourage release of unmarked fish.

Tribal subsistence fisheries occur throughout the Columbia and Yakima rivers. Tribal harvest is monitored by sampling fisheries below Bonneville Dam and at Cascade Locks, The Dalles Dam, John Day Dam, and McNary Dam on the mainstem Columbia River. Tribal fisheries in the Yakima River are also sampled.

The Tribal harvest objective is to provide an average of more than 20,000 coho annually for ocean and freshwater fisheries, with at least 40 percent available for harvest in Zone 6 and the Yakima River Basin. The long-term adult coho minimum escapement target is 3,500 natural-origin coho.

6.4.6 Climate Change

The following discussion of climate change in the Columbia River Basin is largely adapted from Climate Change Impacts on Columbia River Basin Fish and Wildlife (ISAB 2007).

Warming of the global climate is unequivocal. Evidence includes increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global mean sea level. Eleven of twelve years (1995 -2006) rank among the 12 warmest years since 1850. The linear warming trend over the last 50 years (0.13 +/- 0.03°C per decade) is nearly twice that for the last 100 years.

Climate records show that the Pacific Northwest has warmed about 1.0 °C since 1900, or about 50 percent more than the global average warming over the same period. The warming rate for the Pacific Northwest over the next century is projected to be in the range of 0.1-0.6˚C/decade. Projected precipitation changes for the region are relatively modest and unlikely to be distinguishable from natural variability until late in the 21st century. Most models project long-term increases in winter precipitation and decreases in summer precipitation.

Mantua et al. (2010) evaluated the effects of these changes on the freshwater habitat for salmonid populations in Washington. Hydrology in the Yakima River watershed is affected by a mixture of direct runoff from fall rains and spring snowmelt, and is the type of watershed Mantua et al. predict will be most affected by climate change. Likely effects to fisheries are predicted to be:

- Increased air temperatures would increase water temperatures
- Elevated water temperatures would increase thermal barriers to migration
- Increased winter flooding would reduce egg-to-fry survival rates in streams
- Reduced spring snowmelt and summer/fall flows would affect migrating salmonids
- Pre-spawn mortality of summer run salmonids would increase due to reduced flows and elevated water temperatures

Several projections of the potential impact of climate change on cool and cold water fishes have been completed. One of these analyses suggests that temperature increases alone will render 2 to 7 percent of current trout habitat in the Pacific Northwest unsuitable by 2030, 5 to 20 percent by 2060, and 8 to 33 percent by 2090. Salmon habitat may be more severely affected, in part because these fishes can only occupy areas below barriers and are thus restricted to lower and warmer elevations within the region. Salmon habitat loss would be most severe in Oregon and Idaho, potentially exceeding 40 percent by 2090. Loss of salmon habitat in Washington would be less severe, with the worst case predicted to be about 22 percent by 2090. These estimates do not consider the associated impact of changing hydrology.

Increased frequency and severity of flood flows during winter can affect over-wintering juvenile fish and incubating eggs in the streambed. Eggs of fall and winter spawning fish, including Chinook, coho, chum, and sockeye salmon and bull trout, may suffer higher levels of mortality when exposed to increased flood flows. Warmer winter water temperatures also could accelerate embryo development and cause premature emergence of fry. Bull trout require very cold, headwater streams for spawning; therefore, a warming climate may disproportionately impact this species. Recent projections of the loss of habitat suitable for bull trout in the Columbia Basin as a result of climate warming range from 22 to 92 percent.

Changes in mainstem flows due to hydropower operations are substantially greater than the natural runoff changes projected to be caused by climate warming in the 21st century; however, water temperature increases in the mainstem may affect Columbia River salmon in several ways. Water temperature increases will accelerate the rate of fall Chinook egg development (mainstem spawners), and lead to earlier emergence at a smaller average size than historically. Smaller sized fry are likely to have lower survival due to increased vulnerability to predators.

Changes in freshwater flow into the Columbia River estuary caused by climate change will be less than those caused by the hydropower system. Nonetheless, some changes in estuary habitats may occur.

Scientific evidence also strongly suggests that global climate change is already altering marine ecosystems from the tropics to polar seas. Physical changes associated with warming include increases in ocean temperature, increased stratification of the water column, and changes in the intensity and timing of coastal upwelling. These changes will alter primary and secondary productivity, the structure of marine communities, and, in turn, the growth, productivity, survival, and migrations of salmonids. Changing ocean temperatures may also alter salmon behavior, distribution, and migrations, increasing the distance to migrations from their home streams to ocean feeding areas. If salmon migrate farther to

the north and/or food is less available, longer times may be required to reach maturity, delaying the usual times of adult migrations into coastal water and rivers.

As climate and streams warm, tributary habitats will become increasingly important because they usually provide the cool waters for salmonids and other cool-water species in a watershed. Ongoing habitat restoration efforts in the Yakima River and its tributaries are consistent with tributary habitat restoration measures recommended in ISAB (2007) and may help to offset some of the local negative effects of future climate change. Habitat improvement projects in the system may improve the natural river channel characteristics, floodplain function, hydraulic and sediment regimes, and habitat connectivity. Restoring Yakima tributaries to more natural conditions will create a healthy, functioning riparian community providing numerous benefits to fish and wildlife (including reduced water temperatures and improved habitat connectivity). Expected outcomes would benefit salmonids through a healthy, functioning floodplain and riparian community, an increase in spawning and rearing habitat for salmonids, an increase in instream habitat diversity, and upslope stabilization.

6.4.7 Population Growth

The following discussion of population growth in the Columbia River Basin is adapted from Human Population Impacts on Columbia River Basin Fish and Wildlife (ISAB 2007b).

Population is growing in the Columbia River Basin, increasing in all four Basin states and the Province of British Columbia. Regional population growth is projected to continue at least through 2030, although the rate of growth is expected to stabilize or decline. Some rural areas are experiencing rapid population growth, especially those with recreational and scenic amenities

Population density has also changed significantly in the past several decades. The highest densities of people in the Columbia River Basin live west of the Cascade Mountains along the I-5 corridor, a pattern that persisted from 1970-2000. In this same period, population density increased in and around the major urban areas in the basin (Portland–Vancouver, Spokane and Boise). Even more significant to fish and wildlife have been the increases in population densities in central Oregon (Bend–Redmond area) and central Washington (Yakima-Kennewick-Pasco-Richland area).

Population growth increases demand for land, water, and hydroelectricity which in turn generates greater pressure on fish and wildlife. Human development requires water for residential, irrigation, waste water assimilation, recreational, commercial, and industrial uses. Continued population growth will increase demand for these uses and heighten competition for limited water supplies. The effect of increasing water demand will be exacerbated by the effect of climate change on the quantity and temperature of summer stream flows in many subbasins. Limited controls over groundwater leave it vulnerable to intensified use.

Freshwater withdrawals for domestic and public uses are projected to increase by 71 to 85 percent by 2050. In the Canadian portion of the Okanagan Basin, per-capita water use is among the highest in Canada. Freshwater withdrawals for irrigation are projected to decline but will be more than offset by increases in withdrawals for public, domestic, industrial, and commercial uses. These increases will have significant implications for instream flow and for maintenance of riparian and aquatic habitats for fish and wildlife.

Urban development causes marked changes in the physical, chemical, and ecological characteristics of stream ecosystems. In most cases, these changes are detrimental to native aquatic biota, including salmonids. Exurban development (low density, semi-rural residential) has been the dominant settlement trend in the West since 1970, with a high proportion of homes built in areas of productive soils and proximity to water. The rate of exurban development appears to be increasing. This type of development tends to result in degraded habitat for fish and wildlife through direct habitat conversion and loss, alteration of habitat near roads and buildings, and fragmentation of habitats and landscapes. Exurban development has led to decreased species diversity, decreased abundance and local extirpation of some species, as well as increased conflict between wildlife and people.

7.0 ENVIRONMENTAL COMPLIANCE COMMON TO BOTH PROGRAMS

Under the NPCC step review process for aquaculture facilities, project proponents are asked to describe the status of their comprehensive environmental assessment. Upon approval of this Step 1 Master Plan, the Yakama Nation/BPA will initiate preparation of a detailed environmental assessment that meets the criteria of the National Environmental Policy Act (NEPA). This assessment will provide a foundation for compliance with a number of other environmental and regulatory requirements. This chapter provides an overview of the most significant environmental compliance steps to be undertaken during Step 2 of the program.

7.1 NATIONAL ENVIRONMENTAL POLICY ACT

The National Environmental Policy Act (NEPA) of 1969, as amended (42 USC 4321 et seq.), requires federal agencies to assess and disclose the effects of a proposed action on the environment prior to funding, approving, or implementing an action.

This program is a component of a broad suite of studies, research and artificial production ongoing in the Yakima River Basin. BPA analyzed the environmental impacts of research and supplementation projects in an Environmental Impact Statement (EIS) completed in 1996 (USDOE/BPA 1996). This EIS addressed the impacts of construction, operation and maintenance of anadromous fish production facilities. Several supplemental analyses have been performed in subsequent years to address specific implementation measures associated with upgrades and modifications to the Yakima Klickitat Fisheries Project Chinook and coho facilities at Prosser and Marion Drain hatcheries: DOE/EIS-0169-SA-01, completed in May 1999; DOE/EIS 0169-SA-02, completed in August 1999; DOE/EIS 0169-SA-03, completed in 2000; and DOE/EIS 0169-SA-04, completed in 2000.

One or more Environmental Assessments or Supplemental Analyses that assess the environmental consequences of implementing the Yakima URB fall Chinook, summer/fall Chinook and coho hatchery programs will be prepared to address NEPA requirements. This process will include public outreach to assist the Tribe and BPA in identifying key issues that should be addressed in the environmental analysis.

7.2 ENDANGERED SPECIES ACT

The Endangered Species Act of 1973, as amended (16 U.S.C. § 1531 et seq.) requires that federal agencies ensure that actions they authorize, fund or conduct are not likely to jeopardize the continued existence of any ESA proposed or listed species or their designated critical habitat. Neither Yakima River coho or fall Chinook are listed species; however, the effect of the proposed programs on species that are listed will be evaluated.

7.2.1 Biological Opinion

Section 7 of the ESA directs federal departments and agencies to ensure that actions authorized, funded, and/or conducted by them are not likely to jeopardize the continued existence of any federally proposed or listed species, or result in destruction or adverse modification of critical habitat for such species. Section 7(c) requires that federal agencies contact the USFWS and/or the National Marine Fisheries Service (NMFS) (the Services) before beginning any construction activity to determine if federally listed threatened and endangered species or designated critical habitat may be present in the vicinity of a proposed project. A Biological Evaluation/Assessment (BE/BA) must be prepared if actions by a federal agency or permits issued by a federal agency will result in construction (i.e., actual action on the ground) and if the Services determine that threatened and endangered species may occur in the vicinity of a proposed project. The Services use this document as the basis of a Biological Opinion that will outline criteria to ensure the project does not further jeopardize an endangered species. The Yakama Nation will prepare a BA that addresses the potential effects of the aquaculture programs on listed aquatic and terrestrial species.

7.3 CLEAN WATER ACT

Consistency of project construction and operation will be demonstrated with Section 401 of the Federal Water Pollution Control Act (Clean Water Act). The authority to review the programs for consistency with Section 401 is the responsibility of the Washington Department of Ecology.

7.4 NATIONAL HISTORIC PRESERVATION ACT

Funding this project is considered an undertaking within Section 106 of the National Historic Preservation Act of 1966, as amended (P.L.89-665, 16 U.S.C. 470). Section 106 requires that every federal agency take into account how each of its undertakings could affect historic properties. Historic properties are districts, sites, structures and traditional cultural places that are eligible for inclusion on the National Register of Historic Places. The Yakama Nation will take all necessary steps to evaluate potential effects on listed properties.

7.5 STATE APPROVALS

Developing the proposed aquaculture facilities will require various regulatory approvals from State of Washington agencies. It is expected that the Yakama Nation will lead this effort, which will be based on environmental and engineering analyses of potential project construction and operational effects. Permitting requirements will be verified during Step 2 planning and preliminary design; approvals will be sought during Step 3, final design. Among the permits the Tribe anticipates will be required are new

surface and groundwater water rights, and potentially a National Pollution Discharge Elimination System permit for hatchery operation if production reaches a regulated level. In addition, new construction at some sites may be within the jurisdiction of the County's Shoreline Master Program, intended to protect shoreline ecology, public access, and water-dependent uses and to require mitigation of impacts where appropriate.

8.0 ESTIMATED COSTS FOR ALL PROGRAMS

The costs presented in this section are consistent with Council's Step Review, Step 1 Master Plan requirements (NPCC 2006). These conceptual costs are a planning baseline from which to refine cost estimates, evaluate alternatives and protect against budget expansion as the proposed project progresses through the preliminary (Step 2) and final design (Step 3) phases and implementation.

The approach used in this Master Plan to estimate future costs for both operations and capital construction generally follows the principals for inflation and cost escalation described by the Independent Economic Analysis Board in their white paper on Project Cost Escalation Standards (NPCC 2007).

Project cost estimates are based on the proposed programs and conceptual designs presented in Chapters 4 and 5. As described in previous sections of this Master Plan, the Yakama Nation is proposing to construct new facilities at the Prosser, Marion Drain, Sunnyside Dam and Holmes Ranch sites (Figure 6-1). Cost estimates for facility planning and design, construction, acquisition of capital equipment, and environmental compliance are presented in the following sections for the proposed hatchery facilities. Research, monitoring and evaluation, as well as operations and maintenance, are also discussed. A tabular summary of project costs is provided and a 10-year summary of all costs projected from FY 2012 through FY 2021 is presented for each site.

The proposed facilities will enable the Tribe to incorporate best management practices for the culture of coho and Chinook salmon. Estimated operational costs consider these best management practices.

Cost estimates are provided for all program areas from FY 2012 through FY 2021. Construction costs can fluctuate significantly from year to year, as shown in the Engineering News Record (ENR) Construction Cost Index (http://enr.com), which has recorded costs since 1913. Since 1978, changes in annual national averages for construction costs have ranged from 9.21 percent in 1981 to 1.16 percent in 1995. The fluctuation range of average construction costs from 1997 through 2010 has been between -0.1 percent and +9.1 percent.

Before finalizing this Master Plan, the construction industry was still experiencing a downturn; however, it is uncertain how various government programs and other market forces may affect costs over the life of the proposed project. Construction cost estimates for the Yakama Nation facilities proposed to be constructed during the current Fish Accord (Holmes Ranch Hatchery) have been escalated at about 2.5 percent annually up to the proposed year of construction. This is based on the Yakama Nation's agreement with BPA in the current Fish Accord. Cost estimates for operations and maintenance, and equipment research, monitoring, and evaluation are also escalated at 2.5 percent annually (per the current Accord) from FY 2012 through FY 2021. Although historically these types of costs tend to be more stable, the estimates may be high or low in any given year depending on the state of the economy. At this time, they are considered to be reasonable. Signs of economic recovery are emerging; therefore,

deferring or delaying portions of the project could dramatically increase implementation costs of the proposed facilities.

8.1 FUNDING

It is assumed that funding for the proposed projects will be provided through the current Fish Accord (fiscal years 2008 – 2017) and potential future Fish Accords (fiscal years 2018 – 2027). The proposed facilities at Holmes Ranch are identified in the Yakama Nation's current Fish Accord. A summary of the background to the Fish Accords is presented below.

BPA, the U.S. Army Corps of Engineers and the U.S. Bureau of Reclamation (BOR), (the Action Agencies), and the Confederated Tribes of the Warm Springs Reservation of Oregon, the Confederated Tribes of the Umatilla Indian Reservation, the Confederated Tribes and Bands of the Yakama Nation and the Columbia River Inter-Tribal Fish Commission, (the Tribes or the Treaty Tribes) (collectively the Parties), developed a Memorandum of Agreement (Agreement). This Agreement addresses direct and indirect effects of construction, inundation, operation and maintenance of the Federal Columbia River Power System and BOR's Upper Snake River Projects on fish resources of the Columbia River Basin. The Action Agencies and the Tribes intend that this Agreement provide benefits to all the Parties. Reasons for this Agreement include the following:

- To resolve issues between the Parties regarding the Action Agencies' compliance with the Endangered Species Act regarding these FCRPS and Upper Snake Projects;

- To resolve issues between the Parties regarding compliance with the Pacific Northwest Electric Power Planning and Conservation Act and the Clean Water Act;

- To address the Parties' mutual concerns for certainty and stability in the funding and implementation of projects for the benefit of fish affected by the FCRPS and Upper Snake Projects, affirming and adding to the actions proposed in the draft FCRPS and Upper Snake Biological Opinions; and

- To foster a cooperative and partnership-like relationship in implementation of the mutual commitments in this Agreement.

Specifically, to meet the intent and terms of the current MOA, this project would acquire and develop new hatchery facilities designed to produce up to 700,000 coho salmon (parr and smolts) annually for reintroduction in the Yakama Basin (see Chapters 3 and 5). It is the intent to meet this production goal by implementing the Holmes Ranch coho hatchery program (see Section 8.5 below). Flexibility to accommodate additional conservation hatchery programs as well as localized broodstock development programs would be incorporated into the design of the facility.

It should be noted that the Marion Drain and Prosser programs are not funded under the current Fish Accord and will be addressed in the next Accord cycle beginning in 2018.

8.2 PROSSER (CHINOOK AND COHO)

8.2.1 Cost Sharing / Program Areas / Major Milestones

8.2.1.1 Cost Sharing with Other Organizations and Entities

Cost sharing will be an important aspect of funding the proposed program at Prosser. Conceptual costs take into consideration cost sharing that is occurring in current programs and that is expected to continue into the future.

Most cost sharing identified for the Yakama Nation's Prosser Hatchery coho and Chinook programs relate to operations and maintenance for the Prosser and Marion Drain facilities. Cost sharing includes both direct funding and in-kind support. Table 8-1 shows the cost sharing entities involved, including the Yakama Nation, Bureau of Reclamation, and funding from the Mitchell Act. While these cash and in-kind contributions are not shown as direct deductions from the estimated line item budgets presented in this document, they were considered when developing cost estimates if they potentially affected a cost area in the future.

Table 8-1. Summary of cost sharing, Prosser Hatchery

Funding Source or Organization	Date / Fiscal Year	Item or Service Provided	Cash or In-Kind Contribution	Status	Amount
Yakama Nation Gaming Revenue	Annual	Operating expenses	Cash	Confirmed	$49,356
				Total	**$49,356**

Notes and Assumptions:

- Cost share is shown in 2012 dollars
- Cost share provides $44,856 in labor and fringe costs and $4,500 in operating supplies
- Figures provided are consistent with Project No. 1997-013-00
- Estimated cost shares are accounted for in all budgets presented

8.2.1.2 Program Areas and Major Milestones

Completing the Council's Three-Step process often requires three to five years. During this time, considerable planning, design, environmental compliance and analysis of alternatives will occur. A generalized list of program areas and a preliminary time line linking costs to planning, construction, capital equipment, environmental compliance, operations and maintenance and research, monitoring, and evaluation is presented in Figure 8-1 for FY 2012 through FY 2021. A cost summary by program area is shown in Table 8-2. Cost estimates for each program area are presented in the year in which they are expected to occur and are shown in Table 8-8; costs are escalated from FY 2012. It should be noted that only planning and design, environmental compliance, operations and maintenance and monitoring and evaluation for the existing program are shown as funded within the current Accord (2008 – 2017) for Prosser. Development of new facilities is planned for 2018 and under a proposed new Fish Accord.

Program Area	Occurrence	FY 2012		FY 2013		FY 2014		FY 2015		FY 2016		FY 2017		FY 2018		FY 2019		FY 2020		FY 2021	
Land Purchases, Leases and Easements	One Time																				
Planning and Design Step 1	One Time	■	■																		
Planning and Design Step 2 (and Environmental	One Time				■	■															
Planning and Design Step 3 (Final Design)	One Time						■	■													
Construction	One Time													■	■	■					
Capital Equipment	One Time															■					
Annual Operations and Maintenance	Annual																■	■	■	■	■
Monitoring and Evaluation	Annual																	■	■	■	■

Notes and Assumptions:

- Assumes proposed Step 2 and Step 3 funding is available on this schedule
- Assumes that costs for easements are included in the operations budgets
- Assumes a design / build or modified design / build approach is utilized between Step 2 and Step 3
- Assumes construction starting in early FY 2018 (less than a two year schedule dependent on a spring 2018 construction start)
- Assumes all proposed facilities and improvements are built in one construction season (during FY 2018 and early FY 2019)
- Assumes no major environmental compliance issues are identified beyond what is described in Section 7.0
- O&M expenditures likely to start during the last phases of construction (FY 2019) allowing for training/handoff of new facilities and equipment
- M&E expenditures likely to start after last phases of construction (FY 2020), funded under BPA Project No. 1995-063-25

Figure 8-1. General timeline for key milestones and expenditures, Prosser Hatchery.

Table 8-2. Summary of key expenditures by program area, Prosser Hatchery.

Program Area	Estimated Cost	Occurrence	Level of Certainty
Planning and Design Step 1*	$205,000	One Time	Contract to develop Step 1 Master Plan
Planning and Design Step 2**	$666,251	One Time	Placeholder (less than concept)
Planning and Design Step 3***	$1,206,118	One Time	Placeholder (less than concept)
Construction	$17,748,016	One Time	Concept (+/- 35% to 50%) (escalated to 2018 dollars) (includes alternative river water supply - gravity flow option
Capital Equipment	$110,557	One Time	Concept (+/- 35% to 50%) (escalated to 2019 dollars)
Environmental Compliance Step 2 (Permitting, EA, Other)	$96,174	One Time	Concept (+/- 35% to 50%) completed during Step 2 (2014 dollars)
Land Purchases, Leases and Easements ****	$0	NA	
Annual Operations and Maintenance – Prosser Hatchery Program	$1,362,561	Annual	Current O&M costs from project 1997-013-25 (escalated at 2.5% annually to FY 2019)
Monitoring and Evaluation – Prosser Hatchery Program *****	$0	NA	

Notes and Assumptions:
*Shows the actual contract figure for completion of a Step 1 Master Plan
**Shows an estimated placeholder cost estimate based on the conceptual construction cost
***Shows an estimated placeholder cost estimate based on the conceptual construction cost
****No land costs are applied to this project
*****Monitoring and evaluation expenses are covered by project No. 1995-063-25 (for Marion Drain and Prosser)
Budget figures assume that work would proceed on the time line shown in Figure 8-2 and Table 8-8 Ten Year Future Cost Summary

8.2.2 Planning and Design Cost Estimates

The Yakama Nation has solicited input from a range of experts during Step 1 conceptual planning in order to avoid significant design and program changes in later planning stages. In addition, the Tribe sought to validate the program, design criteria and cost estimates to the maximum extent possible through comprehensive early reviews. Input and review will continue to be solicited by a team of knowledgeable individuals through the Step 2 and 3 processes.

8.2.2.1 Step 1 Conceptual Planning and Design

The total budget for the conceptual planning and design work is about $205,000 (Table 8-2). This figure is based on a contracted amount to complete the Step 1 Master Plan and includes conceptual planning, engineering, and development of the Step 1 Master Plan and ultimately responding to the NPCC and ISRP review of this Master Plan.

8.2.2.2 Step 2 Preliminary Planning and Design

The preliminary planning and design stage, intended to meet the Council's Step 2 requirements, is designed to identify any major difficulties or concerns with the program and facility designs. Step 2 design work should provide sufficient detail and specifics to assure that the intent and scope of Step 1 conceptual design work can be met and to further refine the cost estimates. Step 2 will include

refinement of scientific information, environmental compliance and ESA reviews. In addition, near completion of the Step 2 planning and design work, the Tribe may implement other reviews to ensure all cost effective alternatives are being considered.

A placeholder of $666,000 (Table 8-2) has been identified for Step 2 preliminary planning, environmental compliance, site investigations and design. Initiation of this work is proposed in FY 2012. This budget includes costs to refine the M&E program to meet NPCC requirements and to develop planning submittals to meet Step 2 requirements. The budget may need further refinement depending on the outcome of the Step 1 Master Plan approval process.

8.2.2.3 Step 3 Final Planning and Design

A placeholder of $1,206,000 (Table 8-2) has been identified for the Step 3 final planning and design stage. It is anticipated that this work will begin in FY 2013. Refinement of the Step 3 planning and design budget will occur in Step 2 during development of the preliminary design.

The cost estimates for planning and design assume that facilities will be developed along the time line shown in Figure 8-1. Should the program be delayed or implemented in phases, costs for planning and design could increase if facility designs, construction specifications and planning and design documents are performed in multiple packages. The proposed schedule will result in more cost effective planning and implementation for Step 2, Step 3, implementation of construction, and long-term program operations. It should be noted that construction is planned in 2018 because it is not funded under the existing Accord which ends in 2017. Nevertheless, the Yakama Nation is pursuing facility design and environmental compliance within the current Accord on the schedule shown in Figure 8-1.

Step 3 is the final design review prior to construction. Development plans are advanced to a confidence level of +/- 10 to 15 percent and are ready for bid. A 100 percent cost estimate accompanies this submittal along with details on all operational plans.

The Yakama Nation proposes to proceed through Step 3 for Prosser in FY 2014 and FY 2015. Since funding for construction is not in the current Accord, at this time Yakama Nation is planning for construction in FY 2018 and FY 2019.

8.2.3 Capital Construction Cost Estimates

Capital construction costs are estimated based on a conceptual design. Due to the level of uncertainty, a contingency of approximately 20-25 percent is applied to each construction cost area. Such a contingency is largely dependent on the number of uncertainties associated with the project and the amount of pre-investigation work completed. Estimated construction costs represent a maximum range and likely cost reductions would be identified in future planning stages through analysis of alternatives and elimination of many uncertainties.

The current estimate for capital construction is based on the descriptions of facilities and infrastructure provided in Section 4.5.2, Existing Facilities, and Section 4.5.3, Proposed Facilities.

Construction costs associated with renovating and or demolishing existing facilities are included in Table 8-3; details of this work are provided in Section 4.5.3. Figure 4-13 shows the preliminary layout of proposed improvements at Prosser Hatchery. A summary of proposed production facilities is provided

in Section 2.3.1 with details described in Section 4.5.3 for Chinook facilities and Section 5.4.3 for coho facilities.

Table 8-3 summarizes the estimated construction costs for each component of the Prosser Hatchery. Costs are broken down into major infrastructure and facility components and are based on the scope and conceptual descriptions presented in Chapter 4. Details of these estimates are provided in Appendix H. The estimated construction budget for Prosser Hatchery is $17,748,000. These estimates are based on conceptual design and include a contingency of 20 percent to accommodate the level of uncertainty at this stage.

The Yakama Nation proposes to implement all components of the Prosser Hatchery as a single project. Due to the need to maintain continuous operations at this hatchery, construction will need to be phased over at least two years.

Table 8-3. Summary of estimated construction costs, Prosser Hatchery.

Description	Total
Process Water Supply to Head Box and Silt Pond	$1,324,784
Head Boxes, Chiller and Degassing	$160,180
Site Work and Utilities	$1,245,680
Process Water Distribution and Drains	$926,708
Admin and Incubation Buildings	$783,236
Outdoor Rearing Ponds	$5,247,720
Cleaning Waste System Improvements	$54,000
Adult Holding Ponds	$234,220
8 cfs Alternative River Water Supply - Pumped Option	$603,000
8 cfs Alternative River Water Supply - Gravity Flow Option	$1,179,000
Cost Summary with Pump Supply Alternative	
Construction Cost Subtotal – 2012 Dollars	**$10,579,528**
Inflation / Escalation 5% to Mid-Point Construction – 2018	$14,177,579
Mobilization / Demobilization, General Conditions	$1,701,310
Subtotal	**$15,878,889**
Contingency (Included Above – See Appendix H for Detail)	-
Taxes 6%	$952,733
Probable Total Cost - 2018 Dollars	**$16,831,622**
Cost Summary with Gravity Flow Supply Alternative	
Construction Cost Subtotal – 2012 $	**$11,155,528**
Inflation / Escalation 5% to Mid-Point Construction – 2018	$14,949,474
Mobilization / Demobilization, General Conditions	$1,793,937
Subtotal	**$16,743,411**
Contingency (Included Above – See Appendix H for Detail)	-
Taxes 6%	$1,004,605
Probable Total Cost – 2018 Dollars	**$17,748,016**

Notes and Assumptions:

- Cost estimate in 2012 Dollars
- Inflation / escalation at 5% to mid-point construction date of 2018
- Mob / Demobilization, General conditions includes inflation / escalation at 5% to mid-point construction date of 2018
- Costs should be considered conceptual (+/- 35% to 50%)

8.2.4 Capital Equipment Cost Estimates

The new Prosser Hatchery will require investment in various types of equipment, from office furniture and laboratory equipment to water systems. Table 8-4 lists the potential types of equipment by functional area of the proposed operation and their probable costs. A conceptual estimated budget of $111,000 (escalated at 2.5 percent from FY 2012 to FY 2019, when equipment would be needed) has been included for capital equipment associated with the new facilities and operation.

Table 8-4. Capital equipment budget by facility / hatchery functional area, Prosser Hatchery.

Description	Total Cost (FY 2012 Dollars)	Total Cost (FY 2019 Dollars)
Office Equipment	$9,200	$10,936
Computers / Printers	$18,380	$21,848
Office Furniture and Cabinets	$12,100	$14,383
Communications Equipment	$32,278	$38,903
Housing Equipment and Furniture / Permanent Staff Housing	$0	$0
Housing Equipment and Furniture / Temporary Staff Housing	$0	$0
Shop Equipment	$0	$0
Buildings / Facilities Needs	$0	$0
Transportation	$0	$0
Water System Operation	$0	$0
Incubation	$0	$0
Fish Transport	$0	$0
Chinook / Coho Rearing at Hatchery	$20,600	$24,487
Chinook / Coho Rearing at Acclimation Ponds	$0	$0
Coho Rearing at Hatchery	$0	$0
Coho Rearing at Acclimation Ponds	$0	$0
Tagging	$0	$0
M&E Equipment	$0	$0
Technical / Lab Equipment	$0	$0
Disinfection Equipment (Other Disease &Pathology Needs)	$0	$0
Other		$0
TOTAL	**$93,008**	**$110,557**

Notes and Assumptions:

- Costs shown in 2012 and 2019 dollars
- Expenditures will occur in late 2019
- Costs are escalated at 2.5% annually
- Costs should be considered conceptual (+/- 35% to 50%)
- Items are not duplicated in the capital construction and operating budgets

8.2.5 Environmental Compliance Cost Estimates

Developing the proposed Prosser Hatchery as part of the ongoing Prosser coho and Chinook programs will incur environmental compliance costs subsequent to this master planning stage. Compliance steps for the proposed program could include the National Environmental Policy Act (NEPA), a Biological Assessment under the Endangered Species Act, and other laws and regulations that are discussed in

Section 7. Table 8-5 presents the estimated cost by potential permit or other compliance requirement. Costs are estimated to be approximately $96,000 in FY 2019 to meet all requirements to implement the project.

Table 8-5. Estimated cost of environmental compliance, Prosser Hatchery.

Project Area / Permit / Requirement	Estimated Cost to Complete (2012 Dollars)	Estimated Cost to Complete (2014 Dollars)
Water Supply / Quality		
Groundwater Right – two new wells (WDOE)	$5,000	$5,189
NPDES - Hatchery Discharge (EPA) – need TBD	$10,000	$10,378
Surface Water Right	$8,000	$8,303
Planning Approvals		
NEPA Supplemental Analysis (BPA) – tier to 1996 EIS for fish production	$25,000	$25,945
ESA Section 7 Compliance – Biological Assessment (BPA and USFWS / NMFS)	$8,000	$8,303
SEPA (WDOE or WDFW likely lead agency) – adopt NEPA determination	$5,200	$5,397
Section 106 Cultural Resources Clearance (SHPO)	$5,000	$5,189
Wetland Delineation (conduct for Section 404 permit)	$3,120	$3,238
Construction		
JARPA – Includes Section 404, Section 10, Section 401, HPA (Corps, WDOE, WDFW)	$8,000	$8,303
Shoreline Substantial Development Permit (County) for new water intake	$6,000	$6,227
Yakima County Commercial Building Permits	$3,750	$3,892
County Road Permits	$800	$830
NPDES General Construction Storm water and Storm Water Pollution Prevention Plan (EPA)	$4,800	$4,982
Total	**$92,670**	**$96,174**

Notes and Assumptions:

- YN to address wetland delineation
- Assumes majority of expenditures occur in FY 2013 and FY 2014
- Costs are escalated at 2.5% annually
- Costs should be considered conceptual (+/- 35% to 50%)
- Concept completed during Step 2 (2013 and 2014 dollars)
- Note that this program component will have a fall Chinook acclimation and adult collection facility that has yet to be identified. Permitting costs will include instream work for the fishway and a water right. No estimates made yet.

8.2.6 Land Acquisition Costs

All land required for the Prosser coho and Chinook programs has been acquired and no new property or lands will be purchased or require expenditures for this work.

8.2.7 Operations and Maintenance Costs

The following sections present cost estimates for operations and maintenance of the proposed Prosser coho and Chinook hatchery programs.

8.2.7.1 Annual Operating Costs

Operating costs for the proposed hatchery are shown in Table 8-6. Expenses include such items as payroll, utilities, vehicles, supplies, maintenance, and potential subcontracted support services. The Yakama Nation estimates that the budget for operations and maintenance will be $1,146,000 annually (in 2012 dollars) when new facilities are finalized. When this estimate is escalated from FY 2012 to FY 2019 dollars, operational expenses would be about $1,363,000 annually. The 2012 costs are estimated as an average of the FY 2011 and 2012 O&M budgets for Marion Drain and Prosser hatcheries. A revised estimate for utilities is included in this average to account for increased pumping and upgraded facilities. These costs cover both coho and Chinook programs.

8.2.7.2 Projected Operating Costs

These types of costs tend to be more stable historically than construction costs. Operating expenses from FY 2012 to FY 2021 are shown in Table 8-8. It is expected that the facility would be constructed in FY 2018. Cost estimates for ongoing facility operations are escalated at 2.5 percent annually from FY 2012 through FY 2021.

8.2.8 Research, Monitoring and Evaluation Costs

Ongoing research, monitoring and evaluation activities are funded under the current Fish Accord and are expected to be funded again under the next Accord to be negotiated in 2017 (see Table 4-5; Project 1995-063-025). The monitoring and evaluation activities supported by this Agreement were determined by consensus of the scientists from the YN and the Washington Department of Fish and Wildlife (WDFW). Project M&E activities have been subjected to rigorous scientific and technical review by the YKFP's Science / Technical Advisory Committee (STAC) and the Monitoring Implementation Planning Team (MIPT). STAC is responsible for the conceptual design of the project's M&E program, and MIPT must transform the conceptual design into the tasks identified in this Agreement.

A conceptual framework for the proposed monitoring and evaluation plan will be designed to ensure that the future program achieves the performance standards established for natural production and in-hatchery culture practices and operations (Chapter 3). A more detailed description of the monitoring and evaluation program is presented in the draft HGMP (Appendix A). This plan will be developed further in Step 2 of the three-step planning process. Current costs for M&E of this program are identified under Project No. 1995-063-25.

8.2.9 Ten–Year Future Cost Summary

Estimated 10-year costs to operate the Prosser coho and Chinook hatchery program from FY 2012 through FY 2021 are presented in Table 8-8. As stated in Section 8.0, costs for each program area are escalated to the year in which they are expected to occur. This estimated cost summary assumes that implementation of new facilities for Prosser Hatchery would occur in 2017 through 2019.

As previously noted, consistent with Step 1 of the Council's Three-Step process, cost estimates at this stage are conceptual. The Yakama Nation will refine these estimates during the Step 2 and Step 3 planning phases. This 10-year estimated cost summary is designed to be a planning tool and will be updated as costs are refined.

Table 8-6. Annual operating expenses, Prosser Hatchery.

Expense Area	Total Estimated Operations Costs for Marion and Prosser (2012 Dollars)	Total Estimated Operations Costs Allocated to Prosser (2012 Dollars)	Total Estimated Operations Costs, Prosser (2019 Dollars)
Payroll (Taxes, Benefits, Mark-ups)	$850,829	$553,039	$657,390
Vehicles (Fuel, Oil, Maintenance, Mileage, Insurance)	$15,248	$9,911	$11,781
Repairs and Maintenance (Site, Buildings, Equipment)	$53,775	$34,954	$41,549
Rent and Lease (Equipment, Vehicles)	$56,841	$36,947	$43,918
Program Supplies (Office)	$3,300	$2,145	$2,550
Program Supplies (Lab, Shop, Maintenance)	$18,860	$12,259	$14,572
Program Supplies (Water System, Brood Collection, Egg Take, Incubation)	$30,779	$20,006	$23,781
Program Supplies (Rearing and Release)	$79,502	$51,676	$61,427
Utilities (Electrical, Telephone, Sanitary, other)	$130,548	$45,692	$54,313
Travel Costs (Mileage, Lodging, Per diem)	$10,525	$6,841	$8,132
Education and Training	$3,300	$2,145	$2,550
Subcontracts (Professional Fees, Testing, Sampling, Disease Work)	$214,012	$139,108	$165,355
Facility Insurance	$6,625	$4,306	$5,119
Misc. Equipment, Other Improvements	$105,708	$68,710	$81,675
Indirect on Labor and Direct Expenses (18.66%)	$243,902	$158,537	$188,450
TOTAL	**$1,823,753**	**$1,146,275**	**$1,362,561**

Notes and Assumptions:

- Current annual operating costs are on-going; costs estimated to 2019 with site modifications and revisions are reflected in 2012 dollars for reference
- Costs are escalated from 2012 to 2019 at 2.5% annually
- Costs in out years should be considered conceptual (+/- 35% to 50%)
- Costs shown consider both coho and Chinook programs
- The 2012 costs are estimated as an average of the FY 2011 and 2012 O&M budgets for Marion Drain and Prosser hatcheries
- The combined budget is allocated at 35% for Marion Drain and 65% for Prosser

Table 8-7. Annual operating expenses, 10 year projection, Prosser Hatchery.

Expense Area	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Payroll (Taxes, Benefits, Mark-ups)	$553,039	$566,865	$581,037	$595,563	$610,452	$625,713	$641,356	$657,390	$673,824	$690,670
Vehicles (Fuel, Oil, Maintenance, Mileage, Insurance)	$9,911	$10,159	$10,413	$10,673	$10,940	$11,214	$11,494	$11,781	$12,076	$12,378
Repairs and Maintenance (Site, Buildings, Equipment)	$34,954	$35,827	$36,723	$37,641	$38,582	$39,547	$40,535	$41,549	$42,588	$43,652
Rent and Lease (Equipment, Vehicles)	$36,947	$37,870	$38,817	$39,788	$40,782	$41,802	$42,847	$43,918	$45,016	$46,141
Program Supplies (Office)	$2,145	$2,199	$2,254	$2,310	$2,368	$2,427	$2,487	$2,550	$2,613	$2,679
Program Supplies (Lab, Shop, Maintenance)	$12,259	$12,565	$12,879	$13,201	$13,531	$13,870	$14,216	$14,572	$14,936	$15,310
Program Supplies (Water System, Brood Collection, Egg Take, Incubation)	$20,006	$20,507	$21,019	$21,545	$22,083	$22,635	$23,201	$23,781	$24,376	$24,985
Program Supplies (Rearing and Release)	$51,676	$52,968	$54,292	$55,650	$57,041	$58,467	$59,929	$61,427	$62,962	$64,536
Utilities (Electrical, Telephone, Sanitary, other)	$45,692	$46,834	$48,005	$49,205	$50,435	$51,696	$52,988	$54,313	$55,671	$57,063
Travel Costs (Mileage, Lodging, Per diem)	$6,841	$7,012	$7,188	$7,367	$7,551	$7,740	$7,934	$8,132	$8,335	$8,544
Education and Training	$2,145	$2,199	$2,254	$2,310	$2,368	$2,427	$2,488	$2,550	$2,613	$2,679
Subcontracts (Professional Fees, Testing, Sampling, Disease Work)	$139,108	$142,585	$146,150	$149,804	$153,549	$157,387	$161,322	$165,355	$169,489	$173,726
Facility Insurance	$4,306	$4,414	$4,524	$4,637	$4,753	$4,872	$4,994	$5,119	$5,247	$5,378
Misc. Equipment, Other Improvements	$68,710	$70,428	$72,188	$73,993	$75,843	$77,739	$79,683	$81,675	$83,716	$85,809
Indirect on Labor and Direct Expenses (18.66%)	$158,537	$162,500	$166,562	$170,727	$174,995	$179,370	$183,854	$188,450	$193,161	$197,990
TOTALS	**$1,146,275**	**$1,174,932**	**$1,204,305**	**$1,234,413**	**$1,265,273**	**$1,296,905**	**$1,329,328**	**$1,362,561**	**$1,396,625**	**$1,431,540**

Notes and Assumptions: Estimated costs are escalated at 2.5% annually in all operational areas

Table 8-8. Ten-year summary of future costs, FY 2012 - FY 2021, Prosser Hatchery.

Program Area	Fiscal Year									
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
A. Land Purchases, Leases and Easements (to be determined)										
A.1. Land Purchase, Leases and Easements										
B. Planning and Design										
B.1. Step 1: Conceptual Engineering, Planning	$205,000									
B.2. Step 2: Preliminary Engineering, Planning and Environmental Compliance		$333,126	$333,126							
B.3. Step 3: Final Engineering, Planning			$361,835	$844,282						
C. Construction										
C.1. Estimated Construction Costs							$12,423,611	$5,324,405		
D. Capital Equipment										
D.1. Capital Equipment								$110,557		
E. Environmental Compliance										
E.1. Environmental Compliance		$28,852	$67,322							
F. Operations and Maintenance										
F.1. Prosser Hatchery Programs	$1,146,275	$1,174,932	$1,204,305	$1,234,413	$1,265,273	$1,296,905	$1,329,328	$1,362,561	$1,396,625	$1,431,540
G. Monitoring and Evaluation										
G.1. Monitoring and Evaluation Program										
Total Estimated Capital Costs	**$205,000**	**$361,978**	**$762,283**	**$844,282**	**$0**	**$0**	**$12,423,611**	**$5,434,962**	**$0**	**$0**
Total Estimated O&M Costs	**$1,146,275**	**$1,174,932**	**$1,204,305**	**$1,234,413**	**$1,265,273**	**$1,296,905**	**$1,329,328**	**$1,362,561**	**$1,396,625**	**$1,431,540**
Total Estimated Costs	**$1,351,275**	**$1,536,910**	**$1,966,588**	**$2,078,695**	**$1,265,273**	**$1,296,905**	**$13,752,939**	**$6,797,523**	**$1,396,625**	**$1,431,540**

Notes and Assumptions:

A.1. Land purchase, leases and easements (assumes no costs are allocated to this project)
B.1. Step 1 planning (based on current expenditures to complete all Step 1 activities and planning)
B.2. Step 2 planning based on percentage of estimated construction costs (escalated to FY 2013 dollars)
B.2. Step 3 planning based on percentage of estimated construction costs (escalated to FY 2014 dollars)
C.1. Estimated construction costs assume 70% occurs in FY 2018 and 30% in FY 2019 (escalated from FY 2012 to mid FY 2018 dollars)
D.1. Capital equipment, estimated lump sum for equipment items not shown in construction estimate (escalated from FY 2012 to FY 2019 dollars)
E.1. Environmental compliance costs (assumes 90% of expenses occur in FY 2014 and 10% of expenses in FY 2017) (escalated from FY 2012 to FY 2014 dollars)

8.3 MARION DRAIN HATCHERY (CHINOOK)

8.3.1 Cost Sharing / Program Areas / Major Milestones

8.3.1.1 Cost Sharing with Other Organizations and Entities

Cost sharing will be an important aspect of funding the proposed program. Conceptual costs take into consideration cost sharing that is occurring in current programs and that is expected to continue into the future.

Most cost sharing identified for the Yakama Nation's Marion Drain Chinook program currently relates to Operations and Maintenance for the Marion Drain and Prosser facilities. Cost sharing includes both direct funding and in-kind support. Table 8-9 shows the cost sharing entities involved. While these cash contributions from the Yakama Nation are not shown as direct deductions from the line item budgets presented in this document, they were considered when developing cost estimates if they potentially affected a cost area in the future.

Table 8-9. Summary of cost sharing, Marion Drain Hatchery

Funding Source or Organization	Date / Fiscal Year	Item or Service Provided	Cash or In-Kind Contribution	Status	Amount
Yakama Nation Gaming Revenue	Annual	Operating expenses	Cash	Confirmed	$49,356
				Totals	**$49,356**

Notes and Assumptions:

- Cost share is shown in 2012 dollars
- Cost share provides $44,856 in labor and fringe costs and $4,500 in operating supplies
- Figures provided are consistent with Project No. 1997-013-00
- Estimated cost shares are accounted for in Marion Drain and Prosser hatchery budgets

8.3.1.2 Program Areas and Major Milestones

Completing the Council's Three-Step process often requires three to five years. During this time, considerable planning, design, environmental compliance and analysis of alternatives will occur. A generalized list of program areas and a preliminary timeline linking costs to planning, construction, capital equipment, environmental compliance, operations and maintenance and research, monitoring, and evaluation is presented in Figure 8-2 for FY 2012 through FY 2021. A cost summary by program area is shown in Table 8-10. Cost estimates for each program area are presented in the year in which they are expected to occur and are shown in Table 8-16; costs are escalated from FY 2012. It should be noted that only planning and design, environmental compliance, operations and maintenance and monitoring and evaluation for the existing program are shown as funded within the current Fish Accord (2008-2017) for Marion Drain. New facilities are planned for development in 2018 under a proposed new Fish Accord.

Figure 8-2. General timeline for key milestones and expenditures, Marion Drain Hatchery.

Program Area	Occurrence	FY 2012		FY 2013		FY 2014		FY 2015		FY 2016		FY 2017		FY 2018		FY 2019		FY 2020		FY 2021	
Land Purchases, Leases and Easements	One Time																				
Planning and Design Step 1	One Time																				
Planning and Design Step 2 (and Environmental Compliance)	One Time																				
Planning and Design Step 3 (Final Design)	One Time																				
Construction	One Time																				
Capital Equipment	One Time																				
Annual Operations and Maintenance	Annual																				
Monitoring and Evaluation	Annual																				

Notes and Assumptions:
Assumes proposed Step 2 and Step 3 funding is available on this schedule
Assumes that costs for easements are included in the operations budgets
Assumes a design / build or modified design / build approach is utilized between Step 2 and Step 3
Assumes construction starting in FY 2018 (less than a two year schedule dependent on a spring 2018 construction start)
Assumes all proposed facilities and improvements are built in one construction season (during FY 2018 and early FY 2019)
Assumes no major environmental compliance issues are identified beyond what is described in Section 7.0
O&M expenditures will likely start during the last phases of construction (FY 2019) allowing for training and handoff of new facilities and equipment
M&E expenditures will likely start after the last phases of construction (FY 2020), funded under BPA Project No. 1995-063-25

Table 8-10. Summary of key expenditures by program area, Marion Drain Hatchery.

Program Area	Estimated Cost	Occurrence	Level of Certainty
Planning and Design Step 1*	$103,000	One Time	Contract to develop Step 1 Master Plan
Planning and Design Step 2**	$325,694	One Time	Placeholder (less than concept)
Planning and Design Step 3***	$582,598	One Time	Placeholder (less than concept)
Construction	$8,201,463	One Time	Concept (+/- 35% to 50%) (escalated to 2018 dollars)
Capital Equipment	$267,939	One Time	Concept (+/- 35% to 50%) (escalated to 2018 dollars)
Environmental Compliance Step 2 (Permitting, EA, Other)	$103,014	One Time	Concept (+/- 35% to 50%) Completed during Step 2 (2014 dollars)
Land Purchases, Leases and Easements ****	$0	NA	
Annual Operations and Maintenance - Marion Drain Hatchery Program	$805,308	Annual	Current O&M costs shown in 2012 dollars (escalated at 2.5% annually) to 2019 dollars
Monitoring and Evaluation – Marion Drain Hatchery Program *****	$0	NA	

Notes and Assumptions:
*Shows the actual contract figure for completion of a Step 1 Master Plan, shown in 2012 dollars
**Shows an estimated placeholder cost estimate based on the conceptual construction cost
***Shows an estimated placeholder cost estimate based on the conceptual construction cost
****No land costs are applied to this project
*****Monitoring and Evaluation expenses are covered by project # 1995-063-25 (for Marion Drain and Prosser)
Budget figures assume that work would proceed on the time line shown in Figure 8-2 and Table 8-16- Future Cost Summary

8.3.2 Planning and Design Cost Estimates

The Tribe has solicited input from a range of experts during Step 1 conceptual planning in order to avoid significant design and program changes in later planning stages. In addition, the Tribe sought to validate the program, design criteria and cost estimates to the maximum extent possible through comprehensive early reviews. Input and review will continue to be sought by a team of knowledgeable individuals through the Step 2 and 3 processes.

8.3.2.1 Step 1 Conceptual Planning and Design

The total budget for the conceptual planning and design work is about $103,000 (Table 8-10). This figure is based on a contracted amount to complete the Step 1 Master Plan and includes conceptual planning, engineering, and development of the Step 1 Master Plan and ultimately responding to the NPCC and ISRP review of this Master Plan.

8.3.2.2 Step 2 Preliminary Planning and Design

The preliminary planning and design stage, intended to meet the Council's Step 2 requirements, is designed to identify any major difficulties or concerns with the program and facility designs. Step 2 design work should provide sufficient detail and specifics to assure that the intent and scope of Step 1 conceptual design work can be met and to further refine the cost estimates. Step 2 will include

refinement of scientific information, environmental compliance and ESA reviews. In addition, the Tribe may implement other reviews to ensure all cost effective alternatives are being considered when nearing completion of the Step 2 planning and design work.

A placeholder of $326,000 (Table 8-10) has been identified for Step 2 preliminary planning, environmental compliance, site investigations and design. Initiation of this work is proposed in FY 2012 (Figure 8-2). This budget includes costs to refine the M&E program to meet NPCC requirements and to develop planning submittals to meet Step 2 requirements. The budget may need further refinement depending on the outcome of the Step 1 Master Plan approval process.

8.3.2.3 Step 3 Final Planning and Design

A placeholder of $583,000 (Table 8-10) has been identified for the Step 3 final planning and design stage. It is anticipated that this work will begin in FY 2013. Refinement of the Step 3 planning and design budget will occur in Step 2 during development of the preliminary design.

The cost estimates provided for planning and design assume that facilities will be developed along the timeline shown in Figure 8-2. Should the program be delayed or implemented in phases, costs for planning and design could increase if facility designs, construction specifications and planning and design documents are performed in multiple packages. The proposed schedule will result in more cost effective planning and implementation for Step 2, Step 3, implementation of construction, and long-term program operations. It should be noted that construction is planned in 2018 as this project component is not funded under the existing Accord which ends in 2017. However, the Yakama Nation is pursuing facility design and environmental compliance on the schedule provided in Figure 8-2.

Step 3 is the final design review prior to construction. Development plans are advanced to a confidence level of +/- 10 to 15 percent and are ready for bid. A 100 percent cost estimate accompanies this submittal along with details on all operational plans.

The Yakama Nation proposes to proceed through Step 3 for Marion Drain in FY 2014 and FY 2015. Since funding for construction is not in the current Accord, at this time the Tribe is planning for construction in FY 2018 and FY 2019.

8.3.3 Capital Construction Cost Estimates

Capital construction cost estimates are based on a conceptual design. Due to the level of uncertainty, a contingency of approximately 20-25 percent is applied to each construction cost area. Such a contingency is largely dependent on the number of uncertainties associated with the project and the amount of pre-investigation work completed. Estimated construction costs represent a maximum range and likely cost reductions would be identified in future planning stages through analysis of alternatives and elimination of many uncertainties.

The current estimate for capital construction is based on the descriptions of facilities and infrastructure provided in Section 4.5.6, Existing Facilities, and Section 4.5.7, Proposed Facilities.

Construction costs associated with renovating and or demolishing existing facilities are included in Table 8-11; details of this work are provided in Section 4.5.7. Figure 4-19 shows the layout for the main hatchery building.

Costs are broken down into major infrastructure and facility components and are based on the scope and conceptual descriptions presented in Chapter 4 (Table 8-11). Details of these estimates are found in Appendix H. The estimated construction budget for Marion Drain Hatchery is $8,201,000. These estimates are based on conceptual design and include a contingency of about 20 percent to accommodate the level of uncertainty at this stage.

The Yakama Nation proposes to implement all components of the Marion Drain Hatchery as a single project. The proposed hatchery components are relatively simple and phasing construction over multiple years would likely increase overall costs.

Table 8-11. Summary of estimated construction costs, Marion Drain Hatchery

Description	Total
Process Water Supply to Head Boxes	$512,256
Head Boxes, Chiller and Degassing	$1,254,000
Site Work and Utilities	$690,300
Process Water Distribution and Drains	$395,664
Hatchery Building - 28,300 SF	$3,326,744
Adult Holding Ponds	$239,190
Effluent Settling Structure - Dual Cell	$128,880
Construction Cost Subtotal – 2012 $	**$6,547,034**
Inflation / Escalation 5% to Mid-Point Construction – 2018	$6,970,477
Mobilization / Demobilization, General Conditions	$766,752
Subtotal	**$7,737,230**
Contingency (Included Above - See Appendix H for Detail)	
Taxes 6%	$464,234
Probable Total Cost (2018 Dollars)	**$8,201,463**

Notes and Assumptions:

- Costs estimate in 2012 dollars
- Inflation / escalation at 5% to mid-point construction date of 2018
- Mob / Demobilization, general conditions includes inflation / escalation at 5% to mid-point construction date of 2018 (7% total from 2010 to mid-2012)
- Costs should be considered conceptual (+/- 35% to 50%)

8.3.4 Capital Equipment Cost Estimates

Implementing the proposed program will require acquisition of new equipment. The new Marion Drain facility will require investment in various types of equipment, from office furniture and laboratory equipment to water systems. Table 8-12 lists the potential types of equipment by functional area of the proposed operation and their probable costs. A conceptual estimated budget of $268,000 (escalated at 2.5 percent from FY 2012 to FY 2019, when equipment would be needed) has been included for capital equipment associated with the new facilities and operation.

Table 8-12. Capital equipment budget by facility/ hatchery functional area, Marion Drain Facility.

Description	Total Cost (FY 2012 Dollars)	Total Cost (FY 2019 Dollars)
Office Equipment	$9,200	$10,936
Computers / Printers	$18,380	$21,848
Office Furniture and Cabinets	$12,100	$14,383
Communications Equipment	$32,728	$38,903
Housing Equipment and Furniture / Permanent Staff Housing	$0	$0
Housing Equipment and Furniture / Temporary Staff Housing	$0	$0
Shop Equipment	$0	$0
Buildings / Facilities Needs	$0	$0
Transportation	$0	$0
Water System Operation	$0	$0
Incubation	$0	$0
Fish Transport	$151,000	$179,492
Chinook Rearing at Hatchery	$0	$0
Chinook Rearing at Acclimation Ponds	$0	$0
Tagging	$0	$0
M&E Equipment	$0	$0
Technical / Lab Equipment	$0	$0
Disinfection Equipment (Other Disease and Pathology Needs)	$2,000	$2,377
Other	$0	$0
Total	**$225,408**	**$267,939**

Notes and Assumptions:

- Costs shown in 2012 and 2019 dollars
- Expenditures will occur in late 2019
- Costs are escalated at 2.5% annually
- Costs should be considered conceptual (+/- 35% to 50%)
- Items are not duplicated in the capital construction and operating budgets

8.3.5 Environmental Compliance Cost Estimates

Developing the proposed Marion Drain Hatchery as part of the ongoing Marion Drain Chinook program will incur environmental compliance costs subsequent to this master planning stage. Compliance steps for the proposed program could include the National Environmental Policy Act (NEPA), a Biological Assessment under the Endangered Species Act, and other laws and regulations that are discussed in Section 7. Table 8-13 presents the estimated cost by potential permit or other compliance requirement. Costs are estimated to be approximately $103,000 to meet all requirements to implement the project.

Table 8-13. Estimated costs of environmental compliance, Marion Drain Hatchery.

Project Area / Permit / Requirement	Estimated Cost to Complete (2012 Dollars)	Estimated Cost to Complete (2014 Dollars)
Water Supply / Quality		
Groundwater Right (WDOE) – one new well	$5000	$5253
NPDES (EPA) – Hatchery Discharge (need TBD)	$10,000	$10,506
Surface Water Right (WDOE)	$10,000	$10,506
Planning Approvals		
NEPA (BPA) – Supplemental analysis tiering to 1996 fish production EIS	$25,000	$26,266
SEPA (WDFW or WDOE) – adoption of NEPA determination	$5,200	$5,463
ESA Section 7 Compliance (USFWS and NMFS) - Biological Assessment	$8,000	$8,405
Section 106 Cultural Resources Clearance (SHPO)	$5,000	$5,253
Wetland Delineation – part of Section 404 review (Corps)	$6,000	$6,304
Construction		
JARPA – Includes Section 404, Section 10, Section 401, HPA (Corps, WDOE, WDFW)	$8,500	$8,930
Shoreline Substantial Development Permit (County) for new pump station	$6,000	$6,304
County Commercial Building Permits	$3,750	$3,940
NPDES General Construction Storm Water and Storm Water Pollution Prevention Plan (EPA)	$4,800	$5,043
County Road Use Permits	$800	$841
Total	**$68,050**	**$103,014**

Notes and Assumptions:

- At least one well is proposed
- NEPA EIS: On Reservation lands, BPA likely to require NEPA if they are funding the project
- YN will address Section 106 Cultural Resources Clearance (SHPO)
- Assumes majority of expenditures occur in FY 2013 and FY 2014
- Costs are escalated at 2.5% annually
- Costs should be considered conceptual (+/- 35% to 50%)
- Concept completed during Step 2 (2013 and 2014 dollars)

8.3.6 Land Acquisition Costs

All land associated with the Marion Drain Chinook Hatchery program has been acquired and no new property or lands will be purchased or require expenditures for this work.

8.3.7 Operations and Maintenance Costs

The following sections present cost estimates associated with operations and maintenance of the proposed Marion Drain Chinook Hatchery program.

8.3.7.1 Annual Operating Costs

Operating costs for the proposed hatchery are shown in Table 8-14. Expenses include such items as payroll, utilities, vehicles, supplies, maintenance, and potential subcontracted support services. The Yakama Nation estimates that the budget for operations and maintenance will be $677,000 annually in 2012 when new facilities are finalized. If this estimate is escalated from FY 2012 to FY 2019 dollars, operational expenses would be about $805,000 annually. The 2012 costs are estimated as an average of the FY 2011 and 2012 O&M budgets for Marion Drain and Prosser hatcheries. A revised estimate for utilities is included in this average to account for increased pumping and upgraded facilities.

8.3.7.2 Projected Operating Costs

These types of costs tend to be more stable historically than construction costs. Operating expenses from FY 2012 to FY 2021 are shown in Table 8-15. It is expected that the facility would be constructed in FY 2018. Cost estimates for operations, maintenance, research, monitoring, and evaluation are escalated at 2.5 percent annually from FY 2012 through FY 2021.

8.3.8 Research, Monitoring and Evaluation Costs

Current research, monitoring and evaluation activities are funded under the current Fish Accord and are expected to be funded again under the next Accord to be negotiated in 2017 (see Table 4-5; Project 1995-063-025). The monitoring and evaluation activities supported by this agreement were determined by consensus of the scientists from the Yakama Nation and the WDFW. Project M&E activities have been subjected to rigorous scientific and technical review by the YKFP's STAC and the MIPT. STAC is responsible for the conceptual design of the project's M&E program, and MIPT must transform the conceptual design into the tasks identified in this agreement.

A conceptual framework for the proposed monitoring and evaluation plan will be designed to ensure that the program achieves the performance standards established for natural production and in-hatchery culture practices and operations (Section 3). A more detailed description of the monitoring and evaluation program is presented in the draft HGMP (Appendix A). This plan will be developed further in Step 2 of the three-step planning process. Costs associated with research, monitoring and evaluation defined in Project 1955-063-025 will be updated during Step 2.

8.3.9 Ten–Year Future Cost Summary

Estimated 10-year costs to operate the Marion Drain Chinook hatchery program from FY 2012 through FY 2021 are presented in Table 8-16. As stated in Section 8.0 above, costs for each program area are escalated to the year in which they are expected to occur. This estimated cost summary assumes planning and implementation of new facilities for Marion Drain Hatchery would occur in 2017 through 2019.

As previously noted, consistent with Step 1 of the Council's Three-Step process, cost estimates at this stage are conceptual. The Yakama Nation will refine these estimates during the Step 2 and Step 3 planning phases. This 10 year estimated cost summary is designed to be a planning tool and will be updated as costs are refined.

Table 8-14. Annual operating expenses, Marion Drain Hatchery.

Expense Area	Total Estimated Operations Costs for Marion and Prosser (2012 Dollars)	Total Estimated Operations Costs Allocated to Marion Drain (2012 Dollars)	Estimated Operations Costs Marion Drain (2019 Dollars)
Payroll (Taxes, Benefits, Mark-ups)	$850,829	$297,790	$353,979
Vehicles (Fuel, Oil, Maintenance, Mileage, Insurance)	$15,248	$5,337	$6,344
Repairs and Maintenance (Site, Buildings, Equipment)	$53,775	$18,821	$22,372
Rent and Lease (Equipment, Vehicles)	$56,841	$19,894	$23,648
Program Supplies (Office)	$3,300	$1,155	$1,373
Program Supplies (Lab, Shop, Maintenance)	$18,860	$6,601	$7,846
Program Supplies (Water System, Brood Collection, Egg Take)	$30,779	$10,773	$12,805
Program Supplies (Rearing and Release)	$79,502	$27,826	$33,076
Utilities (Electrical, Telephone, Sanitary, other)	$130,548	$84,856	$100,867
Travel Costs (Mileage, Lodging, Per diem)	$10,525	$3,684	$4,379
Education and Training	$3,300	$1,155	$1,373
Subcontracts (Professional Fees, Testing, Sampling, Disease Work)	$214,012	$74,904	$89,037
Facility Insurance	$6,625	$2,319	$2,756
Misc. Equipment, Other Improvements	$105,708	$36,998	$43,979
Indirect on Labor and Direct Expenses (18.66%)	$243,902	$85,366	$101,473
TOTAL	**$1,823,753**	**$677,478**	**$805,308**

Notes and Assumptions:

- Current annual operating costs are on-going, costs estimated increases in 2019 with site modifications and revisions are reflected in 2012 on for reference
- Costs are escalated from 2012 to 2019 at 2.5% annually
- Costs in out years should be considered conceptual (+/- 35% to 50%)
- The 2012 costs are estimated as an average of the FY 2011 and 2012 O&M budgets for Marion Drain and Prosser Hatcheries
- The combined budget is allocated at 35% for Marion Drain and 65% for Prosser
- Total Utility costs are allocated at 65% for Marion Drain and 35% for Prosser
- The overall operations budget for Marion Drain and Prosser is reduced for the cost share shown in Table 8-9 ($44,856 in labor and fringe costs and $4,500 in operating supplies)
- Utility costs are increased to account for the new facilities

Table 8-15. Annual operating expenses 10-year projection, Marion Drain Hatchery.

Expense Area	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Payroll (Taxes, Benefits, Mark-ups)	$297,790	$305,235	$312,866	$320,688	$328,705	$336,922	$345,345	$353,979	$362,829	$371,899
Vehicles (Fuel, Oil, Maintenance, Mileage, Insurance)	$5,337	$5,470	$5,607	$5,747	$5,891	$6,038	$6,189	$6,344	$6,502	$6,665
Repairs and Maintenance (Site, Buildings, Equipment)	$18,821	$19,292	$19,774	$20,268	$20,775	$21,294	$21,827	$22,372	$22,932	$23,505
Rent and Lease (Equipment, Vehicles)	$19,894	$20,392	$20,902	$21,424	$21,960	$22,509	$23,071	$23,648	$24,239	$24,845
Program Supplies (Office)	$1,155	$1,184	$1,213	$1,244	$1,275	$1,307	$1,339	$1,373	$1,407	$1,442
Program Supplies (Lab, Shop, Maintenance)	$6,601	$6,766	$6,935	$7,108	$7,286	$7,468	$7,655	$7,846	$8,043	$8,244
Program Supplies (Water System, Brood Collection, Egg Take)	$10,773	$11,042	$11,318	$11,601	$11,891	$12,188	$12,493	$12,805	$13,125	$13,454
Program Supplies (Rearing and Release)	$27,826	$28,521	$29,234	$29,965	$30,714	$31,482	$32,269	$33,076	$33,903	$34,750
Utilities (Electrical, Telephone, Sanitary, other)	$84,856	$86,977	$89,152	$91,381	$93,665	$96,007	$98,407	$100,867	$103,389	$105,974
Travel (Mileage, Lodging, Per Diem)	$3,684	$3,776	$3,870	$3,967	$4,066	$4,168	$4,272	$4,379	$4,488	$4,600
Education and Training	$1,155	$1,184	$1,213	$1,244	$1,275	$1,307	$1,339	$1,373	$1,407	$1,442
Subcontracts (Professional Fees, Testing, Sampling, Disease Work)	$74,904	$76,777	$78,696	$80,663	$82,680	$84,747	$86,866	$89,037	$91,263	$93,545
Facility Insurance	$2,319	$2,377	$2,436	$2,497	$2,559	$2,623	$2,689	$2,756	$2,825	$2,896
Misc. Equipment, Other Improvements	$36,998	$37,923	$38,871	$39,842	$40,839	$41,859	$42,906	$43,979	$45,078	$46,205
Indirect on Labor and Direct Expenses (18.66%)	$85,366	$87,500	$89,687	$91,930	$94,228	$96,584	$98,998	$101,473	$104,010	$106,610
Totals	**$677,478**	**$694,415**	**$711,775**	**$729,570**	**$747,809**	**$766,504**	**$785,667**	**$805,308**	**$825,441**	**$846,077**

Notes and Assumptions: Estimated costs are escalated at 2.5% annually in all operational areas

Table 8-16. 10 year future cost summary, FY 2012 – FY 2021, Marion Drain Hatchery.

Program Area	Fiscal Year									
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
A. Land Purchases, Leases and Easements (TBD)										
A.1. Land Purchase, Leases and Easements										
B. Planning and Design										
B.1. Step 1: Conceptual Engineering, Planning	$103,000									
B.2. Step 2: Preliminary Engineering, Planning and Environmental Compliance		$227,986	$97,708							
B.3. Step 3: Final Engineering, Planning			$145,649	$436,948						
C. Construction										
C.1. Estimated Construction Costs							$5,741,024	$2,460,439		
D. Capital Equipment										
D.1. Capital Equipment								$267,939		
E. Environmental Compliance										
E.1. Environmental Compliance		$41,206	$61,803							
F. O & M										
F.1. Marion Drain Programs	$677,478	$694,415	$711,775	$729,570	$747,809	$766,504	$785,667	$805,308	$825,441	$846,077
G. Monitoring and Evaluation										
G.1. Monitoring and Evaluation										
Total Estimated Capital Costs	**$103,000**	**$269,191**	**$305,166**	**$436,948**	**$0**	**$0**	**$5,741,024**	**$2,728,378**	**$0**	**$0**
Total Estimated O&M Costs	**$677,478**	**$694,415**	**$711,775**	**$729,570**	**$747,809**	**$766,504**	**$785,667**	**$805,308**	**$825,441**	**$846,077**
Total Estimated Costs	**$780,478**	**$963,606**	**$1,016,941**	**$1,166,518**	**$747,809**	**$766,504**	**$6,526,691**	**$3,533,687**	**$825,441**	**$846,077**

Notes and Assumptions:

A.1. Land purchase, leases and easements (assumes no costs are allocated to this project)
B.1. Step 1 Planning (based on current expenditures to complete all Step 1 activities and planning)
B.2. Step 2 Planning based on percentage of estimated construction costs (escalated to FY 2013 dollars)
B.2. Step 3 Planning based on percentage of estimated construction costs (escalated to FY 2014 dollars)
C.1. Estimated construction costs assume 70% occurs in FY 2018 and 30% in FY 2019 (escalated from FY 2012 to mid FY 2018 dollars)
D.1. Capital equipment, estimated lump sum for equipment items not shown in construction estimate (escalated from FY 2012 to FY 2019 dollars)
E.1. Environmental compliance costs (assumes 90% of expenses occur in FY 2014 and 10% of expenses in 2017) (escalated from FY 2012 to FY 2014 dollars)
F.1. O&M Cost hatchery program (costs escalated at 2.5% annually from 2012 dollars) assumes existing on-going operations and increased activities
G.1. Monitoring and evaluation program (not shown, is covered under Project Number 1995-063-25) See Section 3 in report

8.4 SUNNYSIDE ADULT COLLECTION FACILITY (CHINOOK AND COHO)

8.4.1 Cost Sharing / Program Areas / Major Milestones

8.4.1.1 Cost Sharing with Other Organizations and Entities

Cost sharing will be an important aspect of funding the proposed program. Conceptual costs take into consideration cost sharing that is occurring in current programs and that is expected to continue into the future.

Most cost sharing identified for the Yakama Nation's Sunnyside adult collection of coho and Chinook currently relates to operations and maintenance for the Marion Drain and Prosser facilities. Cost sharing includes both direct funding and in-kind support. Table 8-17 shows the cost sharing entities involved. While these cash contributions from the Yakama Nation are not shown as direct deductions from the line item budgets presented in this document, they were considered when developing cost estimates if they potentially affected a cost area in the future.

Table 8-17. Summary of cost sharing, Sunnyside Adult Collection Facility

Funding Source or Organization	Date / Fiscal Year	Item or Service Provided	Cash or In-Kind Contribution	Status	Amount
BOR	Annual	Electrician support, annual maintenance of ladder	In-kind	Pending	$0
Yakama Nation Gaming Revenue	Annual	Operating expenses	Cash	Confirmed	$49,856
				Totals	**$49,856**

Notes and Assumptions:

- Cost share is shown in 2012 dollars
- Cost share provides $44,856 in labor and fringe costs and $4,500 in operating supplies
- Figures provided are consistent with Project No. 1997-013-00
- Estimated cost shares are accounted for in Marion Drain and Prosser Hatchery budgets

8.4.1.2 Program Areas and Major Milestones

Completing the Council's Three-Step process often requires three to five years. During this time, considerable planning, design, environmental compliance and analysis of alternatives will occur. A generalized list of program areas and a preliminary timeline linking costs to planning, construction, capital equipment, environmental compliance, operations and maintenance and research, monitoring, and evaluation is presented in Figure 8-3 for FY 2012 through FY 2021. A cost summary by program area is shown in Table 8-18. Cost estimates for each program area are presented in the year in which they are expected to occur and are shown in Table 8-21; costs are escalated from FY 2012. It should be noted that only planning and design, environmental compliance, operations and maintenance and monitoring and evaluation for the existing program are shown as funded under the current Fish Accord (2008-2017) for the Sunnyside adult collection facility. Development of new facilities is planned for 2018 under a proposed new Accord.

Program Area	Occurrence	FY 2012		FY 2013		FY 2014		FY 2015		FY 2016		FY 2017		FY 2018		FY 2019		FY 2020		FY 2021	
Land Purchases, Leases and Easements	Annual																				
Planning and Design Step 1	One Time	■	■																		
Planning and Design Step 2 (and Environmental Compliance)	One Time			■	■	■															
Planning and Design Step 3 (Final Design)	One Time						■	■													
Construction	One Time													■	■	■					
Capital Equipment	One Time																				
Annual Operations and Maintenance	Annual															■	■	■	■	■	■
Monitoring and Evaluation	NA																				

Notes and Assumptions:

- Assumes proposed Step 2 and Step 3 funding is available on this schedule
- Assumes that costs for easements are included in operations budgets
- Assumes a design / build or modified design / build approach is utilized between Step 2 and Step 3
- Assumes construction starting in FY 2018 (less than a two year schedule dependent on a spring 2018 construction start)
- Assumes all proposed facilities and improvements are built in one construction season (during FY 2018 and early FY 2019)
- Assumes no major environmental compliance issues are identified beyond what is described in Section 7.0
- O&M expenditures will likely start during the last phases of construction (FY 2019) allowing for training and handoff of new facilities and equipment
- M&E expenditures associated with Marion Drain Facility, funded under BPA Project No. 1995-063-25

Figure 8-3. General time line for key milestones and expenditures, Sunnyside Adult Collection.

Table 8-18. Summary of key expenditures by program area, Sunnyside Adult Collection Facility.

Program Area	Estimated Cost	Occurrence	Level of Certainty
Planning and Design Step 1*	$0	One Time	Contract to develop Step 1 Master Plan (cost included in Marion Drain Table 8-9)
Planning and Design Step 2**	$0	One Time	Placeholder (less than concept) (cost included in Marion Drain Table 8-9)
Planning and Design Step 3***	$0	One Time	Placeholder (less than concept) (cost included in Marion Drain Table 8-9)
Construction	$744,425	One Time	Concept (+/- 35% to 50%) (escalated to 2018 dollars)
Capital Equipment	$0	One Time	Concept (+/- 35% to 50%) (assume no costs allocated to this site)
Environmental Compliance Step 2 (Permitting, EA, Other)	$91,639	One Time	Concept (+/- 35% to 50%) Completed during Step 2 (2014 dollars)
Land Purchases, Leases and Easements ****	$0	NA	
Annual Operations and Maintenance - Sunnyside Adult Collection	$146,543	Annual	Current O&M costs from project 1997-013-25 (escalated at 2.5% annually to 2019)
Monitoring and Evaluation - Sunnyside Adult Collection *****	$0	NA	

Notes and Assumptions:
*Shows the actual contract figure for completion of a Step 1 Master Plan, shown in 2012 dollars
**Shows an estimated placeholder cost estimate based on the conceptual construction cost
***Shows an estimated placeholder cost estimate based on the conceptual construction cost
****No land costs are applied to this project
*****Monitoring and Evaluation expenses are covered by project # 1995-063-25 (for Marion Drain and Prosser)
Budget figures assume that work would proceed on the time line shown in Figure 8-3 and Table 8-23 Future Cost Summary

8.4.2 Planning and Design Cost Estimates

The Yakama Nation has solicited input from a range of experts during Step 1 conceptual planning in order to avoid significant design and program changes in later planning stages. In addition, the Tribe has sought to validate the program, design criteria and cost estimates to the maximum extent possible through comprehensive early reviews. Input will continue to be sought as will review by a team of knowledgeable individuals through the Step 2 and 3 processes.

8.4.2.1 Step 1 Conceptual Planning and Design

The total budget for the conceptual planning and design work is covered under the Marion Drain costs. This figure is based on a contracted amount to complete the Step 1 Master Plan and includes conceptual planning, engineering, and development of the Step 1 Master Plan and ultimately responding to the NPCC and ISRP review of this Master Plan.

8.4.2.2 Step 2 Preliminary Planning and Design

The preliminary planning and design stage, intended to meet the Council's Step 2 requirements, is designed to identify any major difficulties or concerns with the program and facility designs. Step 2 design work should provide sufficient detail and specifics to assure that the intent and scope of Step 1 conceptual design work can be met and to further refine the cost estimates. Step 2 will include

refinement of scientific information, environmental compliance and ESA reviews. In addition, the Yakama Nation may implement other reviews to ensure all cost effective alternatives are being considered when nearing completion of the Step 2 planning and design work.

The costs for Step 2 are covered under the budget for Marion Drain. Initiation of this work is proposed in FY 2012 (Figure 8-3). This budget includes costs to refine the M&E program to meet NPCC requirements and to develop planning submittals to meet Step 2 requirements. The budget may need further refinement depending on the outcome of the Step 1 Master Plan approval process.

8.4.2.3 Step 3 Final Planning and Design

Step 3 final planning and design stage costs for Sunnyside adult collection facilities are covered under projected costs for Marion Drain. It is anticipated that this work will begin in FY 2013. Refinement of the Step 3 planning and design budget will occur in Step 2 during development of the preliminary design.

The cost estimates provided for planning and design assume that facilities will be developed along the timeline shown in Figure 8-3. Should the program be delayed or implemented in phases, costs for planning and design could increase if facility designs, construction specifications and planning and design documents are performed in multiple packages. The proposed schedule will result in more cost effective planning and implementation for Step 2, Step 3, implementation of construction, and long-term program operations. It should be noted that construction is planned in 2018 as it is not funded under the existing Fish Accord which ends in 2017. However, the Yakama Nation is pursuing facility design and environmental compliance on the schedule provided in Figure 8-3.

Step 3 is the final design review prior to construction. Development plans are advanced to a confidence level of +/- 10 to 15 percent and are ready for bid. A 100 percent cost estimate accompanies this submittal along with details on all operational plans.

The Tribe proposes to proceed through Step 3 for Sunnyside Dam in FY 2014 and FY 2015. Since funding for construction is not in the current Accord, at this time the Tribe is planning for construction in FY 2018 and FY 2019.

8.4.3 Capital Construction Cost Estimates

Capital construction costs are concept estimates based on a conceptual design. Due to the level of uncertainty, a contingency of approximately 20-25 percent is applied to each construction cost area. Such a contingency is largely dependent on the number of uncertainties associated with the project and the amount of pre-investigation work completed. Estimated construction costs represent a maximum range and likely cost reductions would be identified in future planning stages through analysis of alternatives and elimination of many uncertainties.

The current estimate for capital construction is based on the descriptions of facilities and infrastructure provided in Section 4.5.8, Existing Facilities, and Section 4.5.9, Proposed Facilities.

Construction costs associated with two alternatives for renovating and or demolishing existing facilities are included in Table 8-19a and 8-19b; details of this work are provided in Section 4.5.9. Figure 4-21 shows the proposed fish trap and sort location.

Costs are broken down into major infrastructure and facility components and are based on the scope and conceptual descriptions presented in Chapter 4 (Tables 8-19a and 8-19b). Details of these estimates are found in Appendix H. The estimated construction budget for alternatives 1 and 2 for Sunnyside Adult Collection Facilities is $744,000 and $1,160,000. These estimates are based on conceptual design and include a contingency of about 30 percent to accommodate the level of uncertainty at this stage. At this time the Yakama Nation is proposing to implement Alternative 1.

Yakama Nation proposes to implement all components of the Sunnyside Adult Collection Facilities as a single project. The proposed components are relatively simple and phasing construction over multiple years would likely increase overall costs.

Table 8-19a. Summary of estimated construction costs, Sunnyside Adult Collection Alternative 1.

Description	Total
Division 01 - General Requirements	$83,160
Division 02 - Existing Conditions	$24,000
Division 03 - Concrete	$17,810
Division 04 - Masonry	-
Division 05 - Metals	$184,600
Division 09 - Finishes	$26,000
Division 26 - Electrical	$65,000
Division 31 - Earthwork	$91,163
Division 33 - Utilities	-
Division 40 - Instrumentation and Controls	$13,000
Division 41 - Material Processing and Handling	-
Division 42 - Process Water Systems	$40,430
Construction Cost Subtotal – 2012 $	**$462,003**
Inflation / Escalation 5% to Mid-Point Construction – 2018	$619,128
Mobilization / Demobilization, General Conditions	$83,160
Subtotal	**$702,288**
Contingency (Included Above – See Appendix H for Detail)	-
Taxes 6%	$42,137
Alt. 1 Probable Total Cost - 2018 Dollars	**$744,425**

Notes and Assumptions:

- Costs estimate in 2012 dollars
- Inflation / escalation at 5% to mid-point construction date of 2018
- Mob / Demobilization, General Conditions includes inflation / escalation at 5% to mid-point construction date of 2018
- Costs should be considered conceptual (+/- 35% to 50%)

Table 8-19b. Summary of estimated construction costs, Sunnyside Adult Collection Alternative 2.

Description	Total
Division 01 - General Requirements	$129,533
Division 02 - Existing Conditions	$24,000
Division 03 - Concrete	$79,625
Division 05 - Metals	$372,450
Division 09 - Finishes	$45,500
Division 26 - Electrical	$65,000
Division 31 - Earthwork	$79,300
Division 40 - Instrumentation and Controls	$13,000
Division 42 - Process Water Systems	$40,755
Construction Cost Subtotal – 2012 $	**$719,630**
Inflation / Escalation 5% to Mid-Point Construction – 2018	$964,373
Mobilization / Demobilization, General Conditions	$129,533
Subtotal	**$1,093,906**
Contingency (Included Above – See Appendix H for Detail)	-
Taxes 6%	$65,634
Alt. 2 Probable Total Cost – 2018 Dollars	**$1,159,540**

Notes and Assumptions:

- Costs estimate in 2012 dollars
- Inflation / escalation at 5% to mid-point construction date of 2018
- Mob / Demob., General Conditions includes inflation / escalation at 5% to mid-point construction date of 2018
- Costs should be considered conceptual (+/- 35% to 50%)

8.4.4 Capital Equipment Cost Estimates

Implementing the proposed programs will require acquisition of new equipment. The new Sunnyside Adult Collection facility may require investment in various types of equipment. Proposed activities and costs under the Prosser coho and Chinook programs will cover capital equipment needs at the Sunnyside Adult Collection Facility.

8.4.5 Environmental Compliance Cost Estimates

Developing the proposed Sunnyside Adult Collection Facility as part of the ongoing Marion Drain and Prosser coho and Chinook programs will incur environmental compliance costs subsequent to this master planning stage. Compliance steps for the proposed program could include the National Environmental Policy Act (NEPA), a Biological Assessment under the Endangered Species Act, and other laws and regulations that are discussed in Section 7. Table 8-20 presents the estimated cost by potential permit or other compliance requirement. Costs are estimated to be approximately $92,000 to meet all requirements to implement the project.

Table 8-20. Estimated cost of environmental compliance, Sunnyside Adult Collection.

Project Area / Permit / Requirement	Estimated Cost to Complete (2012 Dollars)	Estimated Cost to Complete (2014 Dollars)
Water Supply / Quality		
Surface Water Right (WDOE) – for new collection / holding facility	$8,000	$8,303
Planning Approvals		
NEPA EA (TBD if Supplemental Analysis under 1996 EIS possible) (BPA) and in coordination with the USBR	$35,000	$36,323
ESA Section 7 Compliance (USFWS and NMFS) – Biological Assessment	$8,000	$8,303
Section 106 Cultural Resources Clearance (SHPO)	$5,000	$5,189
Floodplain Development Permit (County)	$6,000	$6,227
Wetland Delineation (Corps) – conduct for Section 404	$10,000	$10,378
Construction		
JARPA – Includes Section 404, Section 10, Section 401, HPA (Corps, WDOE, WDFW)	$10,000	$10,378
NPDES General Construction Storm Water and Storm Water Pollution Prevention Plan (EPA)	$5,500	$5,708
County Road Use Permits	$800	$830
Total	**$88,300**	**$91,639**

Notes and Assumptions:

- YN to obtain Section 106 cultural resources clearance (SHPO)
- Assumes majority of expenditures occur in FY 2013 and FY 2014
- Costs are escalated at 2.5% annually
- Costs should be considered conceptual (+/- 35% to 50%)
- Concept completed during Step 2 (2013 and 2014 dollars)

8.4.6 Land Acquisition Costs

All land associated with the Sunnyside adult collection facilities have been acquired and no new property or lands will be purchased or require expenditures for this work.

8.4.7 Operations and Maintenance Costs

The following sections present cost estimates associated with operations and maintenance of the proposed improvements to the Sunnyside adult collection facility.

8.4.7.1 Annual Operating Costs

Operating costs for the proposed Sunnyside adult collection facilities are shown in Table 8-21. Expenses include such items as payroll, utilities, vehicles, supplies, maintenance, and potential subcontracted support services. The Yakama Nation estimates that the budget for operations and maintenance will be $119,000 annually when the new facility is finalized. If this estimate is escalated from FY 2012 to FY 2019 dollars, operational expenses would be about $147,000 annually.

Table 8-21. Annual operating expenses, Sunnyside Adult Collection.

Expense Area	Estimated Operations Costs (2012 Dollars)	Estimated Operations Costs (2019 Dollars)
Payroll (Taxes, Benefits, Mark-ups)	$71,256	$87,636
Vehicles (Fuel, Oil, Maintenance, Mileage, Insurance)	$2,160	$2,656
Repairs and Maintenance (Site, Buildings, Equipment)	$3,000	$3,690
Rent and Lease (Equipment, Vehicles)	$7,416	$9,121
Program Supplies (Office)	$600	$738
Program Supplies (Lab, Shop, Maintenance)	$1,200	$1,476
Program Supplies (Water System, Brood Collection, Egg Take)	$2,736	$3,365
Program Supplies (Rearing and Release)	$0	$0
Utilities (Electrical, Telephone, Sanitary, other)	$9,382	$11,539
Travel Costs (Mileage, Lodging, Per diem)	$0	$0
Education and Training	$0	$0
Subcontracts (Professional Fees, Testing, Sampling, Disease Work)	$0	$0
Facility Insurance	$3,000	$3,690
Misc. Equipment, Other Improvements	$0	$0
Indirect on Labor and Direct Expenses (18.66%)	$18,403	$22,633
Total	**$119,153**	**$144,084**

Notes and Assumptions:

- Costs increases in 2019 with site modifications and revisions are reflected in 2012 for reference
- Costs are escalated from 2012 to 2019 at 2.5% annually
- Costs in out years should be considered conceptual (+/- 35% to 50%)
- Estimated costs for existing operations program do not include M&E costs

8.4.7.2 Projected Operating Costs

These types of costs tend to be more stable historically than construction costs. Operating expenses from FY 2012 to FY 2021 are shown in Table 8-22. It is expected that the facility would be constructed in FY 2018. Cost estimates for operations, maintenance, research, monitoring, and evaluation are escalated at 2.5 percent annually from FY 2012 through FY 2021.

8.4.8 Research, Monitoring and Evaluation Costs

Research monitoring and evaluation costs are not associated with the Sunnyside adult collection facilities. Current research, monitoring and evaluation activities are funded under the current Fish Accord and are expected to be funded again under the next Accord to be negotiated in 2017 (see Table 4-5; Project No. 1995-063-025).

8.4.9 Ten–Year Future Cost Summary

Estimated 10-year costs to operate the Sunnyside adult collection facility from FY 2012 through FY 2021 are presented in Table 8-23. As stated in Section 8.0, costs for each program area are escalated to the

year in which they are expected to occur. This estimated cost summary assumes planning and implementation of new facilities for Marion Drain Hatchery would occur in 2017 through 2019.

As previously noted, consistent with Step 1 of the Council's Three-Step process, cost estimates at this stage are conceptual. The Yakama Nation will refine these estimates during the Step 2 and Step 3 planning phases. This 10 year estimated cost summary is designed to be a planning tool and will be updated as costs are refined.

Table 8-22. Annual operating expenses, 10 year projection, Sunnyside Adult Collection

Expense Area	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Payroll (Taxes, Benefits, Mark-ups)	$71,256	$73,394	$75,596	$77,864	$80,200	$82,606	$85,084	$87,636	$90,265	$92,973
Vehicles (Fuel, Oil, Maintenance, Mileage, Insurance)	$2,160	$2,224	$2,291	$2,360	$2,431	$2,504	$2,579	$2,656	$2,736	$2,818
Repairs and Maintenance (Site, Buildings, Equipment)	$3,000	$3,090	$3,183	$3,278	$3,376	$3,478	$3,582	$3,690	$3,800	$3,914
Rent and Lease (Equipment, Vehicles)	$7,416	$7,638	$7,868	$8,104	$8,347	$8,597	$8,855	$9,121	$9,394	$9,676
Program Supplies (Office)	$600	$618	$637	$656	$675	$696	$716	$738	$760	$783
Program Supplies (Lab, Shop, Maintenance)	$1,200	$1,236	$1,273	$1,311	$1,351	$1,391	$1,433	$1,476	$1,520	$1,566
Program Supplies (Water System, Brood Collection, Egg Take)	$2,736	$2,818	$2,903	$2,990	$3,079	$3,172	$3,267	$3,365	$3,466	$3,570
Program Supplies (Rearing and Release)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Utilities (Electrical, Telephone, Sanitary, other)	$9,382	$9,664	$9,954	$10,252	$10,560	$10,877	$11,203	$11,539	$11,885	$12,242
Travel Costs (Mileage, Lodging, Per diem)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Education and Training	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Subcontracts (Professional Fees, Testing, Sampling, Disease Work)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Facility Insurance	$3,000	$3,090	$3,183	$3,278	$3,377	$3,478	$3,582	$3,690	$3,800	$3,914
Misc. Equipment, Other Improvements	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Indirect on Labor and Direct Expenses (18.66%)	$18,403	$18,955	$19,523	$20,109	$20,712	$21,334	$21,974	$22,633	$23,312	$24,011
Totals	**$119,153**	**$122,727**	**$126,409**	**$130,201**	**$134,107**	**$138,131**	**$142,275**	**$146,543**	**$150,939**	**$155,467**

Notes and Assumptions: Estimated costs are escalated at 2.5% annually in all operational areas

Table 8-23. Ten year summary of future costs, FY 2012 - FY 2021, Sunnyside Adult Collection Facility.

Program Area	Fiscal Year									
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
A. Land Purchases, Leases and Easements (to be determined)										
A.1. Land Purchase, Leases and Easements										
B. Planning and Design										
B.1. Step 1: Conceptual Engineering, Planning										
B.2. Step 2: Preliminary Engineering, Planning and Environmental Compliance										
B.3. Step 3: Final Engineering, Planning										
C. Construction										
C.1. Estimated Construction Costs							$521,098	$223,328		
D. Capital Equipment										
D.1. Capital Equipment								$0		
E. Environmental Compliance										
E.1. Environmental Compliance		$45,819	$45,819							
F. Operations and Maintenance										
F.1. Sunnyside Adult Collection	$119,153	$122,727	$126,409	$130,201	$134,107	$138,131	$142,275	$146,543	$150,939	$155,467
G. Monitoring and Evaluation										
G.1. Monitoring and Evaluation Program										
Total Estimated Capital Costs	**$0**	**$45,819**	**$45,819**	**$0**	**$0**	**$0**	**$521,098**	**$223,328**	**$0**	**$0**
Total Estimated O&M Costs	**$119,153**	**$122,727**	**$126,409**	**$130,201**	**$134,107**	**$138,131**	**$142,275**	**$146,543**	**$150,939**	**$155,467**
Total Estimated Costs	**$119,153**	**$168,547**	**$172,229**	**$130,201**	**$134,107**	**$138,131**	**$663,372**	**$369,870**	**$150,939**	**$155,467**

Notes and Assumptions:
A.1. Land Purchase, Leases and Easements (assumes no costs are allocated to this project)
B.1. Step 1 Planning (included in Marion Drain see Table 8-10 and Table 8-16)
B.2. Step 2 Planning (included in Marion Drain see Table 8-10 and Table 8-16)
B.2. Step 3 Planning (included in Marion Drain see Table 8-10 and Table 8-16)
C.1. Estimated construction costs assume 70% occurs in FY 2018 and 30% in FY 2019 (escalated from FY 2012 to mid FY 2018 dollars)
D.1. Capital equipment costs will be covered under the Prosser Hatchery program
E.1. Environmental compliance costs (assumes 50% of expenses occur in FY 2014 and 50% of expenses in 2015) (escalated from FY 2012 to FY 2014 dollars)
F.1. O&M cost hatchery program (costs escalated at 2.5% annually from 2012 dollars) assumes existing on-going operation
G.1. Monitoring and evaluation program (not shown, is covered under Project 1995-063-25)

8.5 HOLMES RANCH (COHO)

8.5.1 Cost Sharing / Program Areas / Major Milestones

8.5.1.1 Cost Sharing with Other Organizations and Entities

Cost sharing will be an important aspect of funding the proposed program. Cost sharing sources are being identified and will be presented in Step 2.

8.5.1.2 Program Areas and Major Milestones

Completing the Council's Three-Step process often requires three to five years. During this time, considerable planning, design, environmental compliance and analysis of alternatives will occur. A generalized list of program areas and a preliminary time line linking costs to planning, construction, capital equipment, environmental compliance, operations and maintenance and research, monitoring, and evaluation is presented in Figure 8-4 for FY 2012 through FY 2021. A cost summary by program area is shown in Table 8-24. Cost estimates for each program area are presented in the year in which they are expected to occur and are shown in Table 8-30; costs are escalated from FY 2012.

8.5.2 Planning and Design Cost Estimates

The Yakama Nation has solicited input from a range of experts during Step 1 conceptual planning in order to avoid significant design and program changes in later planning stages. The Tribe also sought to validate the program, design criteria and cost estimates to the maximum extent possible through comprehensive early reviews. Input will continue to be solicited and reviewed by a team of knowledgeable individuals through the Step 2 and 3 processes.

8.5.2.1 Step 1 Conceptual Planning and Design

The total budget for the conceptual planning and design work is about $103,000 (Table 8-24). This figure is based on a contracted amount to complete the Step 1 Master Plan and includes conceptual planning, engineering, and development of the Step 1 Master Plan and ultimately responding to the NPCC and ISRP review of this Master Plan.

Program Area	Occurrence	FY 2012		FY 2013		FY 2014		FY 2015		FY 2016		FY 2017		FY 2018		FY 2019		FY 2020		FY 2021	
Land Purchases, Leases and Easements	One Time							■	■	■	■	■	■	■	■	■	■	■	■	■	■
Planning and Design Step 1	One Time	■	■																		
Planning and Design Step 2 (and Environmental	One Time		■	■	■	■															
Planning and Design Step 3 (Final Design)	One Time				■																
Construction	One Time						■	■	■												
Capital Equipment	One Time								■												
Annual Operations and Maintenance	Annual								■	■	■	■	■	■	■	■	■	■	■	■	■
Monitoring and Evaluation	Annual								■	■	■	■	■	■	■	■	■	■	■	■	■

Notes and Assumptions:

- Assumes proposed Step 2 and Step 3 funding is available on this schedule
- Assumes that costs for easements are included in operations budgets
- Assumes a design / build approach is used between Step 2 and Step 3
- Assumes construction starting in FY 2014 (less than a two year schedule dependent on a spring 2014 construction start)
- Assumes all proposed facilities and improvements are built in one construction season (during FY 2014 and early FY 2015)
- Assumes no major environmental compliance issues are identified beyond what is described in Section 7.0
- O&M expenditures will likely start during the last phases of construction (FY 2015) allowing for training and handoff of new facilities and equipment
- M&E expenditures will likely start after the last phases of construction (FY 2015), funded under BPA Project No. 1995-063-25

Figure 8-4. General time line for key milestones and expenditures, Holmes Ranch Hatchery

Table 8-24. Summary of key expenditures by program area, Holmes Ranch Hatchery.

Program Area	Estimated Cost	Occurrence	Level of Certainty
Planning and Design Step 1*	$102,500	One Time	Contract amount to develop Step 1 Master Plan
Planning and Design Step 2**	$317,750	One Time	Placeholder (escalated from 2012 to 2014 dollars at 2.5%)
Planning and Design Step 3***	$568,388	One Time	Placeholder (escalated from 2014 dollars at 2.5%)
Construction	$8,849,104	One Time	Concept (+/- 35% to 50%) (escalated to 2015 dollars at 2.5%)
Capital Equipment	$97,889	One Time	Concept (+/- 35% to 50%) (escalated to 2014 dollars at 2.5%)
Environmental Compliance Step 2 (Permitting, EA, Other)	$340,662	One Time	Concept (+/- 35% to 50%) completed during Step 2 (2014 dollars)
Land Purchases, Leases and Easements ****	$0	NA	
Annual Operations and Maintenance - Holmes Ranch Hatchery Program	$579,427	Annual	Current O&M costs 2015 dollars (escalated at 2.5% annually)
Monitoring and Evaluation – Holmes Ranch Hatchery Program *****	$0	NA	

Notes and Assumptions:
*Shows the actual contract figure for completion of a Step 1 Master Plan
**Shows an estimated placeholder cost estimate based on the conceptual construction cost
***Shows an estimated placeholder cost estimate based on the conceptual construction cost
****No lands costs are applied to this project
*****Monitoring and Evaluation expenses are covered by project # 1995-063-25
Budget figures assume that work would proceed on the time line shown in Figure 8-4 and Table 8-30 Future Cost Summary

8.5.2.2 Step 2 Preliminary Planning and Design

The preliminary planning and design stage, intended to meet the Council's Step 2 requirements, is designed to identify any major difficulties or concerns with the program and facility designs. Step 2 design work should provide sufficient detail and specifics to assure that the intent and scope of Step 1 conceptual design work can be met and to further refine the cost estimates. Step 2 will include refinement of scientific information, environmental compliance and ESA reviews. In addition, the Yakama Nation may implement other reviews to ensure all cost effective alternatives are being considered when nearing completion of the Step 2 planning and design work.

A placeholder of $318,000 (Table 8-24) has been identified for Step 2 preliminary planning, environmental compliance, site investigations and design. Initiation of this work is proposed in FY 2012 (Figure 8-4). This budget includes costs to refine the M&E program to meet NPCC requirements and to develop planning submittals to meet Step 2 requirements. The budget may need further refinement depending on the outcome of the Step 1 Master Plan approval process.

8.5.2.3 Step 3 Final Planning and Design

A placeholder of $568,000 (Table 8-24) has been identified for the Step 3 final planning and design stage. It is anticipated that this work will begin in FY 2013. Refinement of the Step 3 planning and design budget will occur in Step 2 during development of the preliminary design.

The cost estimates provided for planning and design assume that facilities will be developed along the timeline shown in Figure 8-4. Should the program be delayed or implemented in phases, costs for planning and design could increase if facility designs, construction specifications and planning and design documents are performed in multiple packages. The proposed schedule will result in more cost effective planning and implementation for Step 2, Step 3, implementation of construction, and long-term program operations. It should be noted that construction is planned in 2014. The Yakama Nation is pursuing facility design and environmental compliance on the schedule provided in Figure 8-4.

Step 3 is the final design review prior to construction. Development plans are advanced to a confidence level of +/- 10 to 15 percent and are ready for bid. A 100 percent cost estimate accompanies this submittal along with details on all operational plans.

The Yakama Nation proposes and respectfully asks that the Council consider the following steps to accelerate post-Step 3 project implementation. The Tribe proposes to adopt a design / build approach. Following completion of the Step 2 preliminary design, the Tribe would implement design / build and a final construction contract would be negotiated at completion of the final design and Step 3 approval. The design / build approach would provide the most realistic construction cost estimate possible in Step 3. This approach could result in significant cost savings and reduced risk without altering the Council's requirements for the Step 3 submittal or approval, while also helping to ensure that these vitally needed new facilities are adequately reviewed and completed at the earliest possible juncture.

8.5.3 Capital Construction Cost Estimates

Capital construction costs are concept estimates based on a conceptual design. Due to the level of uncertainty, a contingency of approximately 20-25 percent is applied to each construction cost area. Such a contingency is largely dependent on the number of uncertainties associated with the project and the amount of pre-investigation work completed. Estimated construction costs represent a maximum range and likely cost reductions would be identified in future planning stages through analysis of alternatives and elimination of many uncertainties.

The current estimate for capital construction is based on the descriptions of facilities and infrastructure provided in Section 5.4.4, Existing Facilities, and Section 5.4.5, Proposed Facilities.

Construction costs associated with renovating and or demolishing existing facilities are included in Table 8-25; details of this work are provided in Section 5.4.5. Figure 5-10 shows proposed Holmes Ranch Hatchery site improvements.

Costs are broken down into major infrastructure and facility components and are based on the scope and conceptual descriptions presented in Chapter 5 (Table 8-25). Details of these estimates are found in Appendix H. The estimated construction budget for Holmes Ranch Hatchery is $8,849,000. These estimates are based on conceptual design and include a contingency of about 20 percent to accommodate the level of uncertainty at this stage.

Yakama Nation proposes to implement all components of the Holmes Ranch Hatchery as a single project. The proposed hatchery components are relatively simple and phasing construction over multiple years would likely increase overall costs.

Table 8-25. Summary of estimated construction costs, Holmes Ranch Hatchery.

Description	Total
Process Water Supply to Head Boxes	$584,832
Head Boxes, Chiller and Degassing	$1,182,000
Site Work and Utilities	$724,680
Process Water Distribution and Drains	$407,814
Hatchery Building - 14,124 SF	$3,292,736
Adult Holding Ponds	$267,945
Effluent Settling Structure - Dual Cell	$93,675
Hatchery Housing - Remodel (1), New (2)	$480,000
Construction Cost Subtotal - 2012 $	**$7,033,682**
Inflation/Escalation 5% to Mid-Point Construction - 2015	$7,574,506
Mobilization / Demobilization, General Conditions	$773,705
Subtotal	**$8,348,211**
Contingency (Included Above – See Appendix H for Detail)	-
Taxes 6%	$500,893
Probable Total Cost (2015 Dollars)	**$8,849,104**

Notes and Assumptions:

- Costs estimate in 2012 dollars
- Inflation / escalation at 5% to mid-point construction date of 2015
- Mob / Demob., General conditions includes inflation / escalation at 5% to mid-point construction date of 2015
- Costs should be considered conceptual (+/- 35% to 50%)

8.5.4 Capital Equipment Cost Estimates

Implementing the proposed program will require acquisition of new equipment. The new Holmes Ranch Hatchery will require investment in various types of equipment from office furniture and laboratory equipment to water systems. Table 8-26 lists the potential types of equipment by functional area of the proposed operation and their probable costs. A conceptual estimated budget of $98,000 (escalated at 2.5 percent from FY 2012 to FY 2015, when equipment would be needed) has been included for capital equipment associated with the new facilities and operation.

Table 8-26. Capital equipment budget by facility/hatchery functional area, Holmes Ranch Hatchery.

Description	Total Cost (FY 2012 Dollars)	Total Cost (FY 2015 Dollars)
Office Equipment	$0	$0
Computers / Printers	$0	$0
Office Furniture and Cabinets	$0	$0
Communications Equipment	$0	$0
Housing Equipment and Furniture / Permanent Staff Housing	$0	$0
Housing Equipment and Furniture / Temporary Staff Housing	$0	$0

Description	Total Cost (FY 2012 Dollars)	Total Cost (FY 2015 Dollars)
Shop Equipment	$0	$0
Buildings / Facilities Needs	$0	$0
Transportation	$0	$0
Water System Operation	$2,200	$2,369
Incubation	$2,600	$2,800
Fish Transport	$55,500	$59,767
Coho Rearing at Hatchery	$30,600	$32,953
Coho Rearing at Acclimation Ponds	$0	$0
Tagging	$0	$0
M&E Equipment	$0	$0
Technical / Lab Equipment	$0	$0
Disinfection Equipment (Other Disease and Pathology Needs)	$0	$0
Other	$0	$0
Total	**$90,900**	**$97,889**

Notes and Assumptions:

- Costs shown in 2012 and 2015 dollars
- Expenditures will occur in 2015
- Costs are escalated at 2.5% annually
- Costs should be considered conceptual (+/- 35% to 50%)
- Items are not duplicated in the capital construction and operating budgets

8.5.5 Environmental Compliance Cost Estimates

Developing the proposed Holmes Ranch Hatchery as part of the Yakima coho program will incur environmental compliance costs subsequent to this master planning stage. Compliance steps for the proposed program could include the National Environmental Policy Act (NEPA), a Biological Assessment under the Endangered Species Act, and other laws and regulations that are discussed in Section 7. Table 8-27 presents the estimated cost by potential permit or other compliance requirement. Costs are estimated to be approximately $341,000 to meet all requirements to implement the project.

Table 8-27. Estimated cost of environmental compliance, Holmes Ranch Hatchery

Project Area / Permit / Requirement	Estimated Cost to Complete (2012 Dollars)	Estimated Cost to Complete (2014 Dollars)
Water Supply / Quality		
Groundwater Right (WDOE) – for new well	$5,000	$5,189
Change in Use of Surface Water Right (WDOE) – from irrigation to aquaculture	$9,000	$9,340
NPDES – Hatchery Discharge (EPA) – need TBD	$10,000	$10,378
Planning Approvals		
NEPA EIS (TBD if Supplemental Analysis under 1996 EIS possible) (BPA)	$225,000	$233,508
SEPA (WDOE or WDFW) – Adoption of NEPA decision	$5,200	$5,397
ESA Section 7 Compliance (USFWS and NMFS) –	$8,000	$8,303

Project Area / Permit / Requirement	Estimated Cost to Complete (2012 Dollars)	Estimated Cost to Complete (2014 Dollars)
Biological Assessment		
Section 106 Cultural Resources Clearance (SHPO)	$8,000	$8,303
Floodplain Development Permit (County)	$6,000	$6,227
Wetland Delineation (for Section 404 permit)	$24,000	$24,908
Construction		
JARPA – Includes Section 404, Section 10, Section 401, HPA (Corps, WDOE, WDFW)	$10,000	$10,378
NPDES General Construction Storm Water and Storm Water Pollution Prevention Plan (EPA)	$5,500	$5,708
Shoreline Substantial Development Permit (County)	$8,000	$8,303
Kittitas County Commercial Building Permit	$3,750	$3,892
County Road Use Permit	$800	$830
Total	**$328,250**	**$340,662**

Notes and Assumptions:

- NEPA EIS to be updated w/ BPA contract cost
- YN will address Section 106 cultural resources clearance (SHPO)
- Assumes majority of expenditures occur in FY 2013 and 2014
- Costs are escalated at 2.5% annually
- Costs should be considered conceptual (+/- 35% to 50%)
- Concept completed during Step 2 (2013 and 2014 dollars)

8.5.6 Land Acquisition Costs

All land associated with the Holmes Ranch coho program has been acquired and no new property or lands will be purchased or require expenditures for this work. A land easement is needed from Cascade Canal Company for some operations but it is understood that no expenditures are needed for this agreement.

8.5.7 Operations and Maintenance Costs

The following sections present cost estimates associated with operations and maintenance of the proposed Holmes Ranch coho hatchery program.

8.5.7.1 Annual Operating Costs

Operating costs for the proposed hatchery are shown in Table 8-28. Expenses include such items as payroll, utilities, vehicles, supplies, maintenance, and potential subcontracted support services. The Yakama Nation estimates that the budget in 2012 dollars for operations and maintenance will be $515,000 annually. If this estimate is escalated from FY 2012 to FY 2016 dollars (when operational expenses would be incurred) expenses would be about $579,000 annually.

Table 8-28. Annual operating expenses, Holmes Ranch Hatchery

Expense Area	Estimated Operations Costs (2012 Dollars)	Estimated Operations Costs (2016 Dollars)
Payroll (Taxes, Benefits, Mark-ups)	$166,966	$187,922
Vehicles (Fuel, Oil, Maintenance, Mileage, Insurance)	$5,519	$6,211
Repairs and Maintenance (Site, Buildings, Equipment)	$20,189	$22,722
Rent and Lease (Equipment, Vehicles)	$17,046	$19,185
Program Supplies (Office)	$1,800	$2,026
Program Supplies (Lab, Shop, Maintenance)	$7,000	$7,878
Program Supplies (Water System, Brood Collection, Egg Take)	$27,113	$30,516
Program Supplies (Rearing and Release)	$56,418	$63,499
Utilities (Electrical, Telephone, Sanitary, other)	$87,565	$98,555
Travel Costs (Mileage, Lodging, Per diem)	$3,934	$4,428
Education and Training	$1,500	$1,688
Subcontracts (Professional Fees, Testing, Sampling, Disease Work)	$30,035	$33,805
Facility Insurance	$6,500	$7,316
Misc. Equipment, Other Improvements	$0	$0
Indirect on Labor and Direct Expenses (18.66%)	$83,230	$93,676
Total	**$514,813**	**$579,427**

Notes and Assumptions:

- 2012 costs are estimated using averages of the FY 2011 and FY 2012 O&M budgets for Marion Drain and Prosser hatcheries
- Costs are escalated from 2012 to 2016 at 2.5% annually
- Costs in out years should be considered conceptual (+/- 35% to 50%)
- Estimated costs for existing operations program do not include M&E costs
- Tagging costs are included in M&E (Project No. 1995-063-25)

8.5.7.2 Projected Operating Costs

These types of costs tend to be more stable historically than construction costs. Operating expenses from FY 2012 to FY 2021 are shown in Table 8-29. It is expected that the facility would be constructed in FY 2014. Cost estimates for operations, maintenance, research, monitoring, and evaluation are escalated at 2.5 percent annually from FY 2012 through FY 2021.

8.5.8 Research, Monitoring and Evaluation Costs

Current research, monitoring and evaluation activities are funded under the Fish Accord and are expected to be funded again under the next Accord to be negotiated in 2017 (see Table 4-5; Project 1995-063-025). The monitoring and evaluation activities supported by this agreement were determined by consensus of the scientists from the Yakama Nation and the WDFW. Project M&E activities have been subjected to rigorous scientific and technical review by the YKFP's STAC and the MIPT. STAC is responsible for the conceptual design of the project's M&E program, and MIPT must transform the conceptual design into the tasks identified in this agreement.

A conceptual framework for the proposed monitoring and evaluation plan will be designed to ensure that the program achieves the performance standards established for natural production and in-hatchery culture practices and operations (Chapter 3). A more detailed description of the monitoring and evaluation program is presented in the draft HGMP (Appendix B). This plan will be developed further in Step 2 of the three-step planning process. This section provides estimated conceptual costs for research, monitoring and evaluation associated with descriptions in Chapter 3.

8.5.9 Ten–Year Future Cost Summary

Estimated 10-year costs to operate the Holmes Ranch coho program from FY 2012 through FY 2021 are presented in Table 8-30. As stated in Section 8.0, costs for each program area are escalated to the year in which they are expected to occur. This estimated cost summary assumes planning and implementation of new facilities for Holmes Ranch Hatchery would occur in 2012 through 2016.

As previously noted, consistent with Step 1 of the Council's Three-Step process, cost estimates at this stage are conceptual. The Yakama Nation will refine these estimates during the Step 2 and Step 3 planning phases. This 10 year estimated cost summary is designed to be a planning tool and will be updated as costs are refined.

Table 8-29. Annual operating expenses, 10 year projection, Holmes Ranch Hatchery.

Expense Area	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Payroll (Taxes, Benefits, Mark-ups)	$166,966	$171,975	$177,134	$182,448	$187,922	$193,559	$199,366	$205,347	$211,507	$217,853
Vehicles (Fuel, Oil, Maintenance, Mileage, Insurance)	$5,519	$5,684	$5,855	$6,030	$6,211	$6,397	$6,589	$6,787	$6,991	$7,200
Repairs and Maintenance (Site, Buildings, Equipment)	$20,189	$20,794	$21,418	$22,061	$22,722	$23,404	$24,106	$24,829	$25,574	$26,341
Rent and Lease (Equipment, Vehicles)	$17,046	$17,557	$18,084	$18,627	$19,185	$19,761	$20,354	$20,964	$21,593	$22,241
Program Supplies (Office)	$1,800	$1,854	$1,910	$1,967	$2,026	$2,087	$2,149	$2,214	$2,280	$2,348
Program Supplies (Lab, Shop, Maintenance)	$7,000	$7,210	$7,426	$7,649	$7,878	$8,115	$8,358	$8,609	$8,867	$9,133
Program Supplies (Water System, Brood Collection, Egg Take)	$27,113	$27,926	$28,764	$29,627	$30,516	$31,431	$32,374	$33,346	$34,346	$35,376
Program Supplies (Rearing and Release)	$56,418	$58,110	$59,854	$61,649	$63,499	$65,404	$67,366	$69,387	$71,468	$73,613
Utilities (Electrical, Telephone, Sanitary, other)	$87,565	$90,192	$92,898	$95,685	$98,555	$101,512	$104,557	$107,694	$110,925	$114,252
Travel Costs (Mileage, Lodging, Per diem)	$3,934	$4,052	$4,174	$4,299	$4,428	$4,561	$4,697	$4,838	$4,983	$5,133
Education and Training	$1,500	$1,545	$1,591	$1,639	$1,688	$1,739	$1,791	$1,845	$1,900	$1,957
Subcontracts (Professional Fees, Testing, Sampling, Disease Work)	$30,035	$30,936	$31,864	$32,820	$33,805	$34,819	$35,863	$36,939	$38,047	$39,189
Facility Insurance	$6,500	$6,695	$6,896	$7,103	$7,316	$7,535	$7,761	$7,994	$8,234	$8,481
Misc. Equip, Other Improvements	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Indirect on Labor and Direct Expenses (18.66%)	$83,230	$85,727	$88,298	$90,947	$93,676	$96,486	$99,381	$102,362	$105,433	$108,596
Totals	**$514,813**	**$530,258**	**$546,165**	**$562,550**	**$579,427**	**$596,810**	**$614,714**	**$633,155**	**$652,150**	**$671,714**

Notes and Assumptions: Estimated costs are escalated at 2.5% annually in all operational areas

Table 8-30. 10 year summary of future costs, FY 2012 - FY 2021, Holmes Ranch Hatchery

Program Area	Fiscal Year									
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
A. Land Purchases, Leases and Easements (TBD)										
A.1. Land Purchase, Leases and Easements										
B. Planning and Design										
B.1. Step 1: Conceptual Engineering, Planning	$102,500									
B.2. Step 2: Preliminary Engineering, Planning and Environmental Compliance	$95,325	$158,875	$63,550							
B.3. Step 3: Final Engineering, Planning		$284,194	$284,194							
C. Construction										
C.1. Estimated Construct Costs			$2,654,731	$6,194,373						
D. Capital Equipment										
D.1. Capital Equipment				$97,889						
E. Environmental Compliance										
E.1. Environmental Compliance			$340,662							
F. Operations and Mainten.										
F.1. Holmes Ranch Hatchery				$562,550	$579,427	$596,810	$614,714	$633,155	$652,150	$671,714
G. Monitoring and Evaluation										
G.1. M&E Program					$0	$0	$0	$0	$0	$0
Total Estimated Capital Costs	**$197,825**	**$443,069**	**$3,343,137**	**$6,292,262**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
Total Estimated O&M Costs	**$0**	**$0**	**$0**	**$562,550**	**$579,427**	**$596,810**	**$614,714**	**$633,155**	**$652,150**	**$671,714**
Total Estimated Costs	**$197,825**	**$443,069**	**$3,343,137**	**$6,854,812**	**$579,427**	**$596,810**	**$614,714**	**$633,155**	**$652,150**	**$671,714**

Notes and Assumptions:

A.1. Land purchase, leases and easements (assumes no costs are allocated to this project)
B.1. Step 1 Planning (based on current expenditures to complete planning)
B.2. Step 2 Planning based on percentage of estimated construction costs (escalated to FY 2013 dollars)
B.2. Step 3 Planning based on percentage of estimated construction costs (escalated to FY 2014 dollars)
C.1. Estimated construction costs assume occurring in FY 2015 (escalated from FY 2012 to mid FY 2015 dollars)
D.1. Capital equipment, estimated lump sum for equipment items not shown in construction estimate (escalated from FY 2012 to FY 2015 dollars)
E.1. Environmental compliance costs (assumes expenses occur in FY 2014) (escalated from FY 2012 to FY 2014 dollars)
F.1. O&M cost hatchery program (costs escalated at 2.5% annually from 2012 dollars) assumes existing on-going operations
G.1. Monitoring and evaluation program (not shown, is covered under Project Number 1995-063-25)

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The Confederated Tribes and Bands of the Yakama Nation
May 2012

Yakima Subbasin Summer- and Fall-Run Chinook and Coho Salmon Hatchery Master Plan