UPPER WILLAMETTE RIVER CONSERVATION AND RECOVERY PLAN FOR CHINOOK SALMON AND STEELHEAD

Prepared by
Oregon Department of Fish and Wildlife (ODFW) and
the National Marine Fisheries Service (NMFS) Northwest Region

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Disclaimer

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Table of Contents

List of Appendices

(separate document)

List of Figures

List of Tables

Acronym and Abbreviation List

α	Alpha parameter
A	Abundance
A/P	Abundance/productivity
AHSWG	Ad Hoc Supplementation Monitoring and Evaluation Workgroup
AICs	Akaike information criterion
B	Beta parameter
BC	British Columbia
B-H	Beverton-holt function
BiOp	Biological opinion
BMPs	Best management practices
BOR	Bureau of Reclamation
BPA	Bonneville Power Administration
CA	Calapooia
CAPM	Conservation Assessment and Planning Model
CATAS	Conservation Assessment Tool for Anadromous Salmonids
CBFWA	Columbia Basin Fish and Wildlife Authority
C&S	Ceremonial and subsistence
CEP	Oregon State Police Coordinated Enforcement Program
CFS	Cubic feet per second
CHS	Spring Chinook
CIG	Climate Impacts Group
CM	Clackamas
CR	Columbia River
CRE	Columbia River estuary
CREP	Conservation Reserve Enhancement Program
CRF	Mean Columbia River Flow
CRFMP	Columbia River Fish Management Plan
CRITFC	Columbia River Inter-tribal Fish Commission
CRT	**C**ritical risk threshold
CSMEP	Collaborative Systemwide Monitoring and Evaluation Project
CSP	Conservation Supplementation Hatchery Program
CWA	Clean Water Act
CWT	**C**oded-wire tag
D	Diversity
DDT	Dichlorodiphenyltrichloroethane
DIDSON	Duel-Frequency Identification Sonar
DPS	Distinct population segment
EDT	Ecosystem Diagnosis and Treatment
EHM	Mortality associated with estuary habitat conditions
EIS	Environmental impact statement
EMAP	Environmental monitoring and assessment protocol
ESA	Endangered Species Act
ESU	Evolutionarily Significant Unit
EWEB	Eugene Water and Electric Board
Ex Com	Willamette-Lower Columbia ESA Executive Committee
FCRPS	Federal Columbia River Power System
FEIS	Final environmental impact statement
FERC	Federal Energy Regulatory Commission

FMEP	Fisheries Management and Evaluation Plan
FPDO	Fall Pacific Decadal Oscillation
FR	Federal Register
FRAM	Fishery Regulation Assessment Model
FSA	Farm Service Bureau
FW	Freshwater
FWHM	Mortality associated with freshwater habitat conditions (non hydro)
γ	Gamma parameter
GNRO	Oregon Governor's Natural Resources Office
GRTS	Generalized Randomized-Tessellation Stratified technique
H	High extinction risk
HAAT	High Annual Air Temperature
HCP	Habitat Conservation Plan
HFM	Mortality associated with hatchery fish
HGMP	Hatchery Genetic Management Plan
HIP	High Intrinsic Potential
HM	Mortality associated with harvest
HMP	Harvest Mitigation Hatchery Program
HOR	Hatchery Origin Fish
HSRG	Columbia River Hatchery Scientific Review Group
HTT	WATER Habitat Technical Team
IC	Implementation Coordinator
ICTRT	Interior Columbia Technical Recovery Team
ID	Identify
IMST	Independent Multidisciplinary Science Team
IP	Intrinsic Potential
ISAB	Independent Scientific Advisory Board
JCM	Mortality associated with juvenile competition
JHM	Mortality associated with juvenile habitat conditions due to hydro/flood control
L	Low extinction risk
LAAT	Low Average Air Temperature
LCFRB	Lower Columbia Fish Recovery Board
LCR	Lower Columbia River
LCREP	Lower Columbia River Estuary Partnership
LFT	Limiting factor or threat
LWD	Large wood debris
M	Moderate extinction risk
MAT	Minimum abundance threshold
MF	Middle Fork Willamette
MK	McKenzie
MO	Molalla
MOP	Minimum operating pool
MPG	Major population group
MS	Mainstem Willamette
MSCLR	Maximum Snow at Crater Lake and Rainier
MSD	mean square deviation
MU	Management Unit
NEPA	National Environmental Policy Act
NFCP	Native Fish Conservation Policy
NFH	National Fish Hatchery
NGO	Non-government agency

NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration-Fisheries
NOR	Natural Origin Fish
NPCC	Northwest Power and Conservation Council
NRCS	Natural Resources Conservation Service
NS	North Santiam
nSPDO	Negative Spring Pacific Decadal Oscillation index
OAR	Oregon State Administrative Rule
ODEQ	Oregon Department of Environmental Quality
ODF	Oregon Department of Forestry
ODFW	Oregon Department of Fish and Wildlife
ODOT	Oregon Department of Transportation
OPI	Oregon Production Index
OPRD	Oregon Parks and Recreation District
OPSW	Oregon Plan for Salmon and Watersheds
OR	Oregon
OrLCR	Lower Columbia River Conservation and Recovery Plan for Oregon Populations of Salmon and steelhead
OSM	Mortality associated with other species
OSP	Oregon State Police
OSU	Oregon State University
OWEB	Oregon Watershed Enhancement Board
OWRD	Oregon Water Resources Department
P	Productivity
PACFISH	Pacific Anadromous Fish Strategy
PAH	Polycyclic aromatic hydrocarbons
PBDE	Polybrominated diphenyl ethers
PCB	Polychlorinated biphenyls
PCEs	Primary constituent elements
PCR	Polymerase chain reaction
PCSRF	Pacific Coastal Salmon Recovery Fund
PDO	Pacific Decal Oscillation
PFMC	Pacific Fishery Management Council
PGE	Portland General Electric
pHOS	Proportion Hatchery Origin Spawners
PIT	Passive integrated transponders
PNAMP	Pacific Northwest Aquatic Monitoring Partnership
PNI	Pacific Northwest Index
PNOB	Proportion Natural Origin Spawners in Broodstock
pNOS	Proportion Natural Origin Spawners
PNW	Pacific Northwest
PVA	Population viability assessment
QET	Quasi extinction threshold
Rkm	river kilometer
RM	River-mile
RME	Research, monitoring and evaluation
RPA	Reasonable and prudent alternative
SAM	Mortality associated with spawner access
SB	Senate Bill
SHM	Mortality associated with spawner habitat conditions
SLAM	Species Life-cycle Analysis Modules

SMU	Species Management Units
SNPs	Single nucleotide polymorphisms
SS	Spatial Structure
SSA	South Santiam
SSB	Substitute Senate Bill
SS/D	Spatial structure/Diversity
SPDO	Spring Pacific Decadal Oscillation
SRBP	Sandy River Basin Partners
STEP	Salmon and Trout Enhancement Programs
STS	Summer Steelhead
STW	Winter Steelhead
SURPH	Survival under proportional hazards
SVB	Sides, vertices, and boundaries
SWCD	Soil and water conservation district
SWW	Selective water withdrawal
TBD	to be determined
TCM	Total Cumulative Mortality
TDG	Total dissolved gas
TMDL	Total maximum daily loads
TRT	Technical Recovery Team
USACE	U. S. Army Corps of Engineers
USBLM	U. S. Bureau of Land Management
USDA	U. S. Department of Agriculture
USEPA	U. S. Environmental Protection Agency
USFS	U. S. Forest Service
USFWS	U. S. Fish and Wildlife Service
UWR	Upper Willamette River
VH	Very high extinction risk
VL	Very low extinction risk
VSP	Viable salmonid population
WATER	Willamette Action Team for Ecosystem Restoration
WDFW	Washington Department of Fish and Wildlife
WLC	Washington and Lower Columbia
WLC-TRT	Willamette/Lower Columbia Technical Recovery Team
WOE	Weight of Evidence
WQ	Water Quality
WQMP	Water Quality Management Plan
WP BiOp	Willamette Project Biological Opinion (NMFS 2008)
WR	Willamette River Keeper
WRI	Willamette Restoration Initiative
WSC	Watershed Council

Glossary

abundance: In the context of salmon recovery, unless otherwise qualified, abundance refers to the number of adult fish returning to spawn, measured over a time series.

adaptive management: Adaptive management in salmon recovery planning is a method of decision making in the face of uncertainty. A plan for monitoring, evaluation, and feedback is incorporated into an overall implementation plan so that the results of actions can become feedback on design and implementation of future actions.

anadromous fish: Species that are hatched in freshwater, migrate to and mature in salt water,and return to freshwater to spawn.

baseline monitoring: In the context of recovery planning, baseline monitoring is done before implementation, in order to establish historical and/or current conditions against which progress (or lack of progress) can be measured.

biogeographical region: an area defined in terms of physical and habitat features, including topography and ecological variations, where groups of organisms (in this case, salmonids) have evolved in common.

broad sense recovery goals: Goals defined in the recovery planning process, generally by local recovery planning groups, that go beyond the requirements for delisting, to address, for example, other legislative mandates or social, economic, and ecological values.

compliance monitoring: Monitoring to determine whether a specific performance standard, environmental standard, regulation, or law is met.

delisting criteria: Criteria incorporated into ESA recovery plans that define both biological viability (biological criteria) and alleviation of the causes for decline (threats criteria based on the five listing factors in ESA section 4[a][1]), and that, when met, would result in a determination that a species is no longer threatened or endangered and can be proposed for removal from the Federal list of threatened and endangered species. These criteria are a NMFS determination and may include both technical and policy considerations and constitute our best estimate of what would be needed for delisting at this time. New information or analyses could lead us to delist before we reach the delisting criteria.

distinct population segment (DPS): A listable entity under the ESA that meets tests of discreteness and significance according to USFWS and NMFS policy. A population is considered distinct (and hence a "species" for purposes of conservation under the ESA) if it is discrete from and significant to the remainder of its species based on factors such as physical, behavioral, or genetic characteristics, it occupies an unusual or unique ecological setting, or its loss would represent a significant gap in the species' range.

diversity: All the genetic and phenotypic (life history, behavioral, and morphological) variation within a population. Variations could include anadromy vs. lifelong residence in freshwater, fecundity, run timing, spawn timing, juvenile behavior, age at smolting, age at maturity, egg size, developmental rate, ocean distribution patterns, male and female spawning behavior, physiology, molecular genetic characteristics, etc.

endangered species: A species in danger of extinction throughout all or a significant portion of its range.

effectiveness monitoring: Monitoring set up to test cause-and-effect hypotheses about recovery actions: Did the management actions achieve their direct effect or goal? For example, did fencing a riparian area to exclude livestock result in recovery of riparian vegetation?

ESA recovery plan: A plan to recover a species listed as threatened or endangered under the U.S. Endangered Species Act (ESA). The ESA requires that recovery plans, to the extent practicable, incorporate (1) objective, measurable criteria that, when met, would result in a determination that the species is no longer threatened or endangered; (2) site-specific management actions that may be necessary to achieve the plan's goals; and (3) estimates of the time required and costs to implement recovery actions.

evolutionarily significant unit (ESU): A group of Pacific salmon or steelhead trout that is (1) substantially reproductively isolated from other conspecific units and (2) represents an important component of the evolutionary legacy of the species.

extinct: No longer in existence. No individuals of this species can be found.

extirpated: Locally extinct. Other populations of this species exist elsewhere. Functionally extirpated populations are those of which there are so few remaining numbers that there are not enough fish or habitat in suitable condition to support a fully functional population.

factors for decline: Five general categories of causes for decline of a species, listed in the Endangered Species Act section 4(a)(1)(b): (A) the present or threatened destruction, modification, or curtailment of its habitat or range; (B) overutilization for commercial, recreational, scientific, or educational purposes; (C) disease or predation; (D) the inadequacy of existing regulatory mechanisms; or (E) other natural or human-made factors affecting its continued existence.

functionally extirpated: Describes a species that has been extirpated from an area; although a few individuals may occasionally be found, there are not enough fish or habitat in suitable condition to support a fully functional population.

hyporheic zone: Area of saturated gravel and other sediment beneath and beside streams and rivers where groundwater and surface water mix.

implementation monitoring: Monitoring to determine whether an activity was performed and/or completed as planned.

independent population: Any collection of one or more local breeding units whose population dynamics or extinction risk over a 100-year time period is not substantially altered by exchanges of individuals with other populations.

indicator: A variable used to forecast the value or change in the value of another variable.

interim regional recovery plan: A recovery plan that is intended to lead to an ESA recovery plan but that is not yet complete. These plans might address only a portion of an ESU or lack other key components of an ESA recovery plan.

intrinsic potential: The estimated relative suitability of a habitat for spawning and rearing of anadromous salmonid species under historical conditions inferred from stream characteristics including channel size, gradient, and valley width.

intrinsic productivity: The expected ratio of natural-origin offspring to parent spawners at levels of abundance below carrying capacity.

kelts: Steelhead that are returning to the ocean after spawning and have the potential to spawn again in subsequent years (unlike most salmon, steelhead do not necessarily die shortly after spawning).

large woody debris (LWD): A general term for wood naturally occurring or artificially placed in streams, including branches, stumps, logs, and logjams. Streams with adequate LWD tend to have greater habitat diversity, a natural meandering shape, and greater resistance to flooding.

legacy effects: Impacts from past activities that continue to affect a stream or watershed in the present day.

limiting factor: Physical, biological, or chemical features (e.g., inadequate spawning habitat, high water temperature, insufficient prey resources) experienced by the fish that result in reductions in viable salmonid population (VSP) parameters (abundance, productivity, spatial structure, and diversity). Key limiting factors are those with the greatest impacts on a population's ability to reach a desired status.

locally developed recovery plan: A plan developed by State, tribal, regional, or local planning entities to address recovery of a species. These plans are being developed by a number of entities throughout the region to address ESA as well as State, tribal, and local mandates and recovery needs.

maintained status: Population status in which the population does not meet the criteria for a viable population but does support ecological functions and preserve options for ESU/DPS recovery.

management unit: A geographic area defined for recovery planning purposes on the basis of State, tribal or local jurisdictional boundaries that encompass all or a portion of the range of a listed species, ESU, or DPS.

metrics: A metric is something that quantifies a characteristic of a situation or process; for example, the number of natural-origin salmon returning to spawn to a specific location is a metric for population abundance.

morphology: The form and structure of an organism, with special emphasis on external features.

natural-origin fish: Fish that were spawned and reared in the wild, regardless of parental origin.

parr: The stage in anadromous salmonid development between absorption of the yolk sac and transformation to smolt before migration seaward.

Persistence probability: The persistence probability is the complement of the extinction risk (i.e., persistence probability = 1 – extinction probability).

phenotype: Any observable characteristic of an organism, such as its external appearance, development, biochemical or physiological properties, or behavior.

piscivorous: (Adj.) Describes fish that eat other fish.

productivity: The average number of surviving offspring per parent. Productivity is used as an indicator of a population's ability to sustain itself or its ability to rebound from low numbers. The terms "population growth rate" and "population productivity" are interchangeable when referring to measures of population production over an entire life cycle. Can be expressed as the number of recruits (adults) per spawner or the number of smolts per spawner.

recovery domain: An administrative unit for recovery planning defined by NMFS based on ESU boundaries, ecosystem boundaries, and existing local planning processes. Recovery domains may contain one or more listed ESUs.

recovery goals: Goals incorporated into a locally developed recovery plan, which may include delisting (i.e. no longer considered endangered or threatened), reclassification (e.g., from endangered to threatened), and/or other goals. Broad sense goals are a subset of recovery goals (see glossary entry above).

recovery scenarios: Scenarios that describe a target status for each population within an ESU, generally consistent with TRT recommendations for ESU viability.

redd: A nest constructed by female salmonids in streambed gravels where eggs are fertilized and deposited.

recovery strategy: Statements that identify the assumptions and logic – the rationale – for the species' recovery program.

riparian area: Area with distinctive soils and vegetation between a stream or other body of water and the adjacent upland.

salmonid: Fish of the family *Salmonidae*, including salmon, trout, chars, grayling, and whitefish. In general usage, the term usually refers to salmon, trout, and chars.

smolt: A juvenile salmonid that is undergoing physiological and behavioral changes to adapt from freshwater to saltwater as it migrates toward the ocean.

spatial structure: Characteristics of a fish population's geographic distribution. Current spatial structure depends upon the presence of fish, not merely the potential for fish to occupy an area.

stakeholders: Agencies, groups, or private citizens with an interest in recovery planning, or those who will be affected by recovery planning and actions.

Technical Recovery Team (TRT): Teams convened by NMFS to develop technical products related to recovery planning. Planning forums unique to specific states, tribes, or regions may use TRT and other technical products to identify recovery actions.

threatened species: A species likely to become endangered within the foreseeable future throughout all or a significant portion of its range.

threats: Human activities or natural events (e.g., road building, floodplain development, fish harvest, hatchery influences, volcanoes) that cause or contribute to limiting factors. Threats may exist in the present or be likely to occur in the future.

viability criteria: Criteria defined by NMFS-appointed Technical Recovery Teams to describe a viable salmonid population, based on the biological parameters of abundance, productivity, spatial structure, and diversity. These criteria are used as technical input into the recovery planning process and provide a technical foundation for development of biological delisting criteria.

viability curve: A curve describing combinations of abundance and productivity that yield a particular risk of extinction at a given level of variation over a specified time frame.

viable salmonid population (VSP): an independent population of Pacific salmon or steelhead trout that has a negligible risk of extinction over a 100-year time frame.

VSP parameters: Abundance, productivity, spatial structure, and diversity. These describe characteristics of salmonid populations that are useful in evaluating population viability. See NOAA Technical Memorandum NMFS-NWFSC-42, *Viable salmonid populations and the recovery of evolutionarily significant units* (McElhany et al. 2000).

Executive Summary

(Separate document)

Chapter 1: Introduction

1.1 Scope of Recovery Plan

This Recovery Plan (Plan) serves as both a recovery plan under the Federal Endangered Species Act (ESA) and as a State of Oregon conservation Plan under Oregon's Native Fish Conservation Policy (NFCP). The Plan provides a framework and roadmap for the conservation and recovery of ESA listing units for Chinook salmon and steelhead species in the Willamette River system of Oregon. The listing units that are considered threatened under the ESA are:

- The Upper Willamette River (UWR) Chinook (Oncorhynchus tschawytscha) Evolutionarily Significant Unit (ESU)[1]. This ESU includes all naturally spawned populations of spring Chinook salmon in the Clackamas River and in the Willamette Basin upstream of Willamette Falls . Seven artificial propagation programs were considered to be part of the ESU: The McKenzie River Hatchery (Oregon Department of Fish and Wildlife (ODFW) stock #24[2]), Marion Forks/North Fork Santiam River (ODFW stock #21), South Santiam Hatchery (ODFW stock #23) in the South Fork Santiam River, South Santiam Hatchery (ODFW stock #23) in the Calapooia River, South Santiam Hatchery (ODFW stock #23) in the Mollala River, Willamette Hatchery (ODFW #22), and Clackamas Hatchery (ODFW #19) spring-run Chinook salmon hatchery programs. We have determined that these artificially propagated stocks are no more divergent relative to the local natural population(s) than what would be expected between closely related natural populations within the ESU (70 FR 37160; June 28, 2005). The only change in the UWR Chinook salmon hatchery membership since the listing is that the South Santiam (Calapooia) hatchery adult outplanting program was terminated in 2005. Currently the ESU includes the remaining six hatchery programs -- Clackamas, North Santiam, South Santiam (South Santiam River), South Santiam (Molalla River), McKenzie, and Middle Fork Willamette (Jones et al. 2011)..

- The UWR steelhead (Oncorhynchus mykiss) Distinct Population Segment (DPS).[3] The DPS includes all naturally spawned anadromous winter-run steelhead populations in the Willamette River and its tributaries upstream from Willamette Falls to the Calapooia River (inclusive).

Hereafter in this document we refer to the listing units as "UWR Chinook salmon and steelhead ESUs," unless otherwise specified.

The Plan contains the following major elements:

- A description of the context and process of Plan development (Chapter 1).
- Background information on the environmental characteristics of the Willamette River and biological structure of the UWR ESU/DPS (Chapter 2).
- Oregon's recommended criteria to achieve ESA delisting and further "broad sense" recovery, along with a description of the analyses and chapter relations in this Plan (Chapter 3).
- An evaluation of the conservation gaps between current status and different extinction risk levels for individual populations, as determined through a population viability model (Chapter 4).

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[1] Upper Willamette River Chinook listed as threatened in 1999 (64 FR 14208)[1] ; reaffirmed in 2005 (70 FR 37160)

[2] The stock numbers for the McKenzie River Hatchery and South Santiam Hatchery programs were mistakenly reversed in the regulatory description of this ESU.

[3] Upper Willamette River steelhead listed as threatened in 1999 (64 FR 14517)[3]; listing reaffirmed in 2006 (71 FR 834)

- A description of the life cycle and location-specific limiting factors and threats currently impacting each population (See Box 1 and Chapter 5).
- Details about the desired extinction risk status of populations and their threat scenarios chosen to meet delisting and broad sense recovery criteria (Chapter 6).
- A list of recovery strategies and management actions necessary to address limiting factors and threats and close gaps between the current and desired status of populations, or maintain current population status into the future (Chapter 7).
- A description of the research, monitoring, and evaluation, and associated measurable criteria, necessary to assess populations, make delisting decisions, understand uncertainties, and allow adaptive management in the future (Chapter 8).
- An adaptive management framework describing requirements for implementation, effectiveness evaluations, strategy and action modification, and reporting (Chapter 9).
- Details about goal and objectives for meeting broad sense recovery criteria (Chapter 10).

Box 1, A description of Limiting Factors and Threats.

Limiting Factors and Threats

The reasons for a species' decline generally have been described in terms of limiting factors and threats. NMFS has defined limiting factors as the biological and physical conditions that limit a species' viability – e.g., high water temperature – and defines threats as those human activities or natural processes that cause the limiting factors. For example, removing the vegetation along the banks of a stream (threat) can cause higher water temperatures (limiting factor), because the stream is no longer shaded.

In the context of experimental scientific investigation, it is often assumed that there is a single factor that limits a population of organisms. However, complexity and diversity in habitats, life cycle, and genetic adaptation give salmonid populations the resilience that has allowed them to survive over thousands of years. It is often impossible to obtain enough data to determine a single limiting factor in such a complex system, and because of the interrelationships of the elements of such a system, it is not even very useful to talk *as if* salmonid survival is controlled by a single factor (Bisson 1992).

Recently, to avoid the implications of "limiting factor" as it is used in the study of simpler systems, NMFS scientists have moved toward using "ecological concerns" as an umbrella term for the biological and physical conditions that limit a species' viability. However, the term "limiting factors" has been used extensively in Northwest salmon and steelhead recovery plans and in the Pacific Salmon Restoration Fund (PCSRF). For the sake of consistency, we have chosen to continue its use in this plan, while realizing that several limiting factors are implicated for most VSP parameters. Following through with research, monitoring, and evaluation to understand further the relative importance of these factors is also an essential part of the recovery plan.

1.2 Species Recovery under ESA

Section 4(f) of the ESA requires NMFS to develop and implement recovery plans for species listed as endangered or threatened under the Act. These plans must contain to the maximum extent practicable, (1) a description of site-specific management actions necessary to achieve the Plan's goal for the conservation and survival of the species; (2) objective, measurable criteria which, when met, would result in a determination that the species be removed from the list; and (3) estimates of the time required and cost to carry out the measures needed to achieve the Plan's goal and to achieve intermediate steps toward that goal. This Plan is not a regulatory document, in that it does not require actions to be implemented. However, Oregon and NMFS expect that existing efforts will continue. The Plan can also serves as a useful guide for regulatory agencies to use for implementing existing laws, regulations and agreements, to guide their decisions. If assessments and monitoring indicate that the status of the fish and the threats is not improving, more restrictive management, and possibly new or enhanced regulatory programs, may be necessary.

NMFS is the agency responsible for recovery planning for salmon and steelhead, and also for decisions to list and delist marine species, including anadromous fish, as endangered or threatened. Nevertheless, NMFS recognizes that local support of recovery plans is essential to their successful implementation. The agency is committed to involving local citizens and groups—those whose activities directly affect the listed species, and whose activities are most affected by recovery requirements—in development of the plans.

The State of Oregon has taken the lead, in collaboration with NMFS and many other agencies, in developing the Recovery Plan for UWR salmon and steelhead. This Plan fulfills the initial ESA recovery planning requirements for these species, and represents the participation and leadership of local citizen groups.

The primary goal of ESA recovery plans is for the species to reach the point that it no longer needs the protection of the Act and can be delisted. A Federal recovery plan describes those actions that will remove threats to the species and its habitat so that the species becomes self-sustaining in the wild, as well as the objective, measurable criteria and estimates of the time required and cost to carry out the measures needed to achieve the Plan's goal mentioned above. The Recovery Plan will be considered a "living document" where, as new information and analyses becomes available, revised and additional strategies and actions can be added to the Plan.

Once a species is deemed recovered, and removed from a 'listed status,' section 4(g) of the ESA requires the monitoring of the species for a period of not less than five years to ensure that it retains its recovered status and does not decline to such a state that requires the need to again list it as either a threatened or endangered species under the ESA.

1.3 State of Oregon Recovery Planning

The State of Oregon considers this Plan its conservation Plan for the UWR spring Chinook salmon and steelhead ESUs. The Plan supports the State of Oregon's Plan for Salmon and Watersheds (Oregon Plan) and the Oregon Conservation Strategy. These two planning efforts are described in Section 1.5 below. The Plan is designed to meet the requirements of Oregon's Native Fish Conservation Policy (OAR 635-007-0502 to 0509)[4]. The NFCP, adopted by the Oregon Fish and Wildlife Commission in November 2002 and revised in September 2003, provides policy guidance to support implementation of the Oregon

[4] http://www.dfw.state.or.us/fish/nfcp/rogue_river/docs/nfcp.pdf

Plan. The NFCP is Oregon's policy for managing native fish and determining restoration priorities that improve the effectiveness of conservation efforts under the Oregon Plan. The NFCP focuses on the conservation of naturally produced fish because they are the basis for Federal ESA listings and are the foundation for productive fisheries programs. As outlined in the NFCP, a recovery plan developed by ODFW should meet the requirements of conservation plans that are specified in the policy, as well as detail how Oregon proposes to recover each listed species covered in the Plan.

The NFCP uses conservation plans as a means to identify and implement strategies and actions to restore and maintain native fish in Oregon. The conservation plans describe approaches that the State of Oregon can apply to the conservation and sustainability of species and restore biological attributes necessary to achieve desired status goals that will provide significant ecological, economic and cultural benefits for all Oregonians. Conservation plans are developed through a sequential process, nearly identical to the one used for this recovery planning effort, and includes the following elements:

- Determine the management unit
- Determine its current status
- Define a desired status (viability and broad sense goals)
- Determine any gap between the two and the factors causing the gap (limiting factors)
- Identify strategies and actions that address the limiting factors
- Monitor and evaluate the status and actions implemented and use adaptive management to make adjustments.

As a conservation plan under the NFCP, the Plan for UWR spring Chinook and winter steelhead populations go beyond achieving ESA recovery requirements. Its desired status includes achievement of 'broad sense goals,' including meeting social and cultural benefits. This approach to species recovery includes development of goals for harvestable population levels viewed essential by all the parties involved. Although somewhat broader than the definition of recovery provided in the ESA, these broad sense recovery goals incorporate many of the traditional uses as well as rural and Native American values deemed important in Oregon and throughout the Pacific Northwest. Consistent with the Oregon Plan and NFCP, as well as the ESA, this Plan provides structure and guidance to efforts to protect and restore UWR spring Chinook salmon and winter steelhead and their habitats, while providing flexibility for actions to be determined by appropriate parties. It is designed to support and build on the existing conservation network across the ESU and DPS. This partnership of regulatory and non-regulatory entities, private landowners, and others represents an effective means for achieving viability targets and broader recovery goals.

1.4 Plan Development

This Plan is one piece of a larger recovery planning effort for listed species across the Pacific Northwest. It is also part of a broader planning effort by the State of Oregon to conserve and rebuild Oregon's native salmon and steelhead runs. These overlapping processes are discussed in this section. The Plan is the product of a multi-year, collaborative process led by the Oregon Department of Fish and Wildlife, with extensive participation by the Oregon Governor's Natural Resources Office (GNRO), NMFS, and the Oregon UWR Planning and Stakeholder teams (described below). In addition to the cooperative efforts of those entities, the Plan has benefited from the involvement of a number of other State, Federal, and local agencies. The primary authors of the Plan, representing ODFW and NMFS, benefited from the cooperative efforts of those entities as well as the involvement of a number of other State, Federal, and local agencies.

The Plan was developed with the premise that local support is essential to successful implementation, therefore this Plan considered Oregon's contemporary political, social, and infrastructure landscape which includes a broad range of Federal, State, Tribal, and local needs. The Plan also recognized that implementation of recovery actions will depend on the statutory and management authorities of a wide range of State and Federal agencies, and the willing participation of local governments, community-based conservation organizations, industries, and private landowners that influence salmon and steelhead survival throughout their life cycle.

This Recovery Plan provides an informed, comprehensive, and strategic approach to recovery of the UWR spring Chinook ESU and winter steelhead DPS by addressing the limiting factors and threats within population and across life cycle stages. It is based on science, supported by stakeholders, and is built on existing efforts supplemented by new recovery actions as needed. It is intended to be a realistic roadmap to recovery that will adapt over time in response to new threats, societal values, and new information obtained from research and monitoring.

1.4.1 NMFS's Regional Process

Currently, 17 ESUs and DPS's of Pacific salmon and steelhead in the Pacific Northwest are listed under the ESA. NMFS has designated five geographically-based recovery domains for preparing recovery plans for the listed species (Figure 1-1).

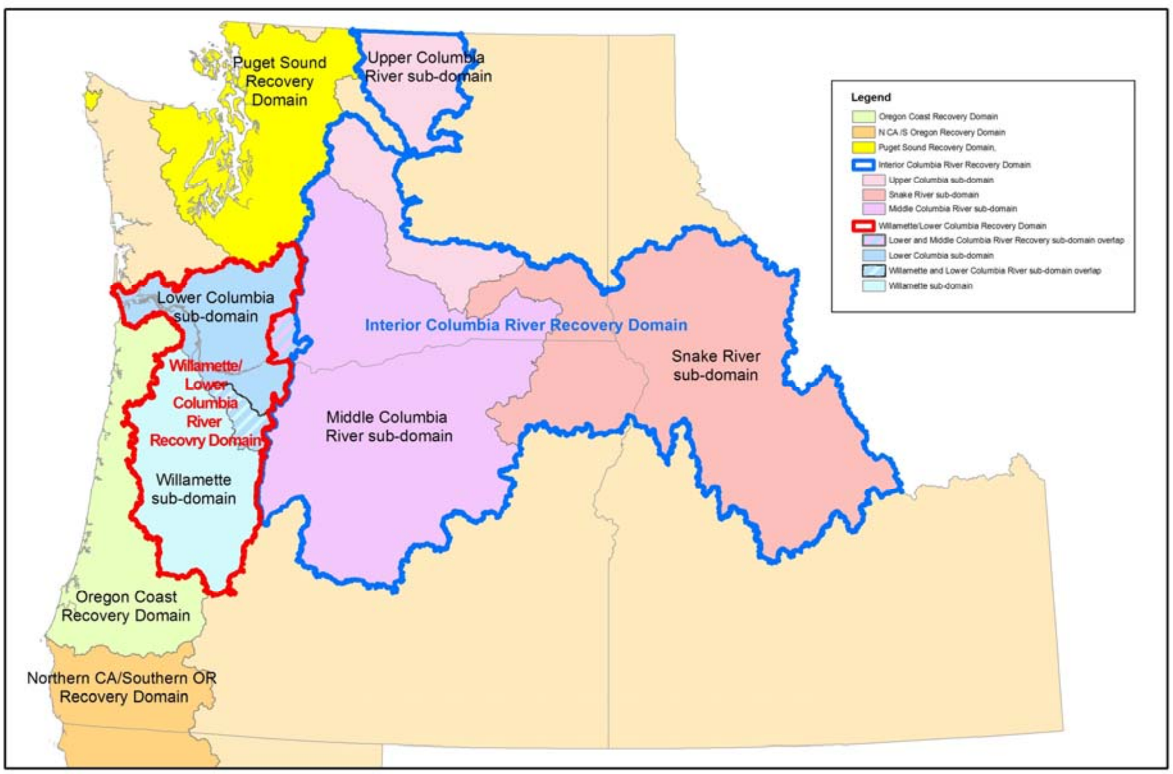

Figure 1-1. Recovery domains for ESA listed salmon and steelhead in Washington and those portions of Oregon and Idaho within the Columbia Basin.

The UWR Chinook salmon ESU and steelhead DPS are within the Willamette/Lower Columbia Domain, which includes all Columbia River subbasins downstream from (and including) the Hood River in Oregon and the White Salmon River in Washington. The other domains are the Interior Columbia River; Puget Sound and Washington Coast; Oregon Coast; and the Southern Oregon/ Northern California Coast domains. Technical and stakeholder involvement in each domain included the following:

- *Technical Recovery Teams*: For each domain, NMFS appointed an independent Technical Recovery Team (TRT) that had geographic and species expertise for the domain and provided a solid scientific foundation for recovery plans. The charge of each TRT was to define ESU/DPS structures, to develop recommendations on biological viability criteria for ESUs/DPSs and populations, to provide scientific support to local and regional recovery planning efforts, and to provide scientific evaluations of recovery plans. The TRTs included biologists from NMFS, State, tribal, and local entities, agencies, academic institutions, and private consulting groups.

  All the TRTs operated from a common scientific foundation. Each TRT used the same biological principles for developing its recommended ESU/DPS and population viability criteria – criteria that will be used, along with threats-based criteria, to determine whether a species has recovered sufficiently to be down-listed to threatened (if endangered) or delisted – although they have developed regionally specific approaches for applying these criteria. Each TRT's recommendations were assessed using the Viable Salmonid Population (VSP) framework, with viability criteria expressed in terms of abundance, productivity (population growth rate), spatial distribution, and diversity (McElhany et al. 2000). The TRT responsible for the domain pertinent to this Plan was the Willamette/Lower Columbia Technical Recovery Team (WLC-TRT).[5]

- *Management Units and Sub-Domains in the Willamette/Lower Columbia Domain* In each domain, NMFS worked with State, tribal, local and other Federal stakeholders to develop local planning forums appropriate to the domain, which built on ongoing, locally led efforts. The Willamette/Lower Columbia Domain is composed of the Lower Columbia River sub-domain and the Upper Willamette River sub-domain. The Upper Willamette River sub-domain, which this Plan addresses, includes the Willamette Basin above Willamette Falls, and spring Chinook in the Clackamas River Basin.

NMFS will ensure that any interdependencies and overlap between the Lower Columbia River "roll up" Plan and this Plan are adequately addressed and that a recovery strategy for the entire domain is clearly communicated. In addition, some recovery actions related to harvest, hatcheries, the Federal Columbia River Power System, and the estuary are regional in scope and will require a regionally consistent set of assumptions and actions. To provide a basis for regional discussion of these issues, NMFS has developed a series of recovery planning modules that are posted on their regional website.[6]

1.4.2 State of Oregon Recovery Planning Process and Use of the Plan

ODFW took the lead in drafting this Plan with the assistance of a cadre of other entities. Partners included NMFS, other State and Federal natural resources agencies, local communities and interested members of the public. The development process was collaborative with broad technical, stakeholder and public involvement. Critical players in the Plan's development were involved at each stage in the decision-making process. The Plan reflects the substantial review, discussion, critique and recommendations of three planning forums: an "expert panel," a diverse public stakeholders' group, and a recovery planning team. Common key staff attended the planning forums to facilitate and oversee the collaborative decision making process. Appendix A identifies the members and affiliations of the Planning and Stakeholder Teams. Appendix C identifies the members of the expert panel. The WLC-TRT

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[5] http://www.nwfsc.noaa.gov/trt/wlc.cfm
[6] http://www.nwr.noaa.gov/Salmon-Recovery-Planning/ESA-Recovery-Plans/Other-Documents.cfm

was also involved in the process. In addition, this Plan has been reviewed for scientific and technical soundness by an Independent Multidisciplinary Science Team (IMST[7]). The involvement of a wide spectrum of participants has been vital to the Plan's development and will help ensure that it is both scientifically and technically sound and supported by various stakeholders and private landowners.

Briefly, the function and composition of the groups was as follows:

- *Upper Willamette Expert Panel.*[8] The Oregon Upper Willamette Expert Panel (Expert Panel) was created by ODFW to assist in recovery planning. The panel consisted of biologists with significant knowledge of the limiting factors and threats influencing Oregon's listed salmon and steelhead populations. Panelists identified common key and secondary threat themes and limiting factors for the populations. The findings of the Expert Panel were passed on for review by the Planning and Stakeholder Teams.

- *Upper Willamette Stakeholder Team*. The Upper Willamette Stakeholder Team (Stakeholder Team) consisted of representatives of local communities; agricultural, business, fishing and timber interests; water and land users and managers; local and State governing bodies; and environmental interests. The Stakeholder Team provided policy guidance in the development of all aspects of the Plan and ensured locally appropriate and locally supported recovery actions that will achieve species recovery goals are included. The Stakeholder Team was particularly instrumental in the development of broad sense recovery goals, recovery scenarios, recovery strategies, and strategic guidance for the development and prioritization of management actions.

- *Upper Willamette Planning Team.* The Upper Willamette River Planning Team (Planning Team) included members from State and Federal agencies, many of whom had technical expertise with salmonids and habitat. The team provided technical guidance and assisted in writing different aspects of the Plan. A list of Stakeholder Team and Planning Team members and their affiliations may be found in Appendix A.

The intent of Oregon's recovery planning effort is to develop recovery plans, including this Plan, that meet ESA requirements, are technically sound, and are supported at the community level. The plans are being developed within the context of Oregon's contemporary infrastructures and political and social landscape and will consider a broad range of State, tribal, and local needs. Involvement by these different entities helps ensure that recovery goals and actions are consistent and compatible with the goals and direction adopted in related efforts. This integrated approach establishes partnerships that allow actions to be implemented effectively and efficiently. Ultimately, the successful implementation of recovery actions will depend on the willing participation of most, if not all, of the entities that influence salmon and steelhead

As with other Oregon recovery plans, this Plan describes strategies to protect and restore a sufficient level of ecologic function to achieve delisting and broad sense recovery of ESA listed species. The Plan recommends actions that could be carried out under the statutory and management authorities of a wide range of State and Federal agencies, industries, local governments, community-based conservation organizations and private landowners. The Plan will evolve as limiting factors and societal values change and as research, monitoring, and evaluation yield new information.

[7] http://www.fsl.orst.edu/imst/
[8] Panel Team Members are listed in Appendix C.

It is anticipated that on August 4, 2011 the Oregon Fish and Wildlife Commission will approve this Plan and adopted associated administrative rules as required by the NFCP. The Plan provides ODFW with conservation and fish management direction, and it will be integrated into other plans and planning processes that ODFW undertakes. The Plan will also be used to guide budget priorities through the Governor's Office, as well as funding and program priorities with State agencies, boards, and commissions. In particular, it will be used to help guide the Oregon Watershed Enhancement Board's (OWEB) funding decisions for watershed councils, soil and water conservation districts (SWCD's), and other implementers. The State of Oregon and NMFS are co-developers of the Plan.

1.4.3 Plan Review, Revision, Adoption and Implementation

The authors used other existing plans, documents, assessments, or requirements in developing this Plan, notably, actions contained in the *Estuary Module* (a recovery plan addressing the Columbia River estuary), the *Willamette River Basin Flood Control Project Biological Opinion* (WP BiOp), Federal Energy Regulatory Commission (FERC) hydropower re-license agreements, the Willamette Total Maximum Daily Load Allocation (TMDL) report, and local habitat restoration or conservation plans. In addition, the contents of this Plan are consistent with, complementary to, or build upon strategies or actions contained in the *Oregon Plan for Salmon and Watersheds*, the *Oregon Conservation Strategy*, the Hatchery Science Review Group's assessment of UWR hatchery programs as well as other recent scientific papers and reports, and the Northwest Power and Conservation Council subbasin plan.

NMFS published a Notice of Availability of the Proposed *Upper Willamette River Conservation and Recovery Plan for Salmon and Steelhead* in the Federal Register on October 22, 2010 and NMFS, ODFW and the Oregon Governor's Office held four formal public meeting and a number of informal sessions in order to obtain comments on the proposed Plan. More than thirty comments were received.

NMFS and ODFW reviewed all comments received for substantive issues and new information and revised the Plan as appropriate. We received a number of very detailed and substantive comments, as well as editorial clarifications and minor corrections, requests to cite specific documents, and suggested changes in wording to clarify the document. Most comments offered support for the Plan and its implementation, along with thoughtful comments. NMFS addressed the comments in the response to comments document, which is available on the NMFS Regional Office website - *http://www.nwr.noaa.gov/*

Based on a number of the comments, the Final Plan places additional emphasis on:

- the importance of successful reintroduction of naturally reproducing salmon and steelhead above the flood control dams in the Willamette River subbasins, and downstream passage for their offspring;
- the long-term challenges associated with setting priorities to protect the existing salmon and steelhead habitat and restoring the additional habitat needed to recover these two species, including the high priority habitat in North and South Santiam, Middle Fork Willamette and McKenzie subbasins and the rearing habitat in the entire mainstem Willamette River (including the lower Willamette River below Willamette Falls);
- the need for over-all integration of research, monitoring and evaluation of spring Chinook, steelhead, and their habitat, to better inform future decisions.
- Climate change and human population growth and how salmon and steelhead recovery efforts can adapt.
- Details describing strategies and actions concerning the effects of hatcheries.

The Oregon Fish and Wildlife Commission was presented with a draft of the Plan in January 2011, and is expected to provide final approval for the Plan as a State of Oregon conservation plan on August 4, 2011.

The Plan will also be published in the Federal Register as a Federal recovery plan for the UWR sub-domain.

1.5 Relationship to Other Planning and Program Efforts

There are other recently completed or currently underway planning efforts that have a significant bearing on the design and/or implementation of this Plan. These planning efforts include:

The Lower Columbia River Conservation Plan for Oregon Populations of Salmon and Steelhead[9]

Many of the analyses in this UWR Plan are similar to those developed in Oregon's final Lower Columbia ESA Recovery Plan for Oregon populations (hereafter the OrLCR Plan), and the OrLCR Plan was used as a design template for organization of this Plan. This established some consistency between the plans. In addition, many of the actions in the OrLCR Plan are common to actions in this Plan, particularly those relating to actions that take effect in the estuary where populations from both domains occur for some portion of their life cycle. Further detail of how OrLCR actions where incorporated into this Plan are noted in relevant sections of this Plan.

Oregon Plan for Salmon and Watersheds[10]

In 1997, Oregon's governor and legislature adopted the Oregon Plan for Salmon and Watersheds to begin State-led recovery efforts. The Oregon Plan is funded principally by Oregon Measure 66 funds (Lottery funds) and seeks to restore salmon runs, improve water quality, and achieve healthy watersheds and strong communities throughout the state. It is a comprehensive partnership between government, communities, private landowners, industry and citizens funded by the Oregon Legislature. The Plan's mission is:

To restore Oregon's native fish populations and the aquatic systems that supports them to productive and sustainable levels that will provide substantial environmental, cultural, and economic benefits. The Plan has a strong focus on salmon because they are important indicators of watershed health and have great cultural, economic and recreational importance to Oregonians.

The Oregon Plan organizes actions around the factors that contribute to the decline in fish populations and watershed health. Most of these actions focus on improving water quality and physical habitat quality and quantity. Watershed councils and soil and water conservation districts lead efforts in many basins. Landowners and other private citizens, sport and commercial fishing interests, the timber industry, environmental groups, agriculture, utilities, businesses, tribes, and all levels of government also come together to organize, fund, and implement these measures, which rely on scientific oversight, coordinated tribal and government efforts, and ongoing monitoring and adaptive management to achieve program success.

The Oregon Plan relies on Oregon's spirit of volunteerism and stewardship, along with public education and awareness, strong scientific oversight, coordinated tribal and government efforts, and ongoing monitoring and adaptive management to achieve program success. Oregon will implement the Oregon Plan consistent with ESA recovery planning and with other Oregon related-salmon programs.

Oregon Conservation Strategy[11]

[9] http://www.dfw.state.or.us/fish/CRP/lower_columbia_plan.asp
[10] http://www.oregon-Plan.org/
[11] http://www.dfw.state.or.us/conservationstrategy/

The Oregon Conservation Strategy (Conservation Strategy) was developed by ODFW in response to a national effort guided by Congress and the U.S. Fish and Wildlife Service (USFWS) to encourage states to develop comprehensive wildlife planning. The Conservation Strategy was approved by the Oregon Fish and Wildlife Commission in August 2005 and by the USFWS in March 2006. Oregon's approach was to establish a long-term vision and set specific goals not only for conservation actions to be implemented by ODFW, but also as a conservation blueprint for all Oregonians. The overarching goal of the Conservation Strategy is to "maintain healthy fish and wildlife populations by maintaining and restoring functioning habitats, prevent declines of at-risk species, and reverse declines in these resources where possible." The Conservation Strategy emphasizes the proactive conservation and management of 11 strategy habitats across eight state ecoregions. It addresses species conservation through a fine filter approach and identified 286 strategy species based on their population status or that represent the diversity and health of wildlife in Oregon.

The two ESA listed species addressed in this Plan are also listed as strategy species in the Conservation Strategy. This Plan's actions also address the six key issues identified in the Conservation Strategy, in addition to others.

Willamette Valley Project Biological Opinion 2008[12]

The Willamette River Basin Flood Control Project (Willamette Project; WP) is operated and maintained by the U.S. Army Corps of Engineers (USACE) and includes 13 multipurpose dams and reservoirs, and about 43 miles of revetments in the upper Willamette River basin and subbasins. Bonneville Power Administration (BPA) markets power generated at some of the Willamette Project dams, and the U.S. Bureau of Reclamation (USBOR) sells a portion of the water stored in WP reservoirs for irrigation purposes. As part of a mitigation agreement, a majority of the fish hatchery programs are funded by these Federal entities. A full description of the Willamette Project is included in the Supplemental Biological Assessment (USACE 2007a).

NMFS issued a Biological Opinion (hereafter WP BiOp; NMFS 2008a[13]) on the impact of the Willamette Project on species listed for protection under the Endangered Species Act. NMFS found that the Action Agencies' Proposed Action alone was not sufficient to avoid jeopardy or adverse modification of critical habitat for UWR Chinook salmon ESU and steelhead DPS, and would destroy or adversely modify their critical habitat.

The WP BiOp noted that the Willamette Project adversely affects UWR Chinook and steelhead by blocking access to a large amount of their historical habitat upstream of the dams and by contributing to degradation of their remaining downstream habitat. In the consultation process the Action Agencies proposed several measures to address these effects in their Proposed Action. Overall, NMFS found these actions insufficient to ensure the species' survival with an adequate potential for recovery, or to prevent destruction or adverse modification to their critical habitat. Therefore, the NMFS opinion proposed a Reasonable and Prudent Alternative (RPA) with additional measures which, combined with the Proposed Action, would allow for survival of the species with an adequate potential for recovery, and avoid destruction or modification of critical habitat. These RPA measures include providing fish passage at three dams and temperature control at another, adjustments to downstream flows, improving water quality, improving hatchery program practices, screening irrigation diversions and conducting habitat mitigation. Some of the modifications to flow have already begun, and other measures will be

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[12] http://www.nwp.usace.army.mil/pm/e/reports/environmental/ba/Final_Will_Supp'l_BA.pdf .
[13] http://www.nwr.noaa.gov/Salmon-Hydropower/Willamette-Basin/Willamette-BO.cfm

implemented in the short-term to decrease the species' risk of extinction until the longer-term passage and temperature control measures are completed.

This Plan relies on the WP BiOp RPA's as a foundation for management actions to address fish access, flow, hatchery fish mitigation, and habitat issues associated with the Willamette Project. Several members of the Upper Willamette Planning Team are also technical representatives in the Willamette Action Team for Ecosystem Restoration (WATER) coordination process (see NMFS 2008a). It is important that Federal and State agencies coordinate implementation of the WP BiOp RPA and this Plan on an ongoing basis.

Northwest Power and Conservation Council Subbasin Plans[14]

In 1980 Congress created the Northwest Power and Conservation Council (NPCC) to give Washington, Oregon, Idaho, and Montana a regional voice in mitigating the effects of Federal energy generating systems on fish and wildlife. Subbasin plans became a vehicle to further define regional mitigation objectives, and to guide BPA mitigation expenditures. In April 2003, the NPCC designated the Willamette Restoration Initiative (WRI) as the lead entity for developing the *draft Willamette Subbasin Plan*. The draft plan (WRI 2004) collated a large amount of habitat and fish/wildlife information that was essential for the development of this Plan. The WRI has since transitioned into the Willamette Partnership[15].

The WRI was originally established to develop and implement a long-range conservation Plan for the Willamette River and its watershed. Completed in 2001, this conservation Plan, called the *Willamette Restoration Strategy*, is the "Willamette chapter" of the Oregon Plan for Salmon and Watersheds. The *Willamette Restoration Strategy* identified 27 critical actions needed to preserve and improve watershed health in the areas of water quality, water supply, habitat and hydrology, and institutions. Two of the actions call for more detailed identification of fish and wildlife conservation priorities and more integrated environmental planning. As they pertain to UWR Chinook and steelhead, this Plan has adopted, expanded, and refined many of the actions, strategies, and priorities that were developed in the restoration strategy and subbasin Plan.

Columbia River Hatchery Scientific Review Group[16]

The Hatchery Scientific Review Group (HSRG) is the independent scientific review panel of the Pacific Northwest Hatchery Reform Project established by Congress in 2000 in recognition that while hatcheries play a legitimate role in meeting harvest and conservation goals for Pacific Northwest salmon and steelhead, the hatchery system was in need of comprehensive reform. The HSRG has reviewed all State, tribal and Federal hatchery programs in Puget Sound and Coastal Washington, and released their final report for those in the Columbia River Basin in early 2009. A Recovery Implementation Science Team (RIST17) subsequently reviewed the HSRG recommendations, and noted some areas of uncertainty with the recommended HSRG broodstock genetic management guidelines. In addition, the ODFW subsequently reviewed emerging information regarding the use of integrated broodstock programs and the draft HGMP levels of wild fish integration. The ODFW analysis brought into question the level of wild fish integration in the draft HGMPs, and proposed new integration guidelines for hatchery programs involving UWR fish. As a result, there is some current uncertainty regarding the best approach for broodstock management and the type of hatchery program that will best promote recovery goals. A goal

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[14] http://www.nwcouncil.org/fw/subbasinplanning/willamette/Plan/
[15] http://www.willamettepartnership.org
[16] http://www.hatcheryreform.us/mfs/welcome_show.action
[17] http://www.nwfsc.noaa.gov/trt/index.cfm

in this Plan is to continue to engage key experts doing empirical and/or theoretical research on genetic and ecological hatchery-wild issues, with the objective of providing some guidance on successful re-introduction in the UWR Chinook ESU.

Columbia River Estuary Recovery Plan Module[18]

The Estuary Module (NMFS 2008b) is part of a larger regional planning effort to develop recovery plans for ESA-listed salmon and steelhead in the Columbia River basin. The Module focuses on habitat in the lower Columbia River below Bonneville Dam and Willamette falls, and how that habitat affects the survival of ESA-listed chum, steelhead, Chinook, and coho from throughout the Columbia River basin. This includes impacts on UWR Chinook and steelhead populations. Geographically, the Module covers the tidally influenced reaches of the lower Columbia River, estuary, and plume. The goal of the Module is to identify actions that, if implemented, would improve the survival of ESA-listed salmon and steelhead during their migration and rearing in the estuary and Columbia River plume.

The Module identifies and prioritizes limiting factors and threats in the estuary that affect the viability of salmon and steelhead populations. The Module lists 23 broad actions whose implementation would reduce the threats and thus increase survival of salmon and steelhead during their time in the estuary. The Module also estimates the cost of implementing each action over a 25-year period. A description of monitoring, research, and evaluation needs is being completed and will be included as an appendix to the Module. The science and regulatory obligations provided through these forums have been incorporated into the NMFS's proposed and final ESA recovery plans for listed Columbia Basin salmon and steelhead. The Estuary Module will be incorporated or adopted by reference into the Plan for the ESU and DPS.

Other Efforts

A number of local governments and non-governmental organizations are actively working to improve the health of the Willamette River. NMFS and ODFW recognize the valuable contribution these organizations are making; Chapter 9 describes our intent to support and coordinate with these efforts as we implement this Plan.

1.6 Tribal Treaty/Trust Obligations

Northwest Indian Tribes have legally enforceable rights reserving to them a share of the salmon harvest. A complex history of treaties, executive orders, legislation, and court decisions have culminated in the recognition of tribes as co-managers who share management responsibilities and rights for fisheries in the Columbia Basin.

Ensuring a sufficient abundance of salmon and steelhead to sustain harvest is an important element in fulfilling trust responsibilities and treaty rights as well as garnering public support for recovery plans. ESA and tribal trust responsibilities complement one another. Both depend on a steady upward trend toward ESA recovery and delisting in the near term, while making aquatic habitat, harvest, and land management improvements for the long term.

1.7 Overview of Recovery Plan Objectives

Recovery plans can provide a central organizing tool for the recovery of listed species. Chapter 3 explains the ESA and Broad Sense Recovery Goals and Criteria that provide the multiple objectives for this Plan.

[18] http://www.nwr.noaa.gov/Salmon-Recovery-Planning/ESA-Recovery-Plans/Estuary-Module.cfm

Chapter 2: Environmental and Biological Background

This chapter describes briefly the geographic setting of the Recovery Plan, life history information for the different species, and the independent populations that are contained within the listed UWR Chinook ESU and UWR steelhead DPS[19]. More detailed information can be found in Plan appendices and supporting plans and documents in citations.

In an earlier Federal decision, NMFS determined that any hatchery stocks found to be part of an ESU or DPS would be considered in determining whether the ESU or DPS is threatened or endangered under the ESA, and would be included in any listing of the ESU or DPS (FR 70 37204). According to the NMFS Hatchery Policy: "Hatchery stocks with a level of genetic divergence relative to the local natural population(s) that is no more than what occurs within the ESU: (a) are considered part of the ESU; (b) will be considered in determining whether an ESU should be listed under the ESA; and (c) will be included in any listing of the ESU." The Hatchery Policy further recognized that the role of hatchery fish in status assessment and recovery would be determined "… in the context of their contributions to conserving natural self sustaining populations." Hatchery fish were recognized to potentially have either positive or negative effects on the status of natural populations. Finally, hatchery fish were not given full protection under Section 4(d) of the ESA; instead "For ESUs listed as threatened, NMFS will, where appropriate, exercise its authority under section 4(d) of the ESA to allow the harvest of listed hatchery fish that are surplus to the conservation and recovery needs of the ESU, in accordance with approved harvest plans."

Hatchery stocks were included in the UWR Chinook ESU and are listed along with naturally produced fish. The inclusion of hatchery stocks in the ESU was based on a review and analysis of hatchery broodstock origins, broodstock age, management history, and life history and genetic information conducted by Drake et al. (2003). The specific hatchery stocks included in the ESU are provided in the final listing notices (70 FR 37160 and 71 FR 834). Most hatchery fish released into the Willamette subbasins are now marked with an adipose fin clip and are available for use in harvest (70 FR 37204), and other management needs. The UWR hatchery stocks will be used to implement some recovery strategies for the ESU and DPS, but recovery goals are focused on the development and conservation of self-sustaining naturally-produced populations.

As defined under the ESA, a "species" includes "any subspecies of fish or wildlife or plants and any other group of fish or wildlife of the same species or smaller taxa in common spatial arrangement that interbreed when mature." The NMFS ESU policy, which applies to Pacific salmon, and the joint NMFS-USFWS DPS policy, which applies to all other species (including *O. mykiss* – anadromous steelhead and resident rainbow trout), implement this provision of the statute. The ESU definition emphasizes reproductive isolation and evolutionary significance. The DPS definition emphasizes discreteness and significance to the taxon. Steelhead and rainbow trout within a common geographic area are not

[19] The ESA defines a species to include any species, sub-species, or distinct population segment (ESA section (3)(15)). NMFS defines distinct population segments as Evolutionarily Significant Units (ESUs) for listing Pacific salmon (and previously used the ESU for listing West Coast steelhead as well) (Waples 1991). An ESU is a group of Pacific salmon that is (1) substantially reproductively isolated from other groups and (2) represents an important component of the evolutionary legacy of the species. Recently, NMFS revised its species determinations for West Coast steelhead (*Oncorhynchus mykiss*) under the ESA, delineating anadromous, steelhead-only "distinct population segments" (DPS). Rainbow trout, the resident form of *O. mykiss*, are under the jurisdiction of the U.S. Fish and Wildlife Service (USFWS). NMFS listed the lower Columbia River steelhead DPS as threatened in January 2006. The Federal Register notice (71 FR 834) contains a more complete explanation of the listing decision and of previous ESA actions related to steelhead.

necessarily reproductively isolated but the two life history forms are discrete (Kostow 2003). NMFS used the DPS policy to delineate listing units of steelhead for the reasons described in the listing notice (70 CFR 37160).

The two species units addressed in this Plan use freshwater habitat in the Willamette River basin for reproduction, juvenile rearing and adult holding, and adult and juvenile migration. UWR Chinook spawn and rear in the Clackamas, Molalla, North Santiam, South Santiam, Calapooia, McKenzie, and Middle Fork Willamette subbasins. Steelhead of the UWR DPS spawn and rear in the Molalla, North Santiam, South Santiam, and Calapooia subbasins. With the exception of the Clackamas River, the principal subbasin rivers join the Willamette River mainstem above Willamette Falls.

2.1 Climate and Geomorphology

Recovery planning efforts for the UWR ESU and DPS focused mostly on conditions within the ecological zones that characterize the upper Willamette River basin and subbasins, and to a lesser extent on the Columbia River estuary. The combined influences of climate and geomorphology of the Willamette Basin have shaped both the life history characteristics and distribution of native salmon and steelhead populations.

The Willamette Basin covers 11,500 square miles and encompasses parts of three physiographic provinces.[20] The Cascade Range covers 60% of the basin and consists of volcanic rocks with elevations exceeding 10,000 feet. The range forms the eastern boundary of the basin. The Willamette Valley covers 30% of the basin. The elongated valley floor is structurally an erosional lowland, filled with flows of Columbia River Basalt (in the northern half of the basin) and younger unconsolidated sediment (Wentz 1998). The Coast Range, comprised of marine sedimentary and volcanic rocks at elevations over 4,000 feet, covers the remainder of the basin and constitutes the western boundary of the Willamette Valley.

Willamette Falls is a natural geomorphic feature that was formed by basalt intrusions. The falls are located in the lower Willamette River basin, ~ 26 miles upstream from the confluence of the Willamette and Columbia rivers. These horseshoe-shaped falls are 40 ft high and 1,500 ft long, and represent the largest waterfall in the Pacific Northwest. Historically the falls limited the upstream migration of some salmon and steelhead races, and in this Plan the falls delineate a geographic boundary between the upper Willamette River basin and the lower Willamette River basin, which has some tidal influence. Major drainage subbasins to the mainstem Willamette River that represent natal freshwater habitats of independent populations of Chinook and steelhead include the Clackamas, Molalla, Santiam, Calapooia, McKenzie, and Middle Fork rivers (natal). The lower reaches of some of the west-side subbasins (termed “West-Side tributaries” in this Plan) have had documented presence of adult Chinook and steelhead, but it is not clear how these fish contribute or are related to the independent populations assigned in Myers et al. 2006). In the larger metapopulation context, fish produced in these subbasins presumably functioned as dependent populations of the UWR ESU. Some of the lower reaches in West-Side tributaries have also had documented presence of Chinook and steelhead juvenile life stages. These fish may be juvenile UWR Chinook and steelhead that were produced in natal Cascade Range subbasins, and are using these reaches for rearing habitat, or they were produced from extant dependant populations. These Coast Range subbasins include the Tualatin, Yamhill, Luckiamute, Marys, Coast Fork, and Long Tom rivers.

The upper Willamette River basin has a moderate climate with cool, wet winters and warm, dry summers. Approximately 10% of the average annual precipitation of 63 inches occurs between May and September.

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[20] Analogous to U.S. EPA level 3 ecoregions (http://www.epa.gov/bioindicators/html/lv3-eco.html).

Precipitation varies markedly with altitude and ranges from about 40 inches at lower elevations to greater than 200 inches in the mountains. Most of the annual streamflow in the Willamette River mainstem occurs typically between November and March in response to winter rain and spring snowmelt; however, melting of late spring snow in the high Cascade Range can prolong runoff into June or July in rivers flowing out of the Cascade Range (Wentz 1998). The peak flows in December and January are sustained at 50% of peak flow for 6 or 7 months of the year. Low flows occur in August and September, with the volume about 20% of the peak flow. Summer flows in the Coast Range tributaries are especially low because of the general absence of any substantial snowpack, and these tributaries historically may never have sustained independent Chinook salmon populations (Dimick and Merryfield 1945).

Anthropogenic Conditions

The Willamette River valley is home to 70% of Oregon's human population (NPCC 2004) including Oregon's three largest cities (Portland, Eugene, and Salem). Figure 2-1 shows the spatial relationships of major land use types. Approximately 70% of the basin is forested, with approximately 36% of the basin in Federal forest ownership. Most of the Federal forest land is located in the higher elevations of the Cascade and Coast ranges and is managed by the U.S. Forest Service (USFS) and U.S. Bureau of Land Management (USBLM). About 22% of the basin area is in agricultural production, and the remaining 8% is urbanized or in other uses (Wentz 1998). More than 60% of the basin area is outside the urban growth boundaries and more than 90% of the valley floor is privately owned (Pacific Northwest Ecosystem Research Consortium 2002).

Several major flood control or hydropower facilities have been developed in the Clackamas River subbasin, and in subbasins of the upper Willamette River basin, including facilities in the North Santiam, South Santiam, McKenzie and Middle Fork Willamette rivers (Figure 2-1). As will be detailed in Chapter 5 of this Plan, dam construction and operations impact salmonids by hindering fish passage to historical upstream spawning and rearing habitat, and by altering the natural hydrologic regimes, especially during summer and fall low flow periods.

2.2 Salmon and Steelhead Distribution and Life Histories

Life histories and habitat use for UWR Chinook and steelhead are discussed below.

2.2.1 UWR Chinook

UWR Chinook salmon have been shown to be genetically strongly differentiated from nearby populations, and are considered one of the most genetically distinct groups of Chinook salmon in the Columbia River Basin (Waples et al. 2004, Beachum et al. 2006). For adult Chinook salmon, Willamette Falls historically acted as an intermittent physical barrier to upstream migration into the upper Willamette River basin, where adult fish could only ascend the falls at high spring flows. It has been proposed that the falls served as an zoogeographic isolating mechanism for a considerable period of time (Waples et al. 2004), and has led to, among other attributes, the unique early run timing of these populations relative to other lower Columbia River spring-run populations. Historically the peak migration of adult salmon over the falls occurred in late May (Wilkes 1845). Low flows during the summer and autumn months prevented fall-run salmon and coho from reaching the upper Willamette River basin.

The Willamette Valley was not glaciated during the last epoch (McPhail and Lindsey 1970) and Willamette Falls likely served as a physical barrier for reproductive isolation of Chinook salmon populations. This isolation had the potential for produce significant local adaptation relative to other Columbia River populations (Myers et al. 2006). Fish ladders were constructed at the falls in 1872 and again in 1971, but it is not clear what role they may have played in the present day in reducing localized adaptations in UWR fish populations. Little information exists on the life history characteristics of the historical UWR Chinook populations, especially since early fishery exploitation (starting in the mid 1880s), habitat degradation (starting in the early 1800s in the lower Willamette Valley), and pollution in the lower Willamette River (by early 1900s) likely altered life history diversity before data collections began in the mid 1900s. Nevertheless, it is thought UWR Chinook salmon still contain a unique set of genetic resources compared to other Chinook stocks in the WLC Domain.

The generalized life history traits of UWR Chinook are summarized in Table 2-1. Today, adult UWR spring Chinook begin appearing in the lower Willamette River in January, with fish entering the Clackamas River as early as March. The majority of the run ascends Willamette Falls from late April through May, with the run extending into mid August (Myers et al. 2006). Chinook migration past the falls generally coincides with a rise in river temperatures above 50°F (Mattson 1948, Howell et al. 1985, Nicholas 1995). Historically, passage over the falls may have been marginal in June because of diminishing flows, and only larger fish would have been able to ascend. Mattson (1963) discusses a late spring Chinook run that once ascended the falls in June. These fish were apparently much larger (11.4–13.6 kg) and older (presumably 6-year-olds) than the earlier part of the run. Mattson (1963) speculated that this portion of the run "intermingled" with the earlier run fish on the spawning ground and did not represent a distinct run. The disappearance of the June run in the 1920s and 1930s was associated with the dramatic decline in water quality in the lower Willamette River (Mattson 1963). This is also the period of heaviest dredging activity in the lower Willamette River. The main channel of the river was moved from the east side of Swan Island, enough dredge material was removed from the Willamette River to increase the size of Swan Island to three times its original size. Dredge material was also used to fill floodplain areas like Guilds Lake (some came from other sources too). Chinook salmon now ascend the falls via a fish ladder.

Table 2-1. A summary of the general life history characteristics and timing of UWR Chinook salmon. Data are from numerous sources.

Life History Trait	Characteristic
Willamette River entry timing	January-April; ascending Willamette Falls April-August
Spawn timing	August-October, peaking in September
Spawning habitat type	Larger headwater streams
Emergence timing	December – March
Rearing habitat	Rears in larger tributaries and mainstem Willamette
Duration in freshwater	12-14 months; sometimes 2-5 months
Estuarine use	Days to several weeks
Life history type	Stream
Ocean migration	Predominately north, as far southeast Alaska
Age at return	3-6 years, primarily 4-5 years

After ascending Willamette Falls, adult Chinook migrate quickly to the upper portions of the larger subbasins and "hold" in the deeper pools with cooler water temperatures through the summer. The historic spawning period for UWR Chinook probably extended from July through October, but at the present spawning generally begins in late August and continues into early October, with peaks spawning in September (Mattson 1948, Nicholas 1995, Willis et al. 1995). Adult Chinook salmon must deposit their eggs at a time that will insure that fry emerge the following spring when productivity is sufficient for survival and growth (Myers et al. 2006). Exact timing varies with water temperature with fish in colder areas, such as the headwaters, spawning earlier than fish lower in the subbasin. Because Chinook spawn in the fall and their offspring emerge from the gravel the following spring, the success of spawning is greatest in areas with relatively stable substrates so that gravel and cobbles shifting during high water events do not damage the eggs.

Chinook fry emerge from gravels from February through March, and sometimes as late as June (Mattson 1962). Unnaturally warm water released in the fall from the large flood control dams on several tributaries hastens the development of eggs and emergence of fry compared to emergence in tributaries with unregulated water flows (Downey et al. 1993). The juveniles rear in areas with a variety of cover types that provide protection. A general trait found in other populations is that older juvenile migrants primarily use mid-channel areas and usually migrate at night, presumably to avoid predators. UWR Chinook typically exhibit a stream-type life history (see Healey 1991 for details of Chinook salmon life history races based on adult and juvenile migration timing), where adults begin migrating upstream through freshwater zones in the Columbia River in the spring. Unlike some stream-type Chinook populations, the rearing and migratory life history pattern of UWR Chinook is more of a continuum. Migration peaks occur in most years, but sometimes there is a very broad distribution (Kirk Schroeder, personal communication). A significant proportion, if not the majority of UWR Chinook, emigrate from freshwater as yearlings, similar to other stream-type Chinook salmon. In general, once fish reach this age, this is a directional downstream migration, although there is evidence that fish are growing during this passage, implying they are eating and rearing as they migrate. Variants to this “classic” timing of stream-type yearling migration have been described for UWR Chinook salmon (Figure 2-2). Juvenile emigration Distinct phases of juvenile emigration out of tributaries into the Willamette River are variable with environmental conditions include: 1) Late winter to early spring as fry, 2) fall to early winter as fingerlings, and 3) late winter through spring as yearlings. These three primary migration types are discussed below based on information provided by Schroeder et al. (2007) for the McKenzie River. The three migratory types have been documented in the McKenzie River subbasin, which is the most natural system remaining in the Willamette Basin, and are also representative of other spring Chinook populations in the Columbia Basin (Schroeder et al. 2007).

- *Fry and early fingerling migration*. Shortly after emergence some UWR Chinook fry can migrate long distances and continue to migrate through spring. It is thought that most of these migrating fish are derived from late-emerging fry from the colder tributaries, or from fish that spent a short time rearing near the spawning areas before migrating and reach fingerling size. ODFW has documented fry from the McKenzie River migrating into the upper and middle reaches of the mainstem Willamette River, and early studies documented fry moving into the Willamette River just upstream of Willamette Falls and migrating over Willamette Falls. For example, Craig and Townsend (1946) showed that juveniles began moving downstream during March soon after emergence. It is thought that historically, many juvenile fish resided for a period of time in the Willamette River. The NPCC (2004) cited studies in the 1940s that reported large numbers of fry in the Willamette River from February through early April.

  ODFW sampling and tagging data are starting to indicate that most fry and fingerling rear in the lower reaches of spawning tributaries and in the Willamette River mainstem in late winter and early spring (Schroeder et al. 2005, 2007). Some fish grow quickly in this area and migrate as subyearling smolts out of the Willamette River basin, probably beginning in early to mid May for the larger fish and continuing into mid July in most years. These fish have been captured in the upper estuarine zone of the lower Columbia River, and have also been captured in June in near-shore ocean samples. Scale samples collected from adults indicate that some of these subyearlings survive and return as spawners. A larger percentage of these subyearlings are from the Santiam River basin, where the altered temperature regime from reservoir releases causes eggs to develop faster and fry to emerge sooner from the gravel, than from the McKenzie Basin, which has a more natural temperature regime.

- *Subyearling migration.* Some Chinook salmon fry remain in the upper Willamette River subbasins and subordinate tributaries through their first spring and summer, and migrate in the fall and early winter. Fall migrations may relate in part to increased flow (and water temperatures) caused by Willamette Valley Flood Control Project operations (e.g., reservoir drawn down for flood risk reduction operations). Sometimes these fall migrations are quite large and the average size of these fish is often larger than the fish that will migrate out of the upper subassins the following spring as yearling smolts. Some of these fall migrants move past Willamette Falls and presumably into the Columbia River mainstem. We do not know if they migrate to the ocean; they likely spend the winter in the Columbia River or estuary before entering the ocean, maybe as early as March.

- *Yearling migration.* Many Chinook salmon rear in the upper Willamette River subbasins through the year and migrate from March through May during their second spring as yearling smolts. These fish generally move fairly quickly through the Willamette River mainstem and over Willamette Falls. We note that juvenile Chinook salmon are also collected in West-side tributaries of the Willamette River. Presumably these fish are migrants from natal basins and use West-side tributaries as a portion of their rearing habitat.

Once they enter the Pacific Ocean, UWR Chinook migrate north along the coasts of British Columbia and southeastern Alaska (Myers et al. 2006). The majority of both hatchery-origin and natural-origin UWR Chinook adults are four and five years old when they return to freshwater, with small proportions of age-3 and age-6 fish. In general, returning hatchery-origin Chinook adults tend to be younger than natural-origin fish, with a higher proportion of age-4 fish.[21] Life history characteristics and genetic background of UWR Chinook populations may have been reduced or traits redirected by artificial propagation, migration barriers, and habitat degradation (Myers et al. 2006; NMFS 2005b).

[21] Age-of-return of hatchery fish can be modified by manipulating the season and size at which the juveniles are released (see Hankin 1990).

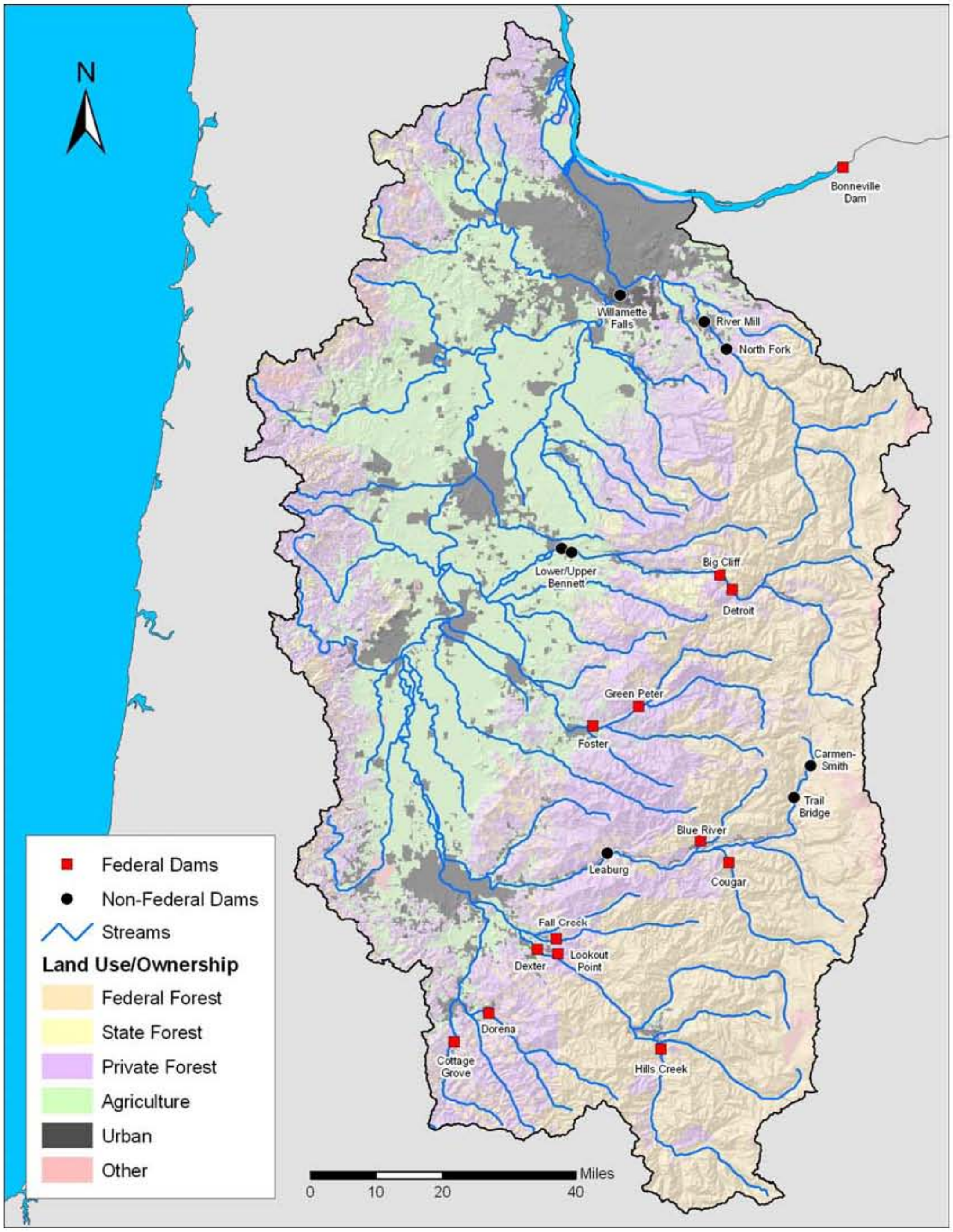

Figure 2-1. Pattern of major land use categories and major flood control/hydropower infrastructures in the Willamette Basin.

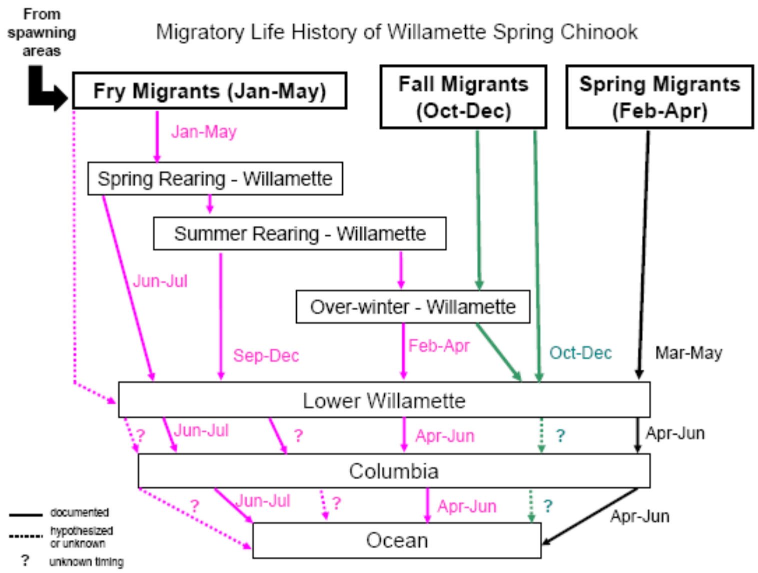

Figure 2-2. A model of variation in outmigration timing and use of different hydrological domains by UWR Chinook salmon (Schroeder et al. 2005).

2.2.2 UWR Steelhead

The run timing of UWR steelhead is a legacy of the fact that, before construction of a fish ladder at Willamette Falls in the early 1900s, flow conditions allowed steelhead to ascend Willamette Falls only during the late winter and spring. As a result, the majority of the UWR winter steelhead run return to freshwater in January through April, pass Willamette Falls from mid February to mid May, and spawn in March through June, with peak spawning in late April and early May. Compared to spring Chinook, UWR steelhead typically migrate further upstream and can spawn in smaller, higher gradient streams and side channels. . Table 2-2 summarizes the generalized life history traits for UWR steelhead. UWR steelhead may spawn more than once, although the frequency of repeat spawning is relatively low. Repeat spawners are predominantly females and usually spend one year post spawning in the ocean and spawn again the following spring.

Juvenile steelhead rear in headwater tributaries and upper portions of the subbasins for one to four years (most often two years), then as smoltification proceeds in April through May, migrate quickly downstream through the mainstem Willamette River and Columbia River estuary and into the ocean. The downstream migration speed depends to some extent on river flow, with faster migration occurring at higher river flows. UWR steelhead typically forage in the ocean for one to four years (most often two years) and during this time are thought to migrate north to Canada and Alaska and into the North Pacific including the Alaska Gyre (Myers et al. 2006).

Table 2-2. A summary of the general of life history characteristics and timing of UWR Steelhead. Data are from numerous sources.

Life History Trait	Characteristic
Willamette River entry timing	February – May
Spawn timing	March – June
Spawning habitat type	Headwater streams
Emergence timing	8-9 weeks after spawning, June - August
Rearing habitat	Headwater streams
Duration in freshwater	1-4 years (mostly 2), smolt in April – May
Estuarine use	Briefly in the spring, peak use in May
Ocean migration	North to Canada and Alaska, and into the North Pacific
Age at return	3 - 6 years, primarily 4 years

2.3 Population and Strata Structure

ESA recovery planning focuses on a biologically-based hierarchical structure that starts at the species level and can be partitioned to a level below an individual population. This hierarchy reflects the fact that historically, anadromous salmonid species typically contained multiple races and distinct populations that were connected to some degree of genetic exchange that reflected local adaptation to geographical and other environmental conditions in the river basins in which they spawned. Thus, the overall biological structure of salmonids is hierarchical; spawners in the same area of the same stream will share more characteristics than those in the next stream over.

For recovery planning purposes the WLC-TRT formally identified two levels in this biological hierarchy: the ESU for salmon or DPS for steelhead, and the independent population (McElhany et al. 2000). The WLC-TRT further defined the hierarchy by grouping the independent populations into larger aggregates that share similar genetic, geographic (hydrographic and ecoregion), and/or habitat characteristics. They called these "major groupings" stratum (plural: strata). This Recovery Plan focuses actions largely at the scale of local independent populations. Although the WLC-TRT did not define strata for the UWR ESU and DPS, we include a brief discussion of biological hierarchy to provide some background.

Three levels of biological hierarchy are defined below:

- *Evolutionarily Significant Unit or Distinct Population Segment:* The ESU or DPS is essentially a metapopulation defined by the common characteristics of populations within a geographic range. Two criteria define a salmon ESU or steelhead DPS listed under the ESA: 1) it must be substantially reproductively isolated from other nonspecific units, and 2) it must represent an important component of the evolutionary legacy of the species (Waples 1991). ESUs and DPSs may contain multiple populations that are connected by some degree of migration, and hence may have broad geographic areas, transcending political borders.

- *Strata:* Strata are groups of populations that have been isolated from one another over a longer time scale than the individual populations, but which retain some degree of connectivity greater than that between ESUs or DPSs. They represent groups of populations with similar life history characteristics, mainly run timing, that spawn within an ecological zone (McElhany et al. 2003). Strata are analogous to the "Major Population Groups" (MPGs) that were defined by the Interior Columbia TRT, and to the "geographic regions" that were described by the Puget Sound TRT.

- *Independent Populations:* McElhany et al. (2000) defined an independent population as "a group of fish of the same species that spawns in a particular lake or stream (or portion thereof) at a particular season and, which, to a substantial degree, does not interbreed with fish from any other group spawning in a different place or in the same place at a different season" (Myers et al. 2006, following McElhany et al. 2000).

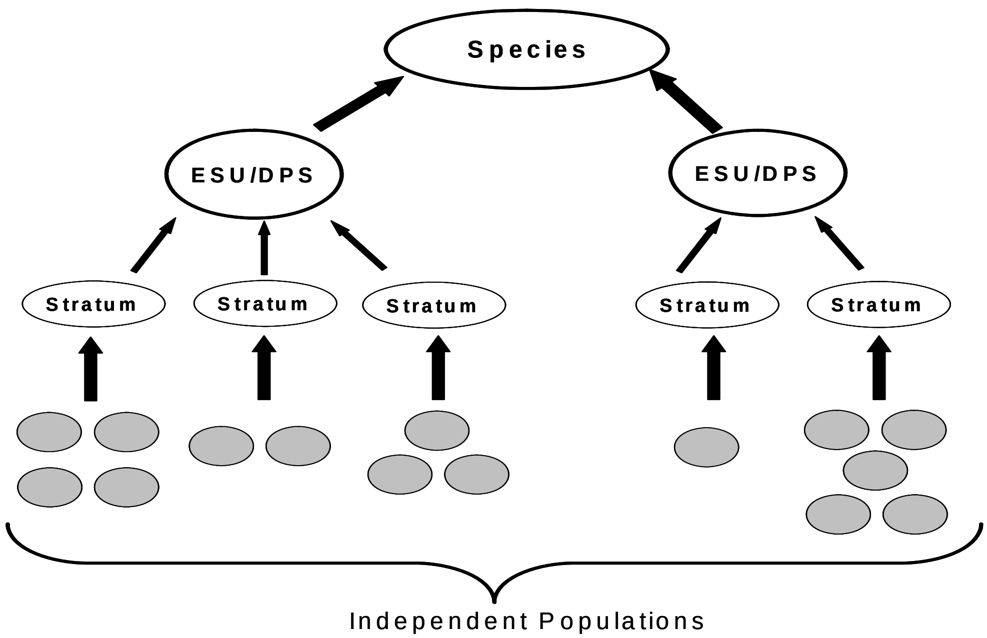

Figure 2-3. A hierarchical population structure for ESA-listed Pacific salmonids as identified by Technical Recovery Teams (TRT's).

2.3.1 UWR Chinook Structure

The WLC-TRT identified seven demographically independent populations of spring Chinook in the UWR Chinook ESU: Clackamas, Molalla, North Santiam, South Santiam, Calapooia, McKenzie, and the Middle Fork Willamette (Figure 2-4). The WLC-TRT classified the Clackamas, North Santiam, McKenzie and Middle Fork Willamette populations as "core populations" and the McKenzie as a "genetic legacy population." All the populations are part of the Cascades Tributaries Stratum for the ESU. The WLC-TRT delineated the populations based on geography, migration rates, genetic attributes, life history patterns, phenotypic characteristics, population dynamics, and environmental and habitat characteristics (Myers et al. 2006).

At the time of listing, the ESU included seven artificial propagation programs: McKenzie River Hatchery (ODFW stock #24), Marion Forks/North Fork Santiam River (ODFW stock #21), South Santiam Hatchery (ODFW stock #23) in the South Fork Santiam River, South Santiam Hatchery in the Calapooia River, South Santiam Hatchery in the Molalla River, Willamette Hatchery (ODFW stock #22), and Clackamas hatchery (ODFW stock #19) spring-run Chinook hatchery programs (NMFS 2005b). Since then, ODFW discontinued the South Santiam Hatchery in the Calapooia River.

2.3.2 UWR Steelhead Population Structure

The WLC-TRT identified four historical demographically independent populations for UWR winter steelhead: the Molalla, North Santiam, South Santiam, and Calapooia (Myers et al. 2006). These population delineations were based on geography, migration rates, genetic attributes, life history patterns, phenotypic characteristics, population dynamics, and environmental and habitat characteristics with guidance found in (McElhany et al. 2000). The populations are shown in Figure 2-5.

The UWR steelhead DPS includes all naturally spawned winter-run steelhead populations in the Willamette River and its tributaries upstream from Willamette Falls to the Calapooia River (inclusive). The North Santiam and South Santiam rivers are thought to have been major production areas (USFWS 1948) and these populations were designated as “core” and “genetic legacy” (McElhany et al. 2003). The four “east-side” subbasin populations are part of one stratum, the Cascade Tributaries Stratum, for UWR winter steelhead. There are no hatchery programs supporting this DPS (NMFS 2006). The hatchery summer-run steelhead that are produced and released in the subbasins are from an out-of-basin stock and not considered part of the DPS.

Winter steelhead have been reported spawning in the West-side tributaries to the Willamette River above Willamette falls, and ODFW recognizes the Tualatin, Yamhill, Rickreall, and Luckiamute West-side subbasins as part of the Willamette Winter Steelhead SMU. In the WLC-TRT assessment these tributaries were not considered to have constituted independent populations historically. Rather, these tributaries may have functioned and continue to function as a population sink with the DPS meta-population structure (Myers et al. 2006). Conversely, under current or future conditions, steelhead production from West-side subbasins may help buffer or compensate for independent populations that are not meeting recovery goals. In future ESA assessments, ODFW would like to discuss with NMFS the possible inclusion of these production areas within the DPS.

In addition, although a naturally reproducing population of UWR steelhead became established in the Middle Fork Willamette in the 1950’s following introductions of hatchery produced fish from the North Santiam, it is generally agreed that steelhead historically did not emigrate farther upstream than the Calapooia River (Dimick and Merryfield 1945; Fulton 1970) and these fish are not included in the DPS.

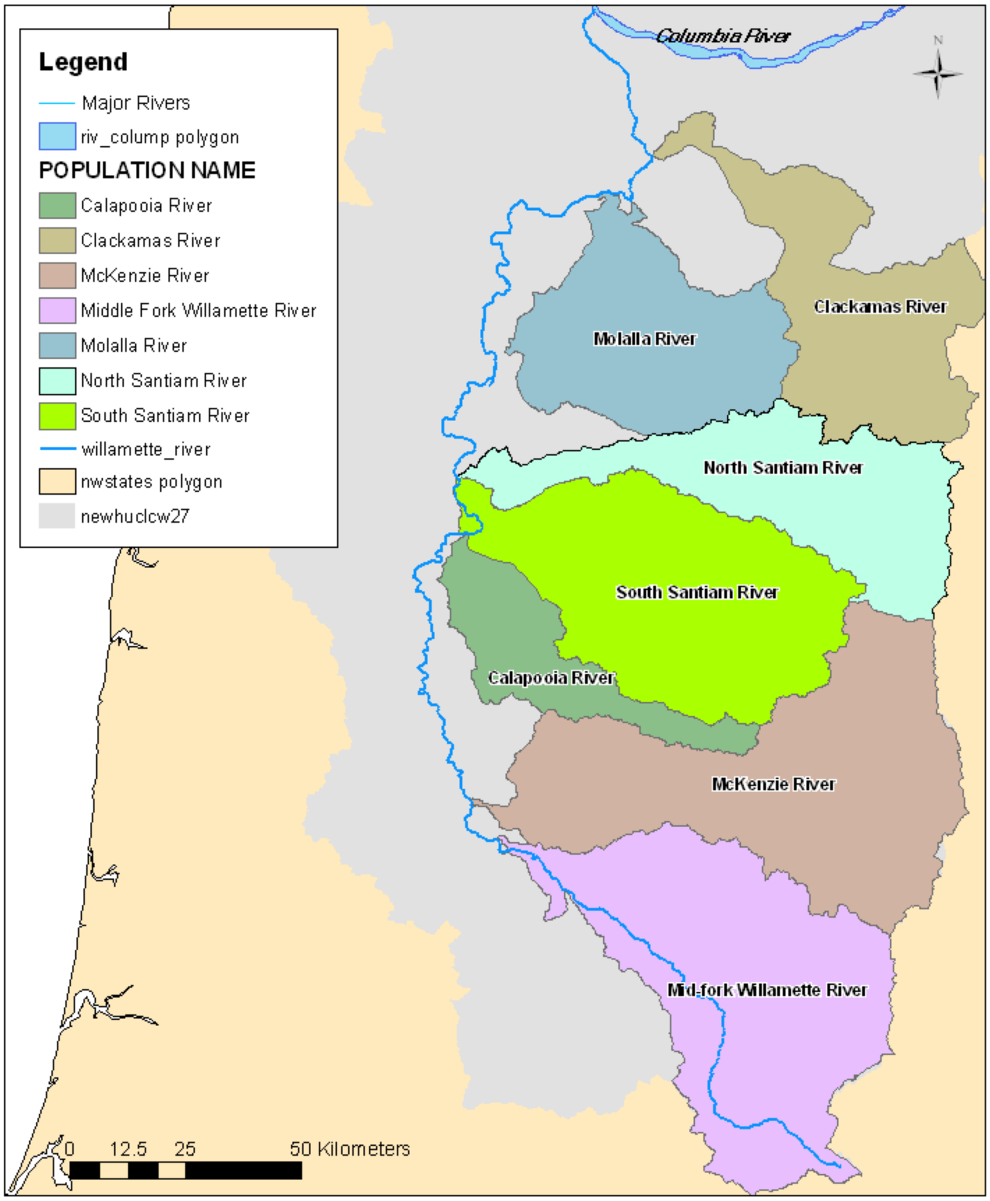

Figure 2-4. Historical populations in the UWR Chinook ESU as proposed by Myers et al. (2006). Figure is from that document.

Addressing Resident Rainbow Trout

The resident form of the species *Oncorhynchus mykiss* (referred to as rainbow or redband trout, depending on location) is sympatric (occupies the same areas) with anadromous *O. mykiss*, or steelhead, in some areas of the UWR steelhead DPS. However, the WLC-TRT did not include the resident form in their delineation of populations within the UWR steelhead DPS, and the NMFS DPS policy and decision to list steelhead separately was recently upheld by the 9th Circuit. Resident *O. mykiss* have not been considered in the viability assessments or recovery strategies for steelhead described in this Plan[22].

Although resident *O. mykiss* are not expressly addressed in this Plan, ODFW and NMFS recognize the potential importance that these fish may play in the viability of UWR steelhead in some populations. A future rainbow trout conservation planning process, if funded, could build off of the strategies and actions identified in this Plan that address tributary habitat issues for steelhead. Actions that improve the habitat for steelhead will benefit resident rainbow trout and are likely to address some of the key or secondary limiting factors for resident *O. mykiss*. As a result, the exclusion of resident rainbow trout in much of this Plan will not adversely impact either the UWR steelhead populations or the resident populations, and the presence of resident *O. mykiss* should actually provide another conservation buffer for UWR steelhead populations in addition to those factored into this Plan.

Kostow (2003) summarized the information available on the inter-relation or isolation between resident rainbow trout and steelhead throughout the Columbia River basin, and found several examples of interactions between the two forms, though the levels to which resident and anadromous *O. mykiss* interactions occur in a particular population and how significant those interactions are to the viability of that population have not been quantified. There are several documented examples of each form producing offspring that adopted the other form's adult life-history (Ruzycki et al. 2003, Blouin 2003, Ardren 2003, Berg 2001, Viola and Schuck 1995, McMichael et al. 1999, as cited in Kostow 2003). There are also occurrences of steelhead adults spawning with rainbow trout (Zimmerman and Reeves 1996; B. Knox [ODFW, personal communication], T. Unterwegner [ODFW, retired, personal communication], as cited in Kostow 2003).

It is difficult to differentiate resident trout from steelhead juveniles during routine sampling. As a result, ODFW has used the presence of larger trout (>20 cm) and the professional opinions of local biologists to characterize the occurrence of resident trout in the UWR steelhead DPS. No estimates have been made of the abundance of any resident populations but they are thought to be common and in moderate abundance.

[22] Kostow (2003) summarized data on *O. mykiss* and determined that the documented interactions between these two sympatric forms met the NMFS definition of populations to include in one ESU

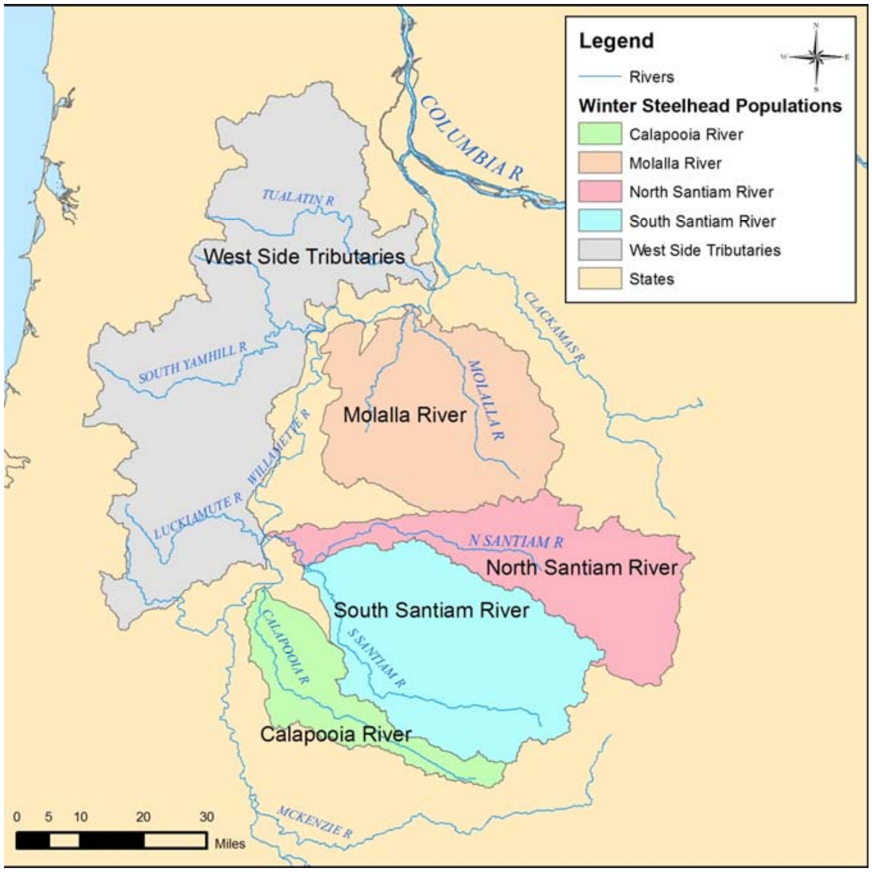

Figure 2-5. Historical independent populations in the UWR steelhead DPS (modified from Myers et al. 2006).

2.4 Critical Habitat

NMFS designated critical habitat for UWR Chinook and steelhead on September 2, 2005 (70 FR 52630). Essential features of designated critical habitat include attributes of substrate, water quality, water quantity, water temperature, food, riparian vegetation, access, water velocity, space, and safe passage that are associated with viability for the ESU and DPS. NMFS identified critical habitat by assigning a value of high, medium, or low to watersheds depending on the conservation value of the watershed to the listed species. Conservation value was determined by evaluating habitat quantity and quality and the relationship to other habitat areas, and with respect to the population occupying that area. The designations focused on physical and biological elements that support one or more life stages and were identified as essential to the conservation of the species, for example spawning gravels, water quality and quantity, side channels, and forage species.

The ratings of areas that provide the greatest biological benefits for listed salmon and steelhead were balanced with economic and other costs to determine final critical habitat designations. Recovery plans use critical habitat designations as one element to consider in identifying and prioritizing recovery actions. Critical habitat designations recognized that salmon habitat is dynamic and that understanding of areas that should be protected and restored for conservation will likely change. Figures 2-6 and 2-7 show the current designated critical habitat for UWR Chinook and UWR steelhead. NMFS will update the critical habitat designations as needed.

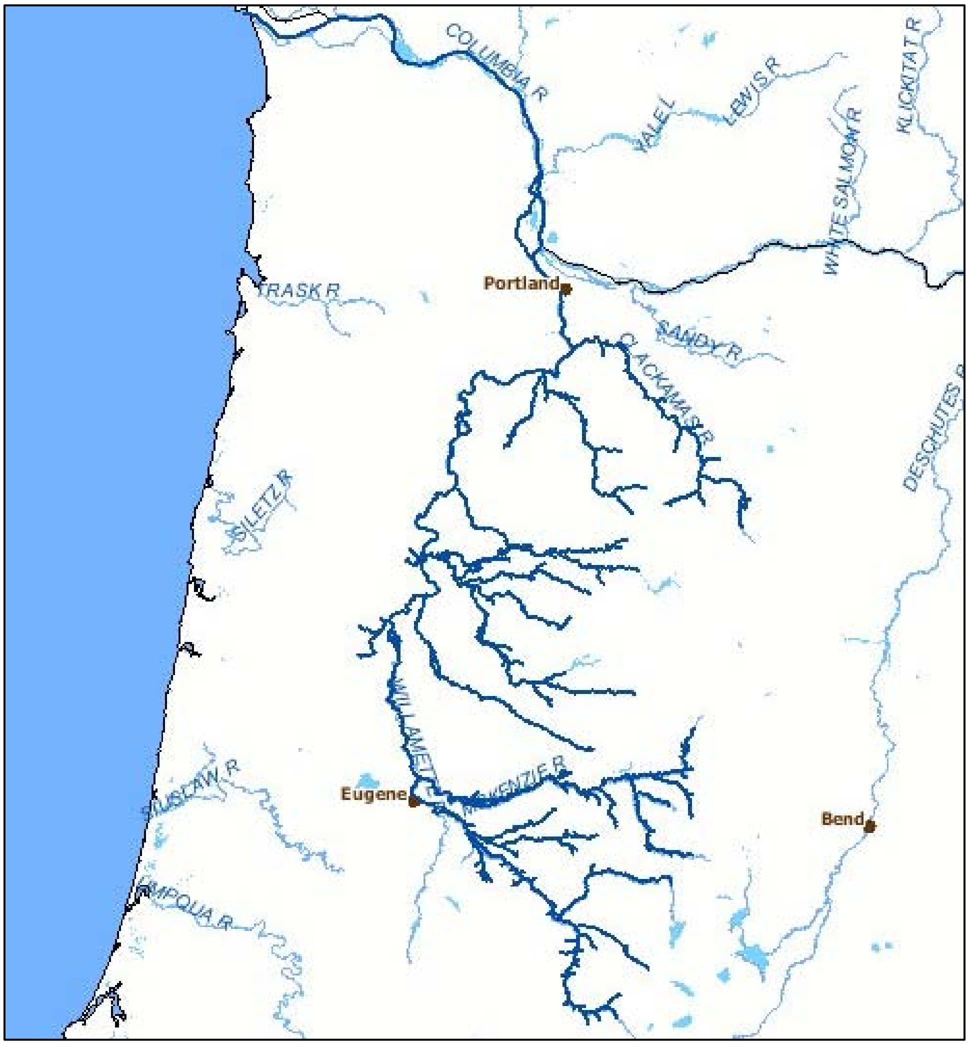

Figure 2-6. Critical habitat designated for the UWR Chinook ESU. Map Source: http://map.streamnet.org/website/CriticalHabitat/viewer.htm

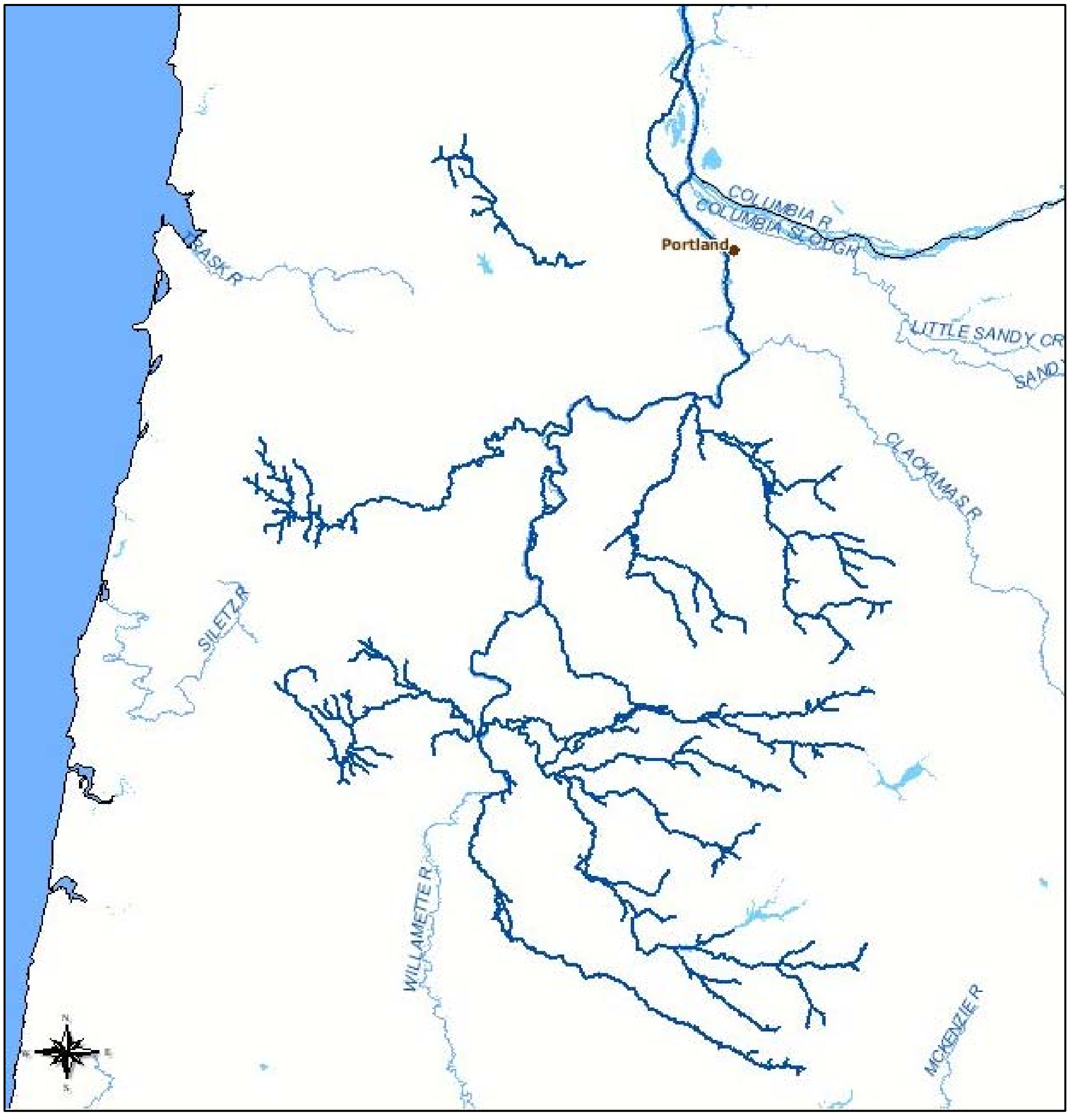

Figure 2-7. Critical habitat for the UWR steelhead DPS.
Map Source: http://map.streamnet.org/website/CriticalHabitat/viewer.htm

Chapter 3: Conservation and Recovery Goals and Criteria

Chapter 3 describes the goals that frame the State of Oregon's and NMFS's path toward recovery of UWR Chinook salmon and steelhead.

- First, the populations must reach desired levels of biological viability and the recovery effort must reduce the impact of the 'listing factors' and 'threats' (see an explanation of these terms in section 1.1) in order to warrant removal of the UWR Chinook ESU and steelhead DPS from the threatened and endangered species list (referred to in this plan as either delisting or ESA recovery). Section 3.1 describes the goals and proposed criteria that would need to be met in order to achieve delisting.

- Second, the State of Oregon seeks to rebuild the wild populations to reach 'broad sense recovery' to provide for sustainable fisheries and other ecological, cultural and social benefits. Section 3.2 describes broad sense recovery goals.

3.1 ESA Recovery Goals

Delisting criteria are objective, measurable criteria that, when met, would result in a determination by NMFS that the ESU is not likely to become endangered within the foreseeable future throughout all or a significant portion of its range. The delisting criteria described here are not necessarily the only set of criteria that would result in delisting. In addition, as new information emerges, NMFS may revisit the delisting criteria. At least every 5 years, NMFS will conduct a review of the each ESU/DPS and determine whether it should be removed from the list or changed in status. Such reviews will take into account a number of factors, including the following:

- The biological and threats criteria described below.
- Management programs in place to address the threats.
- The principles presented in the Viable Salmonid Populations paper (McElhany et al. 2000.)
- Best available information on population and ESU status and new advances in methods to evaluate risk.

To consider delisting, NMFS requires an evaluation of population or demographic parameters (the biological delisting criteria), and threats under the five ESA listing factors in ESA section 4(a) (1) (the threat delisting criteria). Together these make up the "objective, measurable criteria" required under section 4(f) (1) (B) of the ESA.

Biological viability criteria are quantitative metrics that describe DPS characteristics associated with a low risk of extinction for the foreseeable future. These criteria are based on the VSP parameters of abundance, productivity, spatial distribution, and diversity, according to guidelines developed by NOAA's Northwest Fisheries Science Center and published as a NOAA Technical Memorandum, *Viable Salmonid Populations and the Recovery of Evolutionarily Significant Units* (McElhany et al. 2000).

'Limiting factors' are the physical, biological, or chemical features (e.g., inadequate spawning habitat, high water temperature, and insufficient prey resources) experienced by the fish that result in reductions in viable salmonid population (VSP) parameters (abundance, productivity, spatial structure, and diversity). Key limiting factors are those with the greatest impacts on a population's ability to reach a desired status.

"Threats," in the context of salmon recovery, are understood as the activities or processes that cause the biological and physical conditions that limit salmon survival (the limiting factors). "Threats" also refer directly to the listing factors detailed in section 4(a)(1) of the ESA. ESA section 4(a)(1) listing factors are the following:

> A. Present or threatened destruction, modification, or curtailment of [the species'] habitat or range;
> B. Over-utilization for commercial, recreational, scientific, or educational purposes;
> C. Disease or predation;
> D. Inadequacy of existing regulatory mechanisms; or
> E. Other natural or human-made factors affecting [the species'] continued existence.

NMFS has developed a decision framework for making delisting decisions that consists of sets of questions that address the status and change in status of a salmonid ESU/DPS and the risks posed by threats to the ESU/DPS (NMFS 2007a). The relationship between biological criteria, threats criteria, and research, monitoring and evaluation as it pertains to determining an ESU/DPS status is summarized in Figure 3-1. NMFS developed the framework to inform recovery planners how NMFS intends to evaluate ESU/DPS status along with the questions that research, monitoring and evaluation programs should answer in support of status evaluations.

In order to establish objective, measurable criteria for purposes of evaluating the statutory listing factors (ESA section 4(a)(1)(A)-(E)), NMFS must first describe the threats contributing to each listing factor. NMFS must then describe how the severity and trend of a given threat can be monitored and quantifiably evaluated. Typically, this is best accomplished by monitoring the liming factor(s) being altered by the treat. Specific empirical metrics can be identified for each limiting factor to establish quantifiable measures of the impact a given threat is having on the salmonid environment. Ideally, the threat delisting criteria will detail quantitative limiting factor metrics and thresholds that represent low or acceptable levels of risk for a given threat. For example, in order to measure the reduction in habitat-related threats such as removal of stream-side vegetation and operation of dams, we can measure the water temperature to see if it is within the acceptable range. In some cases it may not be feasible or cost effective to monitor the many limiting factor metrics that reflect a threat's impact on salmonid viability. Proxy measures can be identified that, while not quantifying the physical and biological conditions that are limiting salmonid survival and productivity, depict the magnitude and trend of a threat. For example, it may not be feasible to monitor the multitude of limiting factors altered by the threat of urbanization, but monitoring landscape trends in land-use type may serve as a useful proxy for evaluating the impact of urban development on important juvenile rearing habitat.

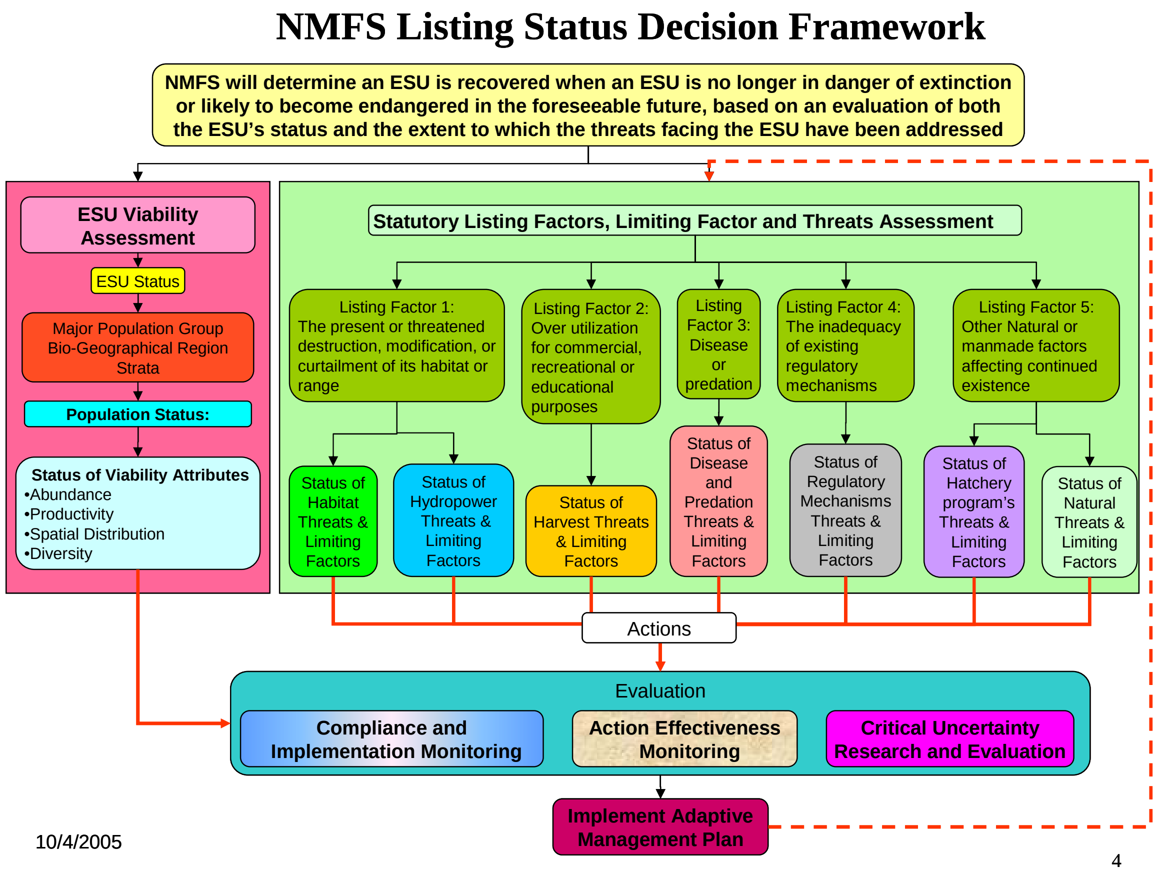

Figure 3-1. NMFS listing status decision framework (from NMFS 2007a).

3.1.1 ESA Biological Goals and Criteria

For ESU/DPS-level status evaluations, this Recovery Plan adopts the viability criteria identified by the WLC-TRT (McElhany et al. 2003, 2006) as the foundation for biological delisting criteria. These criteria were used as technical input into the recovery planning process and provided a technical foundation for development of biological recovery criteria.

The viability criteria relate most directly to the biological delisting criteria; however, they are not synonymous. NMFS establishes delisting criteria based on both science and policy considerations. For instance, science can identify the best metrics for assessing extinction risk and thresholds of those metrics associated with a given level of risk, but setting the acceptable level of risk for purposes of the ESA is a policy decision (McElhany et al. 2006)

To provide a technical foundation for developing biological delisting criteria, NMFS appointed geographically based technical recovery teams[23] (TRTs), which recommended biologically based viability criteria for application to ESA-listed salmonid ESUs. The WLC-TRT (McElhany et al. 2003, 2006) defined biological viability criteria at the levels of the ESU, strata (spatially related populations),

[23] A complete description of the TRT composition, tasks, relationship to ESA recovery planning, and operating principles can be found in the NMFS document *Recovery Planning Guidance for Technical Recovery Teams (TRTs)* http://research.nwfsc.noaa.gov/cbd/trt/guidanc9.pdf

and component populations. The WLC-TRT's approach to viability criteria was guided by a NMFS Technical Memorandum (McElhany et al. 2000). It applied the same biological principles as other TRTs, yet was specific to information available for ESA-listed UWR ESU and DPS populations. The viability criteria identified the biological characteristics and conditions that defined viable populations and strata, and by extension, viable ESUs. At the population level the criteria are based on the biological parameters of abundance, productivity, spatial structure, and diversity[24]. For ESU-level viability criteria, the WLC-TRT considered the geographic distribution and characteristics of component populations to maintain a viable ESU in the context of longer-term ecological and evolutionary processes (see review in Ruckelshaus et al. 2002). Therefore, the ESU-level viability criteria include a framework that determines how many and which populations should be at a particular extinction risk level (very low, low, moderate, high, very high; see Chapter 4 for how these risk levels are determined) for the ESU to have an acceptable low risk of extinction. Population boundaries for listed Pacific salmonids in the Willamette/Lower Columbia recovery domain have been previously identified by Myers et al. (2006). The ESU-level viability criteria adopted by the WLC-TRT were guided by the attributes of recreating some of the basic structure of an historical metapopulation template, and incorporated population-level risk assessment attributes. The criteria had five essential elements:

1. *Stratified Approach*: Life history and ecological complexity that historically existed should have a high probability of persistence into the future. The WLC-TRT partitioned the Willamette/Lower Columbia recovery domain populations into strata based on ecoregion characteristics, life history types and other geographic and genetic considerations[25].
2. *Number of Viable Populations*: Some individual populations within a stratum should have persistence probabilities consistent with a high probability of stratum persistence. The WLC-TRT defined high persistence probability based on the presence of at least two, or one-half, of historic populations, whichever is greater, with a high probability of persistence (>95% probability of persistence over 100 years). The WLC-TRT noted that based on a simple probability analysis, having 2 to 3 populations with a low extinction risk in a stratum provides a relatively significant reduction in risk compared to a single population, but having four or more populations does not greatly reduce the risk. They concluded that a low risk stratum is one with at least two viable populations (i.e., persistence category ≥3; see definition of persistence in Chapter 4), where the average of the persistence categories for all historical populations is ≥2.25.
3. *Representative Populations*: Representative populations need to achieve viability criteria or be maintained, but not every historical population needs to meet the viability criteria. Viable combinations of populations should include "core" populations that are highly productive, "legacy" populations that represent historical genetic diversity, and dispersed populations that minimize susceptibility to catastrophic events.
4. *Non-deterioration*: No population should be allowed to deteriorate until ESU/DPS recovery is assured, and all extant populations must be maintained. Current populations and population segments must be preserved. Recovery measures will be needed in most areas to stop further decline and offset the effects of future impacts.
5. *Safety Factors*: Higher levels of recovery should be attempted in more populations than the minimum needed to achieve ESU/DPS viability because not all attempts will be successful. In addition, there needs to be sufficient viable populations to ensure that the ESU is buffered from the risks of catastrophic events, degraded metapopulation processes, and degraded evolutionary processes.

[24] The VSP report separates abundance and productivity into two separate attributes for a total of four attributes, but because the effects of abundance and productivity on extinction risk are so interconnected, the WLC-TRT analyzed them together.
[25] The WLC-TRT did not identify strata within the UWR Chinook ESU or steelhead DPS, so it is assumed the attributes of a viable stratum are by extension, attributes of a viable ESU.

Recovery efforts must target more than the minimum number of populations and more than the minimum population levels thought to ensure viability. Some populations should be highly viable. Support for these recommendations is provided in the viability reports cited below.

After reviewing the viability criteria developed by the WLC-TRT (McElhany et al. 2003, 2006), Oregon and NMFS used the WLC-TRT viability criteria in developing the following ESU/DPS ESA biological goals and delisting criteria:

1. *ESU/DPS***:** the ESU/DPS demonstrates a high probability of persistence, when:
   a. At least two populations in the ESU and DPS meet Population viability criteria (see 2 below)
   b. The average of all population extinction risk category scores with the ESU or DPS is 2.25 or greater. Details of the logic behind using this averaging approach are in McElhany et al. (2003), which recognizes that having some populations that exceed the VSP population criteria can help mitigate risk from populations with higher risk.
   c. The ESU/DPS maintains a semblance of historical normative metapopulation processes by restoring to viable most of the "core" populations (historically most productive: Chinook 3 of 4 populations, steelhead 2 of 2 populations)
   d. The ESU/DPS maintains a semblance of normative evolutionary processes by improving to very low risk of extinction the remaining "genetic legacy" populations (Chinook: McKenzie population, steelhead: Santiam populations),
   e. All populations not meeting Population viability criteria do not deteriorate and are maintained at a minimum at their current risk of extinction.
2. *Population Viability:* a population is "viable" based on an integrated assessment of the population's abundance, productivity, spatial structure, and diversity statuses that produces an extinction risk classification score of 3 or 4 (based on a scale from 0-4, based on the WLC-TRT's scoring system (Table 2.3 in McElhany et al. [2003])[26, 27].

During technical review of this Recovery Plan the IMST discussed challenges associated with data limitations and uncertainty and how viability criteria were established. In response, we acknowledge that, although the approaches for determining viability at the population level have a robust analytical framework (stock-recruitment, PVA, etc.), scaling up these population attributes to the ESU/DPS scale has far less analytical foundation. However, lacking a full quantitative approach to test the performance of these guidelines, and having no empirical or qualitative basis (which may only serve to propagate uncertainty) to propose an alternate set of guidelines, ODFW and NMFS have determined that the WLC-TRT guidelines are sound, comprehensive, and conservative.

3.1.2 ESA Threats Delisting Criteria

Evaluating the potential reclassification or delisting for a species or ESU also requires an explicit analysis of the five ESA listing factors in Section 4(a) (1) of the ESA. Within each listing factor, NMFS evaluates the severity and trend of the threats (human activities or natural phenomena) that contribute to the species' risk due to the subject listing factor. Establishing measureable criteria for each of the relevant listing/delisting factors helps to ensure that underlying causes of decline have been addressed and

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[26] Viable populations have an extinction risk less than 5%, corresponding to at least a 95% persistence probability and a risk classification score of 3 or greater.
[27] Additional measurable criteria related to monitoring a population's progress in these four VSP parameters through time relative to its desired status (Chapter 6) are given in Chapter 8.

mitigated before considering a species for delisting. However, not all of the listing factors and their component threats are of equal importance in securing the recovery of an ESU or DPS and they may change in importance over time, therefore every potential threat may not need to be fully addressed before delisting is possible.

In 1999, when UWR spring Chinook and winter steelhead were listed under the ESA (64 FR 14308), NMFS cited all of the five listing factors as contributing to the decline of these species. Specifically, the major concerns described were related to: loss of historic spawning and rearing habitat due to dam blockages in the eastside tributaries of the Willamette River, adverse thermal effects downstream from operation of the dams, riparian and stream habitat loss and degradation particularly in the lowland, valley areas (see listing factors A and D below), excessive fishery harvest (see listing factor B below), and adverse effects from hatchery programs (see listing Factor Ebelow).

In addition to evaluating the listing factors and component threats identified at the time of listing, NMFS must also assess any new threats identified since listing to ensure that the species no longer requires protection as a threatened or endangered species.

Section 4(a)(1) of the ESA organizes NMFS' consideration of threats into five factors:

A. The present or threatened destruction, modification, or curtailment of the species' habitat or range
B. Over-utilization for commercial, recreational, scientific, or educational purposes
C. Disease or predation
D. The inadequacy of existing regulatory mechanisms
E. Other natural or human-made factors affecting the species' continued existence

These factors may not all be equally important in securing the continuing recovery of a particular ESU, and each ESU faces a different set of threats within each listing factor. It also is possible that currently perceived threats will become insignificant in the future as a result of changes in the natural environment or changes in the way threats affect the life cycle of salmon and steelhead.

NMFS will use the listing factor criteria below in determining whether an ESU or DPS has recovered to the point where it no longer requires the protections of the ESA. However, NMFS, along with the State of Oregon and our partners in ESA recovery, will continue to work to refine and establish more specific metrics for evaluating threats.

NMFS provides threats criteria, including several examples of more detailed criteria, below:

A. The present or threatened destruction, modification, or curtailment of a species' habitat or range:
    1. Habitat-related threats have been ameliorated such that limiting factors no longer constrain attainment of the desired status of the ESU/DPS and its constituent populations as defined by the biological criteria in this recovery plan, and such that the desired status will be maintained.
        a. Recovery plan actions addressing habitat [threats and/or] limiting factors have been substantially implemented, including related research, monitoring, and evaluation actions. An example, described in more detail in section 8.4, of a simple criterion is a pass/fail test:

           Pass – Positive trend in the status of the habitat degradation metrics

           Fail – Negative trend or no improvement in the status of the habitat degradation metrics

b. To evaluate whether this criterion has been met, additional, specific metrics for assessing habitat conditions and action effectiveness will need to be developed, tracked, and periodically evaluated. NMFS provides the following as examples of specific criteria being implemented or developed:

   i. Specific stream and river reaches (those with designated beneficial uses of anadromous fish spawning, rearing or migration in Willamette River tributaries for each of the populations targeted for low or very low risk, and the mainstem Willamette River), meet the numerical and narrative water temperature, dissolved oxygen, and pH standards set by the Oregon Department of Environmental Quality,[28] or meet the established TMDL load limits

   ii. Specific stream and river reaches (those with designated beneficial uses of anadromous fish spawning, rearing or migration in Willamette River tributaries for each of the populations targeted for low or very low risk, the mainstem Willamette River, the tributary watershed for each of the populations targeted for low or very low risk, and the mainstem Willamette River), meet the numerical and narrative water quality standards for toxics and turbidity once EPA has completed consultation under section 7 of the ESA with NMFS and approved the subject standards.

   iii. Major tributaries and the mainstem Willamette River have sufficient habitat conditions to allow juvenile spring Chinook and steelhead adequate "rest areas" (e.g. thermal refugia, off-channel areas, etc.).

c. Trends in overall habitat condition, in addition to the criteria described above, are stable or improving, including habitat access, hydrograph/water quantity, physical habitat quality and quantity.

d. *Non-deterioration*: No population has deteriorated and all extant populations have been maintained.

2. Hydropower and/or flood control dam related threats have been ameliorated such that they do not limit attainment of the desired status of the ESU/DPS and its constituent populations, as defined by the biological criteria in this recovery plan, and such that the desired status will be maintained.

   i. a. The Willamette Project Biological Opinion, including the RPA has been substantially implemented, including related research, monitoring, and evaluation actions. To evaluate whether this criterion has been met for delisting, NMFS will develop more specific criteria in the future.:

   b. Including, but not limited to a. above, the threat reduction targets for flood control/hydropower outlined in section 6.2 of this recovery plan have been met or flood control/hydropower impacts are otherwise consistent with the desired status

[28] On February 23, 2004, NMFS completed a biological opinion under section 7 of the ESA on the proposed approval of the revised state of Oregon water quality standards for water temperature and intergravel dissolved oxygen by the U.S. Environmental Protection Agency (EPA). The NMFS had previously (July 7, 1999) completed a biological opinion under section 7 of the ESA with EPA that included the revised state of Oregon water quality standard for water column dissolved oxygen. In these biological opinions, NMFS found that the subject water quality standards met the biological requirements of ESA-listed salmon and steelhead for survival and recovery.

of the ESU/DPS and its constituent populations. This includes improved passage (upstream and downstream) for all four tributaries mentioned in a. above. Hydropower management actions will continue to allow for ESUDPS persistence given projected climate changes and other large-scale environmental and ecological impacts. Example of specific criteria are:

i. Evaluation Thresholds for Flood Control/Hydropower Related Metrics for Adult Fish passage

Pass – sufficient number of natural origin adults are allowed above barriers to seed available habitat

Fail – insufficient number of natural origin adults are allowed above barriers to seed available habitat

ii. Prespawn mortality (for mature female fish on or near spawning grounds)

Pass – viable populations: % mortality < 10%[29]; non-viable populations: < 30%

Fail – viable populations: % mortality > 10%; non-viable populations: > 30%

iii. Physical habitat conditions (including flow)

Pass – TBD

Fail – TBD

iv. Water quality conditions

Pass – meet TMDL load allocations for each subbasin

Fail – exceed TMDL load allocations for each subbasin

B. Overutilization for commercial, recreational, or educational purposes:

1. Harvest related threats have been ameliorated such that they do not limit attainment of the desired status of the ESU/DPS and its constituent populations as defined by the biological criteria in this recovery plan, and such that the desired status will be maintained.
   a. The threat reduction targets for harvest outlined in section 6.2 of this recovery plan have been met or harvest impacts are otherwise consistent with the desired status of the ESU/DPS and its constituent populations. To evaluate whether this criterion has been met, an example of a specific criterion related to harvest impacts and action effectiveness (described in section 8.4) is:

      Pass – Chinook: annual total freshwater mortality < 15% and annual total mortally <25%; steelhead: annual total annual mortality < 20%;

      Fail – Chinook: annual total freshwater mortality >15%; steelhead: annual total freshwater mortality > 20%;

2. Any other threats related to overutilization for commercial, recreational, or educational purposes (for example, utilization for research purposes) have been reduced such that they do not limit attainment of the desired status of the ESU/DPS and its constituent populations as defined by the biological criteria in this recovery plan, and such that the desired status will be maintained.

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[29] Based on McKenzie estimates for a population already at a low risk of extinction

C. Disease or predation:

1. Predation related threats have been ameliorated such that they do not limit attainment of the desired status of the ESU/DPS and its constituent populations as defined by the biological criteria in this recovery plan, and such that the desired status will be maintained.
    a. Recovery plan actions related to threats from predation by marine mammals, birds, and fish (including predation among salmon species and predation by hatchery-origin salmon on natural-origin salmon) have been substantially implemented, including related research, monitoring, and evaluation actions.
    b. The threat reduction targets for predation outlined in Section 6.2 of this recovery plan have been met or threats from predation are otherwise consistent with the desired status of the ESU/DPS and its constituent populations. To evaluate whether this criterion has been met, specific metrics related to predation and action effectiveness may need to be developed, tracked, and periodically evaluated.
2. Disease related threats have been ameliorated such that they do not limit attainment of the desired status of the ESU/DPS and its constituent populations as defined by the biological criteria in this recovery plan, and such that the desired status will be maintained.
    a. Hatchery management practices sufficient to limit disease-related threats are being implemented. An example of an additional level of specificity is to require these management practices to be based on protocols recommended by a American Fisheries Society (AFS)-certified disease pathologist.
    b. Monitoring is in place to detect disease and disease impacts on population status.

D. The inadequacy of existing regulatory mechanisms:

1. Regulatory mechanisms have been maintained and/or established and are being implemented in a way that allows the desired status of the ESU/DPS and its constituent populations, as defined by the biological criteria in this recovery plan, to be attained and maintained.
    a. Regulatory programs that govern land use and resource extraction are in place, enforced, monitored, and adaptively managed and are adequate to ensure effective protection of salmon and steelhead habitat, including water quality, water quantity, and stream structure and function, and to attain and maintain the biological recovery criteria in this recovery plan.
    b. The State of Oregon has set instream flow levels for all reaches in which the target populations spawn, rear, or migrate and have regulatory mechanisms in place to ensure that water withdrawals do not prevent instream flow targets from being achieved. [monitoring, and enforcement too]
    c. Regulatory programs are in place and are being implemented, monitored, evaluated and adaptively managed adequately to manage fisheries at levels consistent with the biological recovery criteria of this recovery plan.
    d. Regulatory, control, and education measures are in place and are being implemented, monitored, evaluated and adaptively managed to prevent introductions of non-native plant and animal species.
    e. Regulatory programs have adequate funding, prioritization, enforcement, coordination mechanisms, and research, monitoring, and evaluation to ensure habitat protection and effective management of fisheries.

E. Other natural or man-made factors affecting continued existence.

1. Hatchery related threats have been ameliorated such that they do not limit attainment of the desired status of the ESU/DPS and its constituent populations as defined by the biological criteria in this recovery plan, and such that the desired status will be maintained.
    a. Recovery plan actions related to threats from hatcheries have been substantially implemented, including related research, monitoring, and evaluation actions.
    b. The threat reduction targets for hatcheries outlined in Section 6.2 of this recovery plan have been met or hatchery impacts are otherwise consistent with the desired status of the ESU/DPS and its constituent populations. To evaluate whether this criterion has been met, the specific metrics for evaluating the genetic and ecological risks posed to natural-origin salmon and steelhead by hatchery origin salmon and steelhead described in section 6 form the basis for measuring this listing factor. These are:
        i. If the overall desired status goal for a population is low risk or very low risk, then the target is achieving an average pHOS of ≤10%, regardless of their spawn timing and
        ii. If the recovery goal risk category for a population is 'moderate' then the target average pHOS is ≤ 30%.
        iii. An example of specific criterion is:

        Pass – Over a nine-year period, the average percentage of the total number of spawners that are of hatchery origin is on average less than or equal to that shown in Table 6-10.

        Fail – Over a nine-year period, the average percentage of the total number of spawners that are of hatchery origin is on average higher than that shown in the Table 6-10.
    c. Hatchery programs are being operated in a manner consistent with the target status (and ecological carrying capacity) of each population, and appropriate criteria are being used for managing the interaction of hatchery and natural populations, including hatchery-origin fish spawning naturally.
    d. Hatcheries are operated using appropriate ecological, genetic, and risk containment measures for: (1) release of hatchery juveniles, (2) handling of natural-origin adults, (3) withdrawal of water for hatchery use, (4) discharge of hatchery effluent, and (5) maintenance of fish health during propagation in the hatchery.
    e. Monitoring and evaluation plans are in place and being implemented to measure population status, hatchery effectiveness, and ecological, genetic, and demographic risk containment measures.
2. Other natural and man-made factors have been accounted for such that they do not limit attainment of the desired status of the ESU/DPS and its constituent populations as defined by the biological criteria in this recovery plan, and such that the desired status will be maintained.

Although hatchery-related threats are described above, they are not the only source of threats to the diversity criteria, so it is important to consider any threats that impact biological criteria. For instance, McElhany et al (2003), suggest that metrics and benchmarks for evaluating the diversity of a population should be evaluated over multiple generations and should include:

- substantial proportion of the diversity of a life-history trait(s) that existed historically,
- gene flow and genetic diversity should be similar to historical (natural) levels and origins,
- successful utilization of habitats throughout the range,
- resilience and adaptation to environmental fluctuations.

NMFS concludes that the Biological Delisting Criteria and the Threats Delisting Criteria, as specified above, define conditions that, when met, would likely result in a determination that the UWR spring Chinook ESU and winter steelhead DPS are not likely to become endangered within the foreseeable future throughout all or a significant portion of their range. These conditions represent the best available science at this time. However they may not necessarily be the only conditions that could result in a decision to delist. In addition, as new information emerges, NMFS may revisit the delisting criteria.

3.2 Broad Sense Recovery Goal

Broad sense recovery criteria: Criteria developed by the State of Oregon that go beyond the criteria for ESU delisting, to attain population goals defined in the recovery planning process, generally by local stakeholder groups, that, for example, address other legislative mandates or social, economic, and ecological values. These criteria are outlined in Chapter 10 of this Recovery Plan.

Oregon's 'broad sense recovery is defined as State of Oregon goals of having populations of naturally produced salmon and steelhead sufficiently abundant, productive, and diverse (in terms of life histories and geographic distribution) that the ESU/DPS as a whole (a) will be self-sustaining, and (b) will provide significant ecological, cultural, and economic benefits.

Details of broad sense recovery are in Chapter 10. Oregon's broad-sense recovery goal was developed under the intent of the State's Native Fish Conservation Policy (NFCP) to fulfill the mission of the Oregon Plan for Salmon and Watersheds, which is to restore "Oregon's native fish populations and the aquatic systems that support them to productive and sustainable levels that will provide substantial environmental, cultural, and economic benefits." The Oregon Plan for Salmon and Watersheds is founded on the principle that citizens throughout the region value and enjoy the substantial ecological, cultural and economic benefits that derive from having healthy, diverse populations of salmon and steelhead.

The broad-sense goal in this Recovery Plan was defined in the recovery planning process by local stakeholder and planning teams. This recovery goal is consistent with ESA delisting but is designed to achieve a level of performance for the ESUs and constituent population that is far more robust than needed to remove the ESUs from ESA protection. Broad-sense recovery incorporates ESA delisting goals in the sense that ESA delisting goals would be achieved first during an extended and stepwise process of achieving broad sense recovery goals. Broad-sense recovery represents a level of population performance that may considerably exceed the level at which an ESU or DPS could be delisted, and is a goal that could be based on a combination of legislative mandates, cultural commitments, social values, and voluntary contributions.

Broad Sense Criteria

Oregon's broad-sense recovery criteria are:

- All UWR salmon and steelhead populations have a "very low" extinction risk and are "highly viable" over 100 years throughout their historic range[30]; and
- The majority of UWR salmon and steelhead populations are capable of contributing social, cultural, economic and aesthetic benefits on a regular and sustainable basis.

[30] Having a "very low" extinction risk is equivalent to being "highly viable" in the parlance of population status assessment for recovery plans. A "highly viable" naturally-producing salmonid population with a "very low" extinction risk has less than a 1% probability of extinction over a 100-year period, corresponding to at least a 99% persistence probability. Probabilities result from an integrated assessment of the population's abundance, productivity, spatial structure, and diversity statuses

Chapter 4: Population Status and Conservation Gaps

This chapter provides a brief review of the 2007 status assessment (McElhany et al. 2007) of UWR Chinook and steelhead populations, and an updated status assessment based on new data and modeling methodology. The updated assessment changed some of the status scores for some UWR populations, and this chapter documents those changes. The chapter also describes how the updated population status provides a baseline for current viability attributes for each population, and describes the methodology for estimating the magnitude of improvement (conservation gap) needed in each population to achieve a desired status level. The updated modeling approach was based upon comments received in 2009 from technical reviewers of the OrLCR Plan (which used a similar modeling platform), with respect to an earlier version of the CATAS viability model (see Appendix B for details). The population data files used for the 2007 assessment were updated with new information, and a new procedure was crafted to evaluate the A/P attribute for populations for which there were little or no data.

The chapter focuses on the status of the previously identified independent populations, and does not describe how improvements in the status level for individual populations will be combined to meet the ESU viability criteria developed in Chapter 3 of this Plan. The conservation gaps developed in this chapter contributed to the scoping process for choosing which populations require more recovery effort to meet the ESU viability criteria, and the updated current status and conservation gaps influenced the formation of the ESU-level delisting scenarios described in Chapter 6.

4.1 Population Current Status Assessment

As noted in a previous chapter, the UWR Chinook ESU and steelhead DPS are the listing units under the ESA, but individual populations are the biological units used in this chapter for evaluating the status of UWR Chinook and steelhead ESU/DPS. While the focus of the ESA is on species conservation, we assess the status of populations in terms of extinction risk. Therefore this assessment equates the term "status" with extinction risk. Population status (extinction risk) is a condition that may be thought of ranging from almost 0% (no risk of extinction) to 100% (certain extinction).

As described in the previous assessment of these populations (McElhany et al. 2007), the primary focus of the status assessment was to determine which populations were or were not viable, based on the definition of a viable salmon population (VSP) developed by McElhany et al. (2000). Clearly, one characteristic of a viable population is that the risk of extinction is acceptably low, and McElhany et al. (2006) established a benchmark for population viability as being defined as one with < 5% chance of extinction over a 100-year period. The previous assessment also examined benchmarks for other levels of extinction risk, because population extinction probabilities are along a continuum, ranging from zero (no chance of extinction) to one (extinction is certain). However, the Willamette/Lower Columbia Technical Recovery Team (TRT, McElhany et al. 2003) noted in their supporting documents that that there is limited precision in persistence probabilities estimates (the converse of extinction probabilities estimates) and for criteria development and risk assessment they simply divided the risk continuum into five categories. However, the TRT also recognized that this categorization of discrete risk scores did not convey very well the distribution of uncertainty in risk scores. Therefore, McElhany et al. (2007) explored the uncertainty associated with both the source population data and some analytical features of the assessment by presenting risk as distribution of possible extinction risk scores for each VSP attribute. Graphically, this was represented as diamond shaped profiles whose shape was controlled by the range and frequency of possible extinction risk determinations (Figure 4-1). For each population, the range of possible extinction risk values was bounded by the upper and lower points of the diamonds. The extent of this vertical range reflected a determination of how much uncertainty there was for a particular population's status. The diamond width at any point on the vertical axis represented the likelihood a particular level of extinction risk might be correct. Therefore, the widest point of the diamond corresponded with the most probable extinction risk classification. To visually check the updated status assessment results, each VSP attribute was plotted as extinction risk diamonds, and an overall risk determination for each population was made by combining the scores and ranges for each of the three population attributes (described in McElhany et al. 2007), and plotted in the same diamond profiling for a combined risk determination[31].

Recognizing the limitations above, but to facilitate reporting the population status summaries and subsequent conservation gap development, we have separated the range of extinction probabilities into the five risk categories in Table 4-1. These risk category designations (from very low to very high) are referenced throughout this Plan.

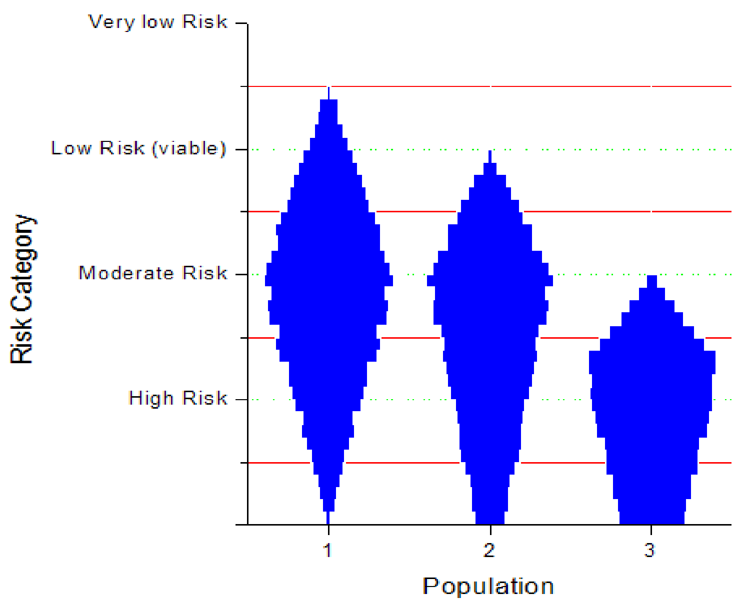

Figure 4-1. Diamond profiles for a single VSP attribute for three hypothetical populations that have different extinction risk profiles.

Table 4-1. Range definition of extinction probabilities and associated risk categories over a 100 year projection (from McElhany et al. 2007).

Probability of Extinction	Extinction Risk (viability) Category	Extinction Risk Category	Risk Category Score
0.00 to 0.01	Viable	Very Low (VL)	4
0.01 to 0.05	Viable	Low (L)	3
0.05 to 0.25	Non-viable	Moderate (M)	2
0.25 to 0.60	Non-viable	High (H)	1
0.60 to 1.00	Non-viable	Very High (VH)	0

[31] As an additional step to address uncertainty inherent to extinction risk modeling, a precautionary change was made in interpreting the extinction risk diamonds. These modifications are described later in this chapter. Those relatively uncommon cases where these modifications resulted in a population assessment that was different from the 2007 assessment (McElhany et al. 2007) are flagged and described.

The risk assessment focused on the four biological VSP attributes of viable populations identified by McElhany et al. (2000): abundance, productivity, diversity, and spatial structure. Specific information for each of these VSP attributes was used in forecasting extinction risk. However, because the four attributes are often interrelated and it is difficult to separate how each variable independently affects extinction risk. This interaction is particularly strong between the abundance (A) and productivity (P) VSP attributes, and for this assessment these two attributes were treated as a single entity of abundance/productivity (A/P). The two attributes were evaluated and ranked as one attribute because abundance cannot be evaluated without the context of productivity, and productivity cannot be evaluated without the context of abundance. For example, a population with low abundance but high productivity may have exactly the same extinction vulnerability (and therefore risk category) as a population with high abundance and low productivity. Further, there are a very large number of possible combinations of abundance and productivity values that may produce the same range of extinction risk probabilities, which underlies the abundance and productivity viability curves developed for several UWR populations (McElhany et al. 2007).

The spatial structure (SS) and diversity (D) attributes were treated as separate attributes for the assessment. However, because of the difficultly of developing metrics for the SS and D attributes that could be quantitatively characterized to extinction risk, a mix of qualitative and quantitative metrics were used, recognizing that relationship to extinction risk in most cases could not be explicitly modeled, unlike the case for the A/P attribute. The methodological details used to score the SS, D, and A/P attributes are presented in McElhany et al. (2007).

4.1.1 Spring Chinook ESU Status – High to Very High Extinction Risk

Of the seven populations that historically comprised the UWR Chinook ESU, the natal subbasins supporting these populations are tributaries within the Willamette River basin[32]. The UWR Chinook ESU is considered to be extremely depressed, likely numbering less than 10,000 fish compared to a historical abundance estimate of 300,000 (Myers et al. 2003). Currently, significant natural production occurs in only the Clackamas and McKenzie populations (McElhany et al. 2007). Juvenile spring Chinook produced by hatchery programs are released throughout many of the subbasins and adult Chinook returns to the ESU are typically 80-90% hatchery origin fish. Flood control/hydropower development has eliminated or adversely changed freshwater habitat for spring Chinook habitat in most subbasins. In addition, a large fraction (30% to 80%) of adult spring Chinook reaching each subbasin die before spawning, for reasons not yet clearly understood.

In the previous assessment, McElhany et al. (2007) determined that the Clackamas population was the only population in the ESU with an extinction risk rating of low or better (i.e. viable), that the Mckenzie population fell into the moderate risk category, and the remaining five populations were classified as being at very high risk (Figure 4-2, from McElhany et al. 2007). Although there was uncertainty in the status determinations for these five populations, mostly due to lack of abundance and productivity data, it was not to the extent that it cast doubt on whether they were viable or non-viable, and the results of the updated assessment did not differ appreciably from the results of the earlier status evaluation. However, the classification for Clackamas Chinook salmon was downgraded from low to moderate risk and the classification for McKenzie Chinook salmon was upgraded from moderate to low risk.

[32] The Clackamas population was originally addressed in the OrLCR Plan because of its shared geography with other LCR species and populations. That assessment and recovery strategy are superseded by the updated analyses performed for the Clackamas population described in this Plan.

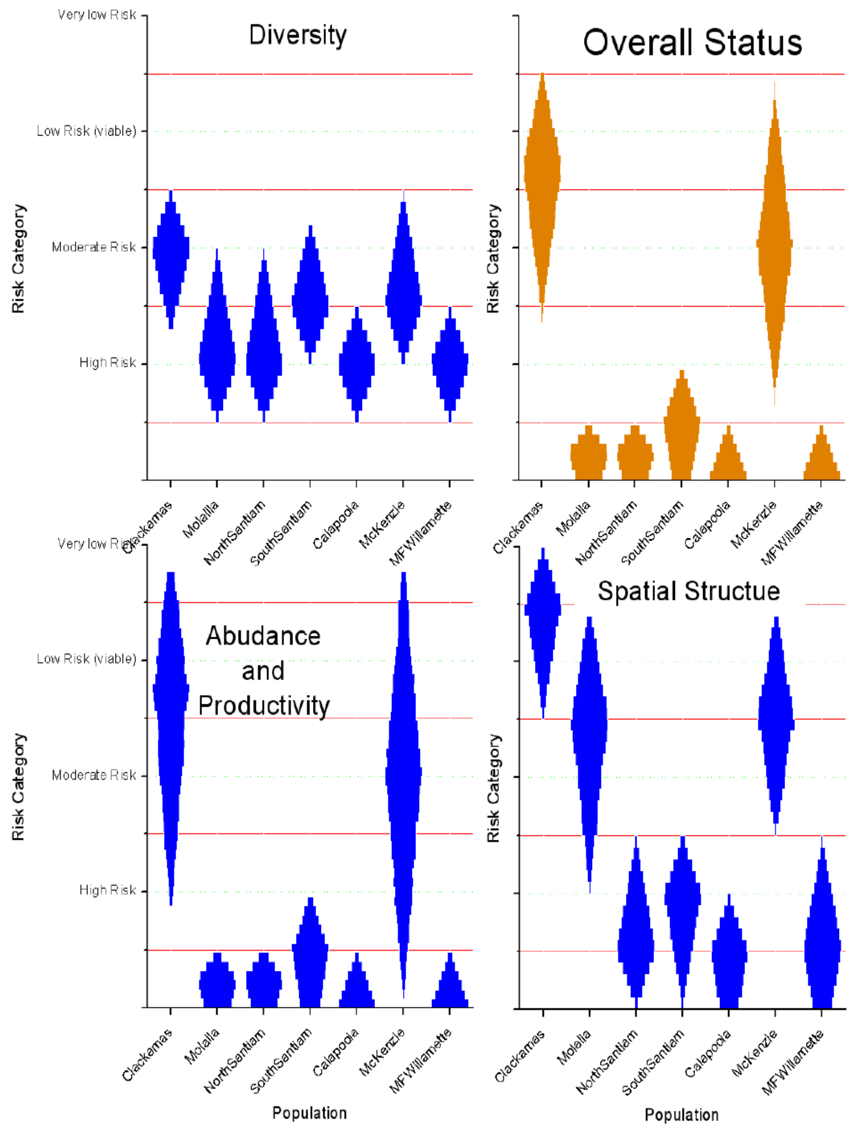

Figure 4-2. Extinction risk ratings for UWR spring Chinook populations from an earlier assessment (McElhany et al. 2007).

4.1.2 Winter Steelhead DPS Status –Low to Moderate Extinction Risk

The UWR steelhead DPS was historically comprised of four winter-run populations occurring in subbasins that originate in the Cascade Mountains. Steelhead also use West-side tributaries on an intermittent basis, but as a unit these subbasins are not thought to have functioned as an independent population (Myers et al. 2006).

For UWR steelhead, although the DPS is depressed relative to historical levels, the risk of extinction is modest, especially compared to the UWR Chinook populations that share much of the same geography. In their assessment of these populations, McElhany et al. (2007) found that while most of these populations probably fell into the 'moderate' extinction risk classification, there was a large degree of uncertainty in this result as illustrated by the elongated status diamonds in Figure 4-3. As a result of the most recent assessment of these populations, the overall risk status for the North Santiam, South Santiam, and Molalla populations was upgraded from moderate to low extinction risk. This was largely due to new estimates of extinction risk that were obtained from running an updated version of the CATAS population viability model (Appendix B).

4.2 Population Conservation Gaps

As discussed in the preceding section, many UWR Chinook populations were determined to have extinction risk levels that are consistent with a classification of non-viable. The term "conservation gaps" is used here to help describe the magnitude of improvements needed to improve a population's current condition to a targeted "recovery" condition, and address the extinction risks of each risk category. For example, if the current extinction risk classification for a population is high risk, then the magnitude of improvements needed to reach moderate, low, and very low risk levels, would each be defined as a conservation gap.

Conservation gaps were estimated for each of the three VSP attributes: abundance/productivity, diversity, and spatial structure. Methodology for these conservation gaps are in Appendix I. Although conservation gaps were developed for both the diversity and spatial structure attributes, there are several reasons to emphasize the abundance/productivity conservation gap. First, abundance/productivity is weighed more heavily than spatial structure and diversity attributes in the overall status determinations (McElhany et al. 2007) and has a greater influence on a population's overall extinction risk determination. Second, none of the population viability attributes are truly independent. For example, a population that has limited life cycle and genetic diversity will be less likely to have the productivity and resilience to rebound from periods of unfavorable environmental conditions. Likewise, a spatially fragmented population will be more vulnerable to local disturbances and be slow to recover after such events. This condition will effectively depress overall population abundance and as a result make the population more vulnerable to extinction. Third, for salmonid populations the process of extinction is better understood as it relates to abundance and productivity, whereas the process is less direct and more difficult to quantify for population diversity and spatial structure.

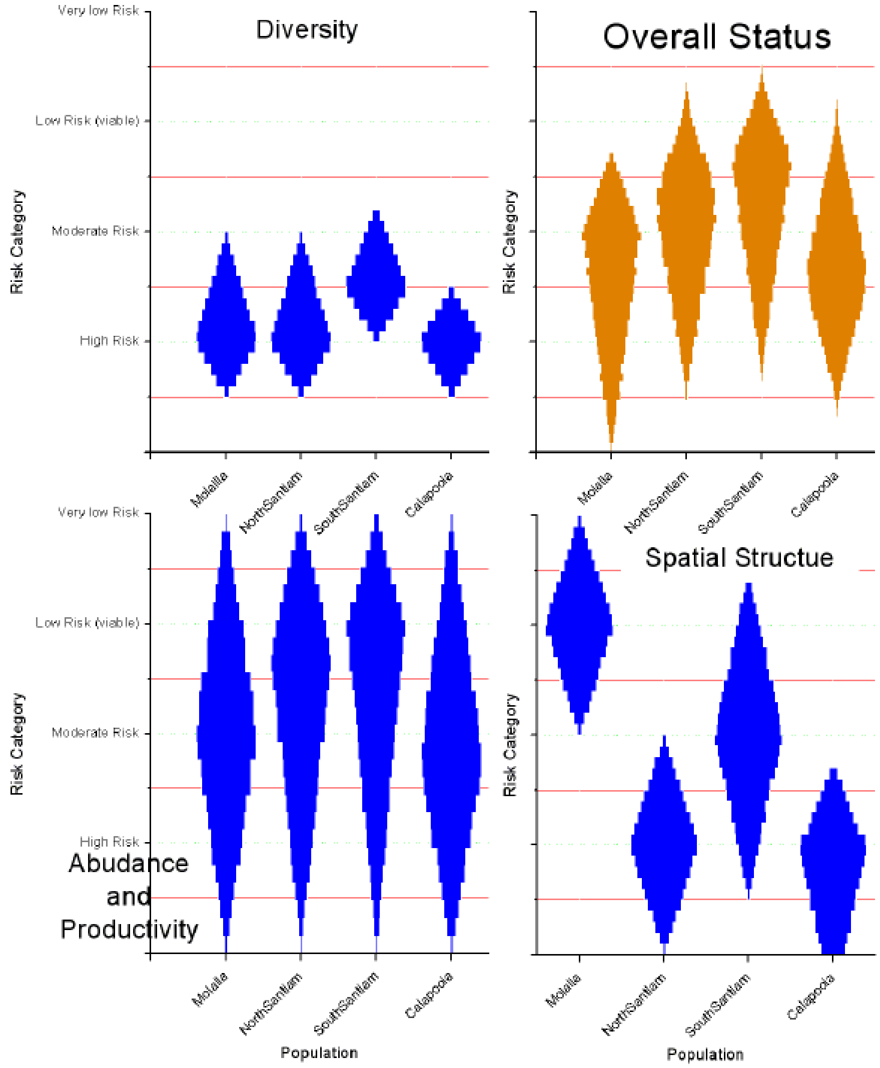

Figure 4-3. Extinction risk ratings for UWR steelhead populations from an earlier assessment (McElhany et al. 2007).

4.2.1 Summary of Current Status and Conservation Gap

Given the individual extinction scorings for VSP attributes in the previous subsections, Table 4-2 summarizes the overall extinction risk for each UWR Chinook salmon and steelhead population.

Table 4-2. Summary of the key elements and their respective scores used to determine current status risk classification for the diversity attribute for UWR Chinook salmon and steelhead. See Table 4-1 for extinction risk classification abbreviation.

Species / Population	A/P	Diversity	Spatial Structure	Overall Extinction Risk Category
Chinook				
Clackamas	M	M	L	M
Molalla	VH	H	H	VH
North Santiam	VH	H	H	VH
South Santiam	VH	M	M	VH
Calapooia	VH	H	VH	VH
McKenzie	VL	M	M	L
MF Willamette	VH	H	H	VH
Steelhead				
Molalla	VL	M	M	L
North Santiam	VL	M	H	L
South Santiam	VL	M	M	L
Calapooia	M	M	VH	M

The conservation gaps presented in Table 4-3 are reported as single numbers without a range or uncertainty bars. However, for each gap there is a range of possible results, in terms of population status, that cover more than one extinction risk classification.

To illustrate this principle we provide an example using a coho population in the Lower Columbia River ESU:

> The risk classifications of high, moderate, low, and very low for Sandy coho as described in the OrLCR Plan correspond with A/P conservation gap values of 416, 1,387, 2,656, and 3,766 adult spawners respectively (Figure 4-6). However, these values do not represent point estimates but rather underlying distributions of possible values. Therefore, as illustrated in Figure 4-6, a survival increase that results in the population growing by 1,387 wild coho would 'lift' the status diamond for Sandy coho from its current very high risk classification to a moderate risk classification (i.e. close the A/P conservation gap).
>
> However, there is considerable uncertainty how much the extinction risk will actually decline with a 1,387 increase in population abundance. As the placement of the diamond on this graph reflects, there is a chance that the population would not raise above the zone of high risk. Conversely there is also a chance, somewhat greater, that the population would enter the low risk zone. There is even a small possibility in this example that the extinction risk could fall into the very low risk zone.

As applied to UWR populations, there is a diamond-like distribution of extinction probabilities for each conservation gap value listed in Table 4-2. Therefore, as a practical matter, when recovery actions are taken to deliver the survival improvements necessary to close a particular conservation gap, there is a possibility that the future resulting population status could land above or below the intended target.

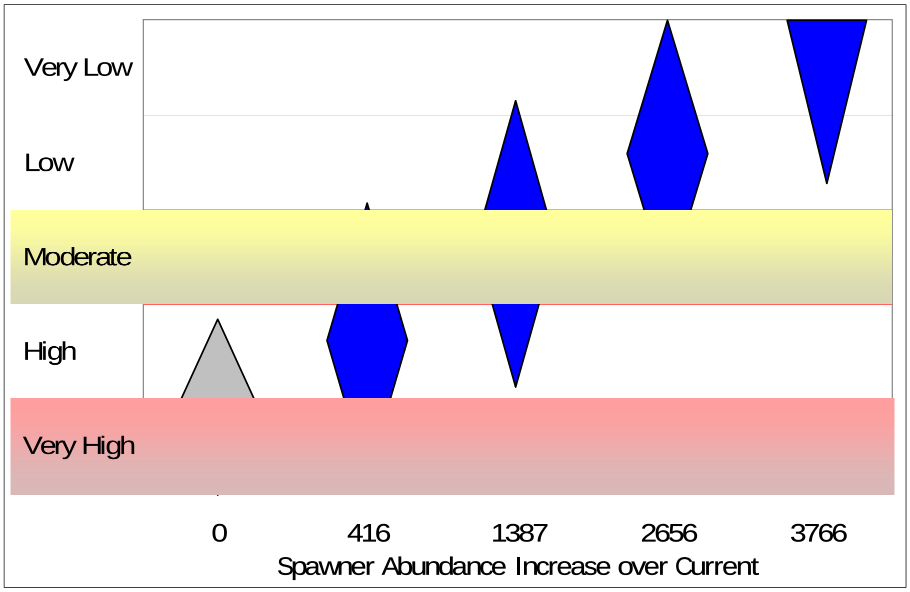

Figure 4-4. An example of forecasting a distribution of possible status outcomes (blue diamonds) if the abundance increases necessary to close A/P conservation gaps. Gaps identified for an example population from the LCR coho ESU (Sandy coho). Current conditions status represented diamond on far left.

Table 4-3. Estimated conservation gaps for UWR Chinook and steelhead population attributes of abundance/productivity (A/P; gap in number of spawners), and for category scores of diversity (D) and spatial structure (SS). The A/P gaps include a 20% conservation buffer, as described in Chapter 6 of this Plan. A/P gaps with * were not calculated. Shaded cells indicate the population is already above a risk threshold for that attribute and therefore does not have a conservation gap at that risk level.

Species/Population	Conservation Gaps											
	High Risk			Moderate Risk			Low Risk			Very Low Risk		
	A/P	D	SS	A/P	D	SS	A/P	D	SS	A/P	D	SS
Chinook												
Clackamas							*	1		946	2	1
Molalla	696			*	1	1	1,409	2	2	*	3	3
North Santiam	*			*	1	1	5,400	2	2	*	3	3
South Santiam	*			3,100			4,860	1	1	*	2	2
Calapooia	590		1	*	1	2	1,200	2	3	*	3	4
McKenzie							*	1	1	3,491	2	2
MF Willamette	*			*	1	1	5,820	2	2	*	3	3
Steelhead												
Molalla							*	1	1	557	2	2
North Santiam				*		1	*	1	2	4,687	2	3
South Santiam							*	1	1	1,212	2	2
Calapooia			1	21		2	331	1	3	498	2	4

As might be expected, the A/P conservation gaps that were calculated varied among populations. For several of the spring Chinook populations in particular the A/P conservation gaps were large. However, since the finding was primarily for the 'no data' populations, the accuracy of these gap estimates is strongly dependent on the adequacy of the approach used to build the recruitment models for these populations (Appendix B).

Further, the A/P conservation gaps estimated for some populations are very large relative to the current size of the population. It is likely that some of these estimates are too large and may be an artifact of the gap estimation methodology, which assumes a linear population response at all population densities and conservation levels. For the nearly extinct populations, this linear assumption is probably incorrect and has likely led to the generation of some exceptionally large A/P conservation gaps.

The estimation procedure could have been modified to reflect a more non-linear behavior at these low abundance levels. However, it was not clear how the nonlinearity should be modeled and there was no assurance a more complicated model would reduce output uncertainty. Therefore, the current approach was applied for all populations. Still, the response for some populations to the proposed recovery actions will not be accurately known until the response can actually be observed at some point in the future. An active post-implementing monitoring program for these populations will be especially critical.

The spatial structure conservation gaps for most populations were greater than for the diversity gaps (Table 4-3). This reflects the fact that much of the historical habitat remains inaccessible for most of the populations, resulting in most populations being in the non-viable category with respect to spatial structure (Table 4-2)[33].

[33] From Maher et al. (2005): “It is important to note that physical accessibility does not equate to fish presence and just because a stream is deemed accessible does not mean it is now or was ever used by a salmonid species. In presenting these data we do not mean to say that fish have or will utilize 100% of the accessible reaches and it is reasonable to assume that these data overestimate the stream lengths associated with current or historical distribution (see fish distribution maps).”

Chapter 5: Limiting Factors and Threats

Chapter 5 describes limiting factors and threats to the recovery of the UWR Chinook ESU and steelhead DPS. Limiting factors are the physical, biological, or chemical conditions (e.g., inadequate spawning habitat, habitat connectivity, high water temperature, insufficient prey resources) and associated ecological processes and interactions experienced by the fish that result in reductions in viable salmonid population parameters (abundance, productivity, spatial structure, and diversity). Threats are the human activities or natural events (e.g., road building, floodplain development, fish harvest, hatchery influences, and volcanoes) that cause or contribute to limiting factors. These limiting factors and threats (LFTs) were identified and ranked for importance through a comprehensive review of potential limiting factors and threats across the entire lifecycle. Identifying how suites of management actions (Chapters 6 and 7) strategically addressed these LFTs provides the conceptual basis for restoring viability of UWR Chinook and steelhead.

This chapter is divided into four sections. The first section describes the components of limiting factors and threats and the basic approach that the Expert Panel and the Planning Team used to develop them. The remaining sections provide the results of this process.

Development Process

The process of identifying LFTs for UWR Chinook and steelhead populations is based on strong technical, policy-level and stakeholder involvement. Individuals with expertise about conditions at the State, ESU and watershed levels were brought in at different steps of an iterative process to identify the LFT's at the independent population level, as well as common threat themes across the ESU and DPS.

- ODFW created an Expert Panel to establish a foundation for LFT determinations. Pooling their collective knowledge, nine biologists with significant knowledge of UWR Chinook and steelhead convened to provide their professional opinion on the LFTs that significantly influence the current status of UWR Chinook and steelhead populations. The specific purpose for convening the panel of experts was to quickly develop an initial list and ranking of potential LFTs that would serve as a starting point for more detailed and lengthy deliberations by the UWR Planning Team. This first step of an iterative process is described in greater detail in Appendix C.
- The initial list of LFTs developed by the Expert Panel was extensively reviewed and modified during a series of meetings by the Planning Team. At these planning team meetings, additional information was presented and discussed that either supported or refuted the initial list provided by the Expert Panel. Based on the consensus of the Planning Team, the initial list of LFTs was modified to reflect additional information and more detailed deliberations of the Planning Team. The Planning Team also modified the Expert Panel's findings regarding LFTs that occur in the estuary based on the Columbia River Estuary Recovery Plan Module[34] (LCREP 2007).
- The updated list of LFTs was provided to the Stakeholder Team for their review. Stakeholder comments and input on the updated list of limiting factors and threats were reviewed by the Planning Team, who again modified the list by consensus.
- The Planning and Stakeholder teams then reviewed the revised draft of this chapter of the recovery Plan. The Planning Team then reviewed these comments received on the draft and revised the LFT's and discussions as appropriate. This iterative process involving the Expert Panel, Planning Team and Stakeholder Team resulted in the LFTs described in subsequent sections of this chapter.

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[34] http://www.nwr.noaa.gov/Salmon-Recovery-Planning/ESA-Recovery-Plans/Estuary-Module.cfm

Approach to Uncertainty

There are several sources of uncertainty related to the LFT assessment. For example, there is the likelihood some threats were not identified with enough detail or some critical limiting factors were not correctly ranked as to their importance. It should be noted that in addition to the information reported in the listing determination, this Plan applied a multistep threat review undertaken by scientists with a high level of salmonid and ecosystem knowledge, as described above, and it is assumed the life cycle approach to LFT determination has identified the most important factors limiting UWR Chinook and steelhead viability. However there is a lack of empirical data linking specific limiting factors to VSP metrics for UWR Chinook and steelhead populations, and that the interactive or cumulative nature of some LFTs is not completely understood. The risk of this uncertainty is that the impact of some factors may not have been sufficiently unmasked, relative to repairing life cycle bottlenecks. This source of uncertainty is addressed by having robust and flexible suites of integrated actions that target known life cycle bottlenecks. The scenario analyses (Chapter 6), management actions (Chapter 7), and implementation strategy (Chapter 9) are essentially the treatments designed to repair the major life cycle bottlenecks represented by the LFTs. To the extent there is no measurable biophysical response to these treatments (suites of strategic actions), it would subsequently be assumed that the importance of some of the LFTs was not adequately characterized, or that actions have not been sufficiently implemented. In either case, this Plan relies on a testable adaptive management strategy to reduce uncertainty in the LFT assessment through re-alignment of critical uncertainty research, actions, monitoring, and evaluation.

5.1 Limiting Factor and Threat Analysis Components

5.1.1 General Limiting Factor Categories

As described above, limiting factors are the physical, biological, or chemical conditions and associated ecological processes and interactions (e.g., population size, habitat connectivity, water quality, water quantity, etc.) experienced by the fish that may influence VSP parameters (abundance, productivity, spatial structure, and diversity). After considering a set of draft guidelines and list of limiting factor categories developed by NMFS (NMFS 2005a), Oregon chose a modified set of limiting factors (Table 5-1), based on the premise that this set better identifies LFTs at specific life stages and spatial scales, and therefore better for identifying effective recovery actions.

Table 5-1. General limiting factor categories identified for UWR Chinook and steelhead populations, category definitions, and the VSP parameters they affect. Factor categories are in alphabetical order.

Limiting Factor Category	Definition	VSP Parameters Potentially Affected *
Competition	Adverse interaction between naturally produced fish and other fish or other species, both of which need some limited environmental factor (i.e. food or space).	A, P, D, SS
Disease	Pathological condition in naturally produced fish resulting from infection.	A, P, D, SS
Food web	Changes in the food web, such as from macrodetritus-based to a microdetritus-based input, or because of reduced salmon carcasses.	A, P, D, SS
Habitat access	Impaired access to spawning and/or rearing habitat. Examples include impassable culverts, direct mortality at dams, delayed migration over dams, dewatered stream channels, etc. If, for example, a stream has been diked- thereby eliminating access to off-channel habitat- habitat access should be considered a problem. If off-channel habitat to which access has been eliminated is in impaired condition, it is also considered an element of the physical habitat quality/quantity limiting factor.	A, P, SS, (sometimes D)

Hydrograph/water quantity	Altered hydrograph, timing and magnitude of flows	A, P, D, SS
Physical habitat quality/quantity	Habitat characteristics include floodplain connectivity and function, channel structure and complexity, channel morphology, riparian condition (including loss or alteration of stream habitat) and large wood recruitment, sediment routing (fine and coarse sediment), and upland processes. Quantity refers to the amount of accessible habitat for different life history stages.	A, P, D, SS
Population traits	Impaired population condition(s) including: genetic, life history, morphological, productivity, fitness, behavioral characteristics, and population size. Population traits may be lost through such means as hatchery influences, selective harvest mortality, and altered environmental conditions from human actions or natural occurrences. Although population traits are caused by other limiting factors, they may also act independently as a limiting factor.	Harvest: A, P, D, SS Hatcheries: A, P, D Hydro: A, P, D, SS
Predation	Consumption of naturally produced fish by another species (does not include fishery mortality).	A, P, D, SS
Water quality	Water characteristics including temperature, dissolved oxygen, suspended sediment, pH, toxics, etc.	A, P, D, SS

*VSP parameters: A- abundance, P – productivity, D –diversity, SS – spatial structure

5.1.2 General Threat Categories

As described above, threats to UWR Chinook and steelhead are human impacts, including fishing , hatchery operations, flood control/hydropower system operations, the introduction of exotic species, and land use practices (e.g., road building, riparian development, etc.), or natural occurrences (e.g., flood, drought, volcano, tsunami, etc.) that *cause or contribute to* limiting factors. A single threat may cause or contribute to one or more limiting factors and may affect one or more life stages, and conversely, a single limiting factor may be caused by one or more threats. This implies that LFTs can have interacting and cumulative impacts on UWR Chinook and steelhead VSP's. In addition, past threats can have legacy effects, and may continue to contribute to current limiting factors.

For this LFT assessment, five broad threat categories were considered originally: fish harvest management, hatchery management, flood control/hydropower management, land use management (excluding flood control/hydropower), and introduced species. The "introduced species" threat category was redefined as "other species" in Table 5-2 and in subsequent sections to better reflect management strategies that address both native and non-native species impacts would be addressed (see description below of different LFT effects of other species).

In Chapters 6 and 7 these threat categories were further partitioned into threat sub-categories that better reflected specific threats and how they would be addressed in this Plan. We re-emphasize that there is considerable uncertainty regarding emerging threats such as climate change and population growth and how they will affect salmon and steelhead. We did not define climate change and population growth as unique threat categories in this Plan, because we assume these additional sources of risk will be manifested through LFTs already accounted for in the existing categories. We assume the ramifications of climate change and human population pressure will increase the need for coordination among management actions to address LFTs.. We provide a general description of the potential impacts of climate change and human population growth to UWR ESUs in section 5-3 below. Chapters 7 and 9 describe an approach for assessing the risk of climate change.

Table 5-2. The general threat categories and a brief description of how they are manifested into limiting factors for UWR Chinook and steelhead populations.

Threat Category	How Threats Cause or Contribute to Limiting Factors
Flood Control/Hydro Management	Hydropower and flood control management cause a loss or alteration of stream habitat. Management includes dam construction and operations, conversion of riverine habitat to reservoir, and water withdrawals and flow alterations.
Land Management	Land management practices associated with agriculture, timber harvest, mining and grazing activities, diking, damming, development of transportation corridors, and urbanization can degrade or destroy ecosystem function by altering habitat characteristics, including sediment, connectivity of side channels and water quality
Other Species	Effects of other species include predation and competition effects by native and non-native fish, or other animals, and habitat degradation effects by non-native plants.
Harvest Management	Fisheries cause direct and indirect mortality to naturally produced fish. Direct mortality occurs when a fish is caught and killed directly as a result of an authorized fishery. Indirect mortality includes mortality of fish that are caught and released or that encounter fishing gear but are not landed. Most harvest regimes target abundant hatchery fish and are regulated to limit impacts on naturally spawned fish. However, naturally spawned fish can be incidentally caught and killed in fisheries aimed at hatchery fish. Fisheries can also result in genetic selection (e. g. size or age)
Hatchery Management	Hatchery programs can harm salmonid viability in several ways: hatchery-induced genetic change can reduce fitness of wild fish; hatchery-induced ecological effects—such as increased competition for food and space—can reduce population productivity and abundance; hatchery-imposed environmental changes can reduce a population's spatial structure by limiting access to historical habitat; hatchery-induced disease conveyance can reduce fish health. Practices that introduce native and non-native hatchery fish can increase predation on juvenile life stages. Hatchery practices that affect natural fish production include removal of adults for broodstock, breeding practices, rearing practices, release practices, number of fish released, reduced water quality, and blockage of access to habitat.

5.1.3 Life Stages and Geographic Areas Considered

Life-Stage Definitions

ODFW provided guidance to the Expert Panel and Planning Team regarding life stages to consider. These life stages are described below.

- *Egg / alevin*: Life stages from egg deposition until emergence from the gravel. An alevin has not absorbed its yolk sac, a primary source of nutrition.
- *Fry:* Life stage between alevin and parr. A fry has emerged from the gravel but has not left the redd; it has absorbed its yolk sac.
- *Summer parr*: A summer parr is any juvenile Chinook salmon or an Age 1+ or older juvenile steelhead that is actively foraging in freshwater rearing habitat in summer.
- *Winter parr*: A winter parr is an Age 1 juvenile Chinook salmon or any juvenile steelhead using winter rearing habitat for foraging and shelter.
- *Smolt*: A juvenile salmonid migrating downstream to the ocean. A smolt is undergoing physiological adaptations in order to osmoregulate in saltwater.
- *Sub adult*: Fish rearing in the ocean.
- *Adult*: Maturing fish, either in the ocean or freshwater, that are migrating toward spawning areas
- *Spawner*: Sexually mature fish.
- *Kelt*: A post spawn steelhead returning to saltwater.

The purpose of dividing the parr life stage into summer and winter seasons is that juveniles use winter and summer habitat differently, and different actions are often required to address LFTs impacting this seasonal use. The Planning Team also partitioned the juvenile life stages in two different ways based on geographic considerations. Juvenile life stages in freshwater were based on the concept that differences in seasonal habitat needs often require different actions to adequately address LFT concerns. Juvenile life stages in the estuary were based on a condensed version of the life history strategies used to identify LFTs in the Estuary Module (NMFS 2008b), (Table 5-3).

Geographic Areas

UWR Chinook and steelhead experience LFTs that are life-stage specific as they navigate through different geographic areas during their life cycle. The Planning Team examined the wide range of factors impacting the UWR Chinook and steelhead populations in the different locations, and recognized five distinct geographic areas where life-stage specific LFTs may occur. These areas span the lifecycle of UWR Chinook and steelhead, and are summarized in Table 5-4 and depicted spatially in Figure 5-1. The key and secondary threats to UWR Chinook and steelhead in these geographic areas are discussed under the various threat categories in the sections below.

Table 5-3. Juvenile life history categories used in the analysis of LFTs and threats in the UWR Chinook and steelhead Recovery Plan and the analogous life history strategies defined in the Estuary Module (NMFS 2008b).

Classifications of juvenile life history stages in the estuary used in this Plan	Classifications of juvenile life history stages used in the Estuary Module
Parr	Early fingerling - Freshwater rearing: 60 - 120 days. Size at estuarine entry: 60-100 mm. Time of estuarine entry: Apr.-May. Estuarine residence time: <50 days.
	Late fingerling - Freshwater rearing: 50 - 180 days. Size at estuarine entry: 60-130 mm. Time of estuarine entry: June-Oct., present through winter. Estuarine residence time: 0 -80 days.
Smolt	Subyearling - Freshwater rearing: 20 - 180 days. Size at estuarine entry: 70-130 mm. Time of estuarine entry: April-Oct. Estuarine residence time: <20 days.
	Yearling - Freshwater rearing: >1 year. Size at estuarine entry: >100 mm. Time of estuarine entry: Feb.-May. Estuarine residence time: <20 days.

Table 5-4. Geographic areas used to organize LFTs in the UWR Chinook and steelhead Recovery Plan.

Geographic Area	Description	Life Stage and Principal Function
Natal Subbasin	Streams and reservoirs within a specific population area where production occurs	egg/alevin (hatching, early life development) fry, summer and winter parr (rearing) smolt (migration, some rearing) adult (migration, staging) spawner (spawning), kelt (downstream migration)
Mainstem Willamette	The mainstem Willamette River above Willamette Falls	fry (rearing, migration)[35] parr (rearing) smolt (migration, some rearing) adults (migration)
West-Side Tributaries	Streams on the west side of the Willamette River above Willamette Falls	parr (rearing)
Estuary	Tidally influenced areas of the Columbia River below Bonneville Dam and the Willamette River below Willamette Falls including the Columbia River Plume	parr (rearing) smolt (migration, some rearing) adults (migration)
Ocean	Saltwater areas outside of the estuary	Sub-adult (foraging)

[35] CHS survey data indicate presence of fry in the mainstem Willamette River, with a possible rearing role (see Schroeder et al. 2005)

Figure 5-1. A map of the five principal geographic areas encompassing the life cycles of UWR Chinook and steelhead populations. These areas were used to spatially organize LFTs according to life stages. Legend indicates independent population boundaries. Shaded parallel hatching represents areas above large Federal flood control facilities that have limited or no provisions for fish access to historical spawning areas.

5.1.4 Prioritizing Limiting Factors and Threats

The developers of this Plan believe successful implementation of a recovery plan should be based on strategic guidance that identifies the relative importance of LFTs. Rather than provide a comprehensive list of potential LFTs, the authors have identified the LFTs that the planning team predicts will be the most significant impediments to viable populations of UWR Chinook and steelhead. Toward this end, this Plan recognizes two categories of LFTs:

Key limiting factors and associated threats that expected to have had the greatest impact on current population viability.

Secondary limiting factors and associated threats are also expected to have had significant impacts on population viability, but to a lesser degree than key concerns.

The words underlined in the previous two sentences underscore a number of important points regarding the process used to identify key and secondary LFTs. Ideally, the process of ranking LFTs would include mortality estimates (loss of production) at each life stage for each species and population. Unfortunately, empirical estimates do not exist for most life stages and populations, so we have based the key and secondary limiting factors for each population on the consensus expert opinion of the Planning Team.. The Team used existing data and analyses where appropriate (see subsections in Appendix C) to make these determinations. However, the team did not have sufficient data to quantify the effect of any of the LFTs on population survival rates, either acting alone or together." Nor does it address the issue of whether multiple and related secondary LFTs can act together to be elevated to a key concern. During Planning Team discussions it became clear that some LFTs would have to be addressed before others to meet recovery targets. The scenarios in Chapter 6 attempt to address these priority and timing issues.

5.2 Overview of Common Threats and Associated Limiting Factors

This section summarizes background information on the broad threats that are common to multiple populations within the UWR ESUs. Appendix C contains subsections with more extensive and detailed background information that was developed by NMFS, and used by the Expert Panel and subsequent teams to evaluate the threats. Section 5.4 below includes information on the LFTs specific to UWR populations.

Flood Control/Hydropower Management

Specific threats from flood control and hydropower management include: 1) blocked or impaired fish passage for adults and juveniles, 2) loss of some riverine habitat (and associated functional connectivity) due to reservoirs, 3) reduction in instream flow volume due to water withdrawals, 4) lack of sediment transport and role in habitat function, 5) altered physical habitat structure, and 5) altered water temperature and flow regimes.

Within the Willamette River basin, the largest flood control/hydropower complex is termed the Willamette Project, managed principally as a flood control system by the US Army Corps of Engineers (USACE; see the supplemental BA [USACE 2007a] for more detail). The most recent Biological Opinion for the Willamette Project (NMFS 2008a), and supporting references within, provides an extensive review of the multiple impacts this project has on UWR Chinook and steelhead populations and habitats within subbasins, but also as they contribute to habitat quality impacts in the Willamette River mainstem. Within the Willamette subbasins where these projects are located, the flood control structures block or delay adult fish passage to major portions of the historical holding and spawning habitat for UWR Chinook (North Santiam, South Santiam, McKenzie and Middle Fork Willamette subbasins), and for UWR steelhead in the North Santiam and South Santiam basins. In addition, most Willamette Project dams have limited facilities or operational provisions for safely passing juvenile Chinook salmon and steelhead downstream of the facilities. Past operations and current configurations of the Willamette Project have impacted several salmonid life stages, through impacts on water flows, water temperatures, total dissolved gas (TDG), sediment transport, and channel structure.

In addition to the Federally owned and operated flood control/hydropower facilities, other subbasin facilities such as the PGE complex in the Clackamas basin, the EWEB Carmen Smith complex (and associated structures) in the McKenzie basin, and municipal flow control facilities contribute to the flood control/hydropower LFTs. Improvements for anadromous fish at these facilities are negotiated and formalized under processes and subsequent relicensing under the FERC.

Hydropower impacts also extend to the Columbia River estuary, through which UWR Chinook and steelhead adults migrate, and juveniles rear and migrate. The indirect but cumulative impacts on estuarine habitat quality and quantity are related to the more than 450 Columbia Basin dams in the United States and Canada that provide active storage > 42 million acre-feet of water. Within the United States, 14 of these dams are mainstem multi-purpose hydropower projects in the Columba and Snake drainages, and are referred to collectively as the Federal Columbia River Power System (FCRPS). Other (non-Federal) hydropower facilities also contribute to storage, and dams in Canada account for about half of the total storage. Management of the FCRPS (and co-coordinated non Federal projects) for hydropower, flood control and other uses has significantly changed the quantity and timing of flows entering the Columbia River estuary and plume from historical conditions (Fresh et al. 2005). The operation of the FCRPS and other facilities in the Columbia basin principally influences juvenile life stages of UWR salmonid populations as they migrate below Willamette Falls. Jay and Naik (2002) reported a 16% reduction of annual mean flow over the past 100 years and a 44% reduction in spring freshet flows. Jay and Naik (2002) also reported a shift in the hydrograph from 14-30 days earlier in the year, meaning that spring freshets are occurring earlier in the season. In addition, the interception and use of spring freshets (for irrigation, reservoir storage, etc.) have increased flows during other seasons (Fresh et al. 2005).

Land Management

Impacts of land management on UWR Chinook and steelhead include current land use practices causing limiting factors, as well as current practices that are not adequate to restore limiting factors caused by past practices (legacy impacts). Past and present land management may affect salmonid population viability by affecting abundance, productivity, spatial structure and/or diversity. Past land use (including agricultural, timber harvest, mining and grazing activities, diking, damming, development of transportation, and urbanization) are significant factors now limiting viability of UWR Chinook and steelhead. These factors severed access to historically productive habitats, and reduced the quality of many remaining habitat areas by weakening important watershed processes and functions that sustained them. The IMST recently published an extensive review of land use effects (including those imposed by dams) on the rehabilitation of salmonids in Oregon, and references therein can be reviewed for conditions specific the Willamette basin (IMST 2010). The following is a very brief synopsis of general land use impacts.

Estuarine Areas

The Columbia River estuary provides critical habitat for juvenile salmonids as they achieve the necessary growth and physiological development to survive in the ocean. Historically, the lower estuary contained rich and complex foraging habitat that likely promoted rapid growth and increased survival. Over the years, land and water management activities have degraded the quantity and quality of these attributes of estuarine habitat, resulting in a homogenization of both habitat complexity and the functional use of remaining estuarine habitat by UWR Chinook and steelhead. Combined with the effects of the Columbia basin hydropower/flood control systems, the primary activities that have contributed to current estuary and lower mainstem habitat conditions include channel confinement (primarily through diking), channel manipulation (primarily dredging), floodplain development, and water withdrawal for urbanization and agriculture (LCFRB 2004). The presence of jetties, pile dikes, tide gates, docks, breakwaters, bulkheads, revetments, seawalls, groins, ramps and other structures have changed circulation patterns, sediment deposition, sediment erosion, and habitat formation in the estuary (Williams and Thom 2001). Together, habitat alteration through dredging, disposal of sand/gravel, wetland filling, instream and overwater structures, dikes and navigational structures have significantly altered estuary size/function, and reduced connectivity with peripheral wetland and side channel habitat. . As a result of these changes, the surface area of the estuary has decreased by approximately 20% over the past 200 years (Fresh et al. 2005). In some reaches like the lower Willamette River, the loss of shallow and side channel rearing habitat has been much greater. This loss of access to historical rearing habitats has restricted juvenile UWR salmonids to sometimes sub-optimal habitat.

In addition to physical modification of estuarine habitat, water quality has been severely degraded in parts of the estuary. Agricultural, urban and industrial practices in the Columbia River Basin have led to higher water temperatures and contaminants in the estuary. The amounts of urban and industrial contaminants are particularly high in the highly urbanized areas of the lower Willamette River. Degraded water quality, toxins from urban and industrial sources are considered a threat in some stream reaches in Portland, including the lower Willamette River.

Water and sediment quality is also an issue in near shore areas. For example, a site in the estuary near Astoria is in the process of becoming a superfund site, ie added to the National Priorities List. Contaminants of concern include petroleum, PAHs, heavy metals and organotins (chemical compounds based on tin with hydrocarbon substituents).

Upper Willamette Mainstem and subbasins

Land management activities have also severely degraded stream habitat conditions in the Willamette River mainstem above Willamette Falls and associated subbasins. In the Willamette River mainstem and lower sub-basin mainstem reaches, high density urban development and widespread agricultural effects have impacted aquatic and riparian habitat quality and complexity, sediment and water quality and quantity, and watershed processes. In upper subbasin mainstem reaches and subordinate tributary streams, the major drivers of current habitat conditions are past and present forest practices, roads, and barriers. Aquatic habitat degradation is primarily the result of past and/or current land use practices that have affected functional attributes of stream channel formation, riparian connectivity, and magnitude and frequency of contact with floodplains, as well as watershed processes. In many subbasins the flood control/hydropower structures in the principal subbasins created new baseline *control* conditions upon which subsequent habitat alterations have been overlaid. Among the land use activities that have led to current habitat conditions are:

- Timber harvest on unstable slopes and riparian areas has led to the decoupling of watershed processes. Improperly located, constructed, or maintained roads have degraded stream flow and sediment supply processes. The legacy effects of splash dams to transport logs continues to inhibit instream structural complexity and available spawning gravel in several stream systems;
- Agricultural development, especially along lowland valley bottoms in the mainstem Willamette reaches, and lower reaches of principal subbasins has directly impacted riparian areas and floodplains. Historical floodplain habitats were also lost through the filling of wetlands and levee construction. Runoff from agricultural lands where pesticides, herbicides, and fertilizers are applied has reduced sediment and water quality;
- Livestock grazing has directly impacted soil stability (trampling) and streamside vegetation (foraging), and delivered potentially harmful bacteria and nutrients (animal wastes) to streams;

- Construction of small scale dams, culverts, and other barriers has limited access to spawning and rearing habitats;
- Urban and rural-residential development in the lower subbasins and the mainstem Willamette River floodplain has led to the degradation of riparian and floodplain conditions, as well as an alteration of the natural drainage network due to roads, ditches and impervious surfaces. For example, prior to the 1850s, the lower Willamette River was comprised of approximately 80% shallow water and 20% deep habitat. Those proportions have now reversed, and the river is 80% deep and 20% shallow water habitat.
- Sand and gravel mining along some Willamette basin streams has impacted stream channels by altering instream substrate and sediment volumes.

Together these activities continue to inhibit the amount and quality of spawning and rearing habitats available to UWR salmon and steelhead populations, principally by severing access to historically productive habitats, and by weakening the important watershed processes and functions that once created and maintained healthy freshwater ecosystems for UWR Chinook and steelhead production. Today, many streams have lower frequency and complexity of pools compared to historical conditions. And many of those that remain lack the complex structure needed to retain gravels for spawning and invertebrate production, and the connectivity with shallow, off-channel habitat areas that once provided refugia from floods, over-wintering and hiding cover, and productive early-rearing habitat.

These activities have also reduced water quality in the principle subbasins and mainstem Willamette River. Land uses that involve water withdrawals have contributed to elevated water temperatures in many population areas at critical periods. Elevated stream temperatures are often the result of multiple factors including water withdrawals and/or altered hydrology and a lack of intact, functional and contiguous riparian management zones and sufficient streamside buffers. In some areas, water quality has also been reduced because of contaminants for agricultural use, and contaminants generated from urban storm water runoff and industrial sources.

Today, many land use practices are better than they were in the past and, as a result, many stream reaches once degraded by past practices are recovering. Many landowners now understand the advantages of good conservation practices and are changing their approaches to contribute to restoration of healthy watershed processes and functions. A suite of regulatory programs have also been implemented to protect and restore salmon and steelhead physical habitat and water quality. Together these changes are improving the physical quality of salmon and steelhead habitats and providing more suitable environments for spawning and rearing. However, restoration to date has often been opportunistic rather than strategic. Furthermore, restoration of habitat and water quality has been more problematic in urban areas where economic needs play a more prominent role and riparian areas are expected to serve multiple needs (e.g., industrial, residential, recreation, habitat), and floodplain and riparian restoration efforts are exceedingly expensive. Even with significant improvements, many stream reaches remain far below historic habitat potential, and human population growth will continue to exert pressure on functional stream reaches. There will need to be continued effort to protect existing habitat and repair degraded habitat to levels that will support viable salmon and steelhead populations.

Other Species

Negative effects of both native and introduced plant and animal species were identified as LFTs to UWR Chinook and steelhead populations. However, some actions will occur in the context of hatchery management for each sub-basin, , while others will be addressed in the Estuary Module as part of suite of habitat improvement actions, hatchery actions, and direct predator control actions that will benefit multiple ESUs. Anthropogenic introductions of non-native species and out-of-ESU races of salmon or steelhead can increase predation and competition on native UWR Chinook and steelhead.

Predation Effects in the Estuary

Predation by native species may influence salmonid population viability by affecting abundance, productivity, spatial structure and/or diversity. Sources of predation are principally from terns, cormorants, and pikeminnow and the mortality impacts caused by pinniped predation. Ecosystem alterations attributable to hydropower dams and to modification of estuarine habitat have increased predation on all UWR Chinook and steelhead population. In the estuary, habitat modification has increased the number and/or predation effectiveness of Caspian terns, double-crested cormorants, and a variety of gull species (LCREP 2006; Fresh et al. 2005). For example, new islands formed through the disposal of dredged materials have attracted terns away from their traditional habitats, which may now be degraded. Reduced sediment in the river increased the terns' efficiency in capturing steelhead juveniles migrating to saltwater at the same time that the birds need additional food for their broods. In 1997 it was estimated that avian predators consumed 10-30% of the total estuarine salmonid smolt production in that year (LCREP 2004). The draft 2005 Season Summary of Research, Monitoring, and Evaluation of Avian Predation on Salmonid Smolts in the Lower and Mid-Columbia River (Collis and Roby 2006) estimates that 3.6 million juvenile salmonids were consumed by terns in 2005. Stream-type juvenile salmonids are most vulnerable to avian predation by Caspian terns because the juveniles use deep-water habitat channels that have relatively low turbidity and are close to island tern habitats. Double-crested cormorants consume a similar number of juvenile salmonids (approximately 3.6 million juveniles) from their East Sand Island nesting grounds (Collis and Roby 2006). Habitat alterations combined with large releases of hatchery juvenile salmonids may have also shifted the balance of historic predator:prey dynamics, such as the native piscivorous Northern Pikeminnow. As noted above, effects of these species will be managed with actions described in the Estuary Module.

Predation Effects above Willamette Falls

In the upper Willamette River subbasins, there is concern that reservoirs associated with flood control/hydropower facilities have created habitat conditions that make juvenile migrants more susceptible to introduced predatory fishes, with greatest concern being largemouth and smallmouth bass. Predation by largemouth bass in Green Peter Reservoir was identified as a LFT for UWR juvenile salmonids. Centrarchid abundance in Lookout Pt. Reservoir is reported to be high, particularly for crappie (Greg Taylor, USACE Willamette Review symposium 2010), but the magnitude of crappie predation on juvenile salmonids is unclear. Predation by bass may be a concern in other areas as well, such as slow water areas in sub-basins and the mainstem Willamette that are associated with the remaining floodplain.

Predation by introduced salmonids in the Willamette basin has also been identified as LFTs for some UWR Chinook and steelhead populations. The loss of winter steelhead habitat due to flood control/hydropower facilities was mitigated with a hatchery program using an out-of-ESU summer steelhead broodstock[36]. Predation on juvenile UWR Chinook by summer steelhead has been identified as a secondary LFT for the North Santiam, South Santiam, and McKenzie Chinook populations. In addition, predation on juvenile UWR Chinook by an introduced strain of rainbow trout (Cape Cod strain) that supports a trout mitigation program[37], has been identified as a secondary LFT for the McKenzie Chinook population. The effects of these species will be managed by hatchery management.

Competitive Effects

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[36] Further program detail: http://www.dfw.state.or.us/HGMP/docs/2006/06-upper-willamette-summer-steelead.pdf
[37] Further program detail: http://www.dfw.state.or.us/HGMP/docs/2006/06-upper-willamette-rainbow-trout.pdf

Other species, both native and introduced, can compete for resources with UWR Chinook and steelhead populations. Hatchery management practices that release large numbers of hatchery juveniles can reduce available food resources for natural origin juveniles, limiting growth and health. Juveniles of the summer steelhead hatchery mitigation program in the Willamette River basin may compete with juveniles of native winter steelhead, and has been identified as a key LFT in the North and South Santiam subbasins. The management of these species for in-basin effects will be managed by actions within hatchery programs affecting UWR spring Chinook and winter steelhead. In the estuary, where juvenile UWR Chinook and steelhead compete with hatchery fish that are produced throughout the Columbia basin, broader hatchery management coordination will be needed.

Harvest Management

Depending on their distribution, run timing relative to fishery openings, and vulnerability to gear, UWR Chinook and steelhead may be caught in ocean, lower Columbia River, mainstem Willamette River, and sub-basin fisheries. These fisheries influence salmonid population viability by causing direct and incidental mortality to naturally produced fish. Direct mortality is associated with fisheries that are managed to specifically harvest target stocks. Incidental mortality includes mortality of fish that are caught and released, captured by fishing gear but not landed, or harvested incidentally to the target species or stock.

As further described below, exploitation rates from commercial and recreational fisheries on UWR spring Chinook have been substantially reduced in response to extremely low returns in the mid-1990's and subsequent ESA listings in 1999. For spring Chinook, freshwater fishery impacts have been reduced by approximately 75% from 2001 to present compared to the 1980 through the late 1990's (Figure 5-2) by implementing selective harvest of hatchery-origin fish in commercial and recreational fisheries, with all unmarked, wild spring Chinook being released. This fishery management change was enabled after all hatchery Chinook returning were adipose finclipped. Impacts from ocean fisheries has averaged 11% from 1996-2006 (the last year of reported data in NMFS 2008c). Excessive fishery harvest was cited as a listing factor for the Willamette Chinook ESU in 1999 when fishery exploitation rates were greater than 50% in ocean and freshwater fisheries (NMFS 2008c) However, in light of the significant reforms in harvest management implemented since the time of listing under the Pacific Salmon Treaty for ocean fisheries (NMFS 2008c) and ODFW's FMEP for freshwater fisheries (ODFW 2001a, 2010[38]), the proposed Plan did not identify fishery harvest as a primary or secondary LFT on populations residing above Willamette Falls and explained that other primary and secondary LFTs are the key bottlenecks currently impeding the recovery of these spring Chinook populations. For example, very high pre-spawning mortality (typically 50-95%) of spring Chinook in every population, except the McKenzie, post-fisheries is the primary factor influencing spawning escapement. The current average freshwater fishery exploitation rate of 8-9% over the last decade is of little consequence to spawning escapement when pre-spawning mortality rates are so high. In addition, of the fish that survive to spawn below the Federal dams in the North Santiam, South Santiam, and Middle Fork Willamette populations, their progeny suffer high mortality rates due to the discharge of unusually warm reservoir water in the fall while the eggs are in the gravel incubating. Since fishery harvest rates have been significantly reduced for more than a decade (two generations) on all Willamette spring Chinook populations, yet significant improvements in the number of naturally-produced fish have not occurred, this Plan does not consider fishery harvest rates to be a primary or secondary LFT now inhibiting the recovery of spring Chinook populations above Willamette Falls. In fact, the lowest returns of naturally-produced fish on record were observed in recent years (2008-2009) while exploitation rates have continued to remain at low levels. The one exception is the Clackamas population, where fishery harvest is still identified as a secondary

[38] http://www.nwr.noaa.gov/Salmon-Harvest-Hatcheries/State-Tribal-Management/upload/FMEP-U-Will-Chnk-2009.pdf

limiting factor because this population does not have the significant problems with pre-spawning mortality, poor egg incubation, inadequate upstream and downstream passage, and loss of oversummering habitat.

The impacts of hatchery programs that support harvest are described below, in this section, in Chapter 6 and in Appendix E.

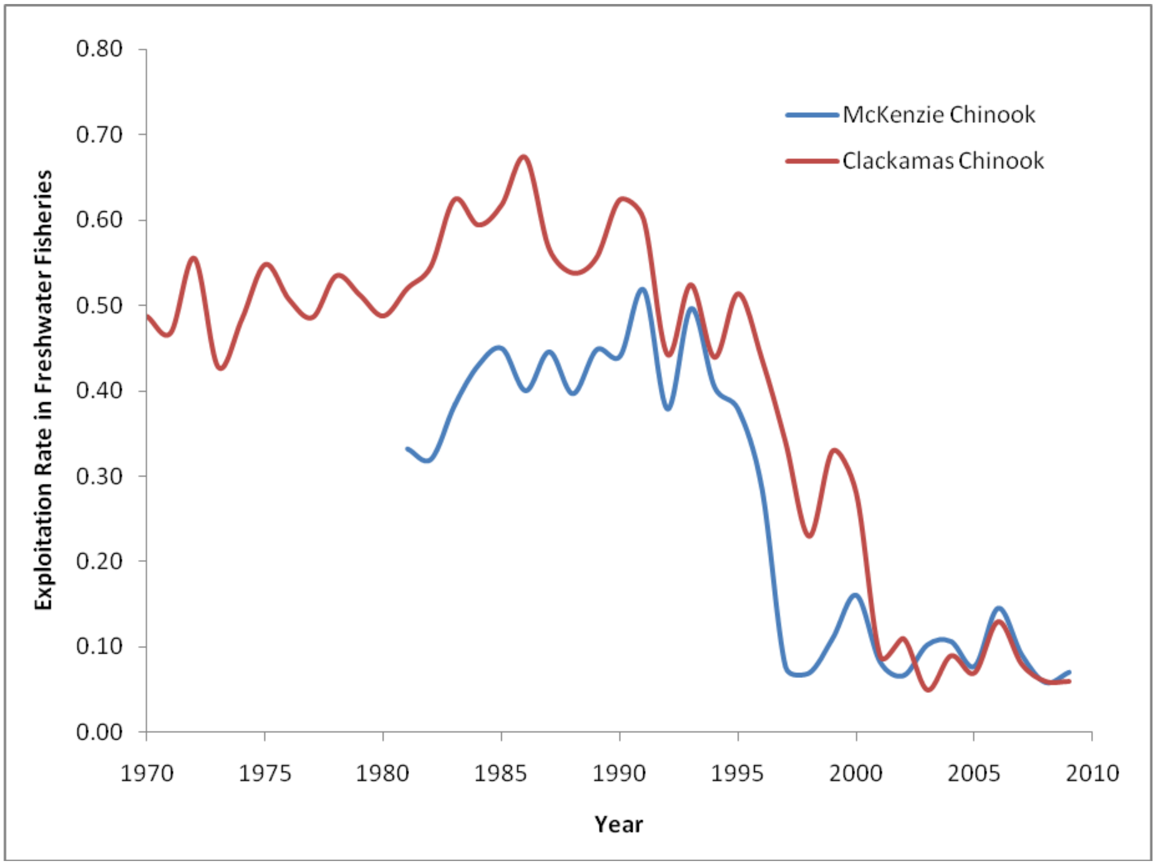

Figure 5-2. Freshwater fishery exploitation rates for McKenzie and Clackamas spring Chinook stocks. Rates include fisheries in the lower Columbia River, mainstem Willamette River, and Clackamas and McKenzie Rivers. Full implementation of selective fisheries, where only adipose finclipped Chinook can be harvested, went into effect in 2002. Data are from ODFW (2001a) and ODFW (2010).

For UWR winter steelhead, a similar situation exists regarding fishery harvest management. Significant reforms were implemented in the early 1990's that required catch and release of all unmarked, wild winter steelhead. Hatchery programs were eliminated and changes to trout stocking and fishing regulations were made to reduce fishery exploitation rates. Whereas fishery harvest may have been a listing factor for winter steelhead, the reforms that have been implemented have reduced fishery harvest impacts such that it is no longer identified as a primary or secondary LFT. The current exploitation rates on wild steelhead from sport fisheries are in the range of 0-3% (ODFW 2001b[39]). Steelhead are not intercepted in ocean fisheries to a measurable degree.

[39] http://www.nwr.noaa.gov/Salmon-Harvest-Hatcheries/State-Tribal-Management/upload/FMEP-U-Will-stlhd.pdf

The specific details of the complex harvest management system that is now in place are discussed below. Significant portions of the following background information were adapted from ODFW (2001a) and a summary white paper prepared for the Expert Panel (Appendix C). UWR Chinook salmon and steelhead cross numerous fisheries jurisdictions as they make their way from natal upper Willamette subbasins all the way to Canada and Alaska and then back again. These various fisheries focus on different stocks and populations, and take fish to meet commercial and recreational needs. Because of their exposure to fisheries across large geographic regions of the West Coast, management of UWR Chinook and steelhead is governed by a number of organizations such as the Pacific Salmon Commission, NMFS (administering the ESA), the Pacific Fishery Management Council, the states of Oregon and Washington, and the Columbia River Compact (see description in NMFS 2008c and NMFS 2008f). Consequently, many regulating factors that affect harvest impacts on Columbia River stocks are associated with laws, policies, or guidelines established to manage other individual or combined stocks, but that indirectly control impacts on Columbia River fish.

Fishery managers adjust harvest annually in response to changes in abundance to achieve specified escapement levels or harvest rate limits to allow harvest of strong (generally hatchery) stocks while protecting weak (generally wild) stocks. Management is governed by international treaty agreements, fisheries conservation acts, regional conservation goals, the Endangered Species Act, and State and tribal management agreements. Management through these various organizations has contributed to the decline of harvest rates for UWR Chinook and steelhead. Fishery managers strive to reduce exploitation rates on wild UWR Chinook and steelhead while meeting various harvest goals by continuously reviewing changes in population abundance and marine survival conditions, and adjusting exploitation rates and timing accordingly. Commercial and recreational harvest of wild Chinook and steelhead has been reduced through a combination of time, area, gear, and mark-selective regulations to optimize harvest of hatchery stocks

The different types of fisheries that may directly or indirectly affect the populations are detailed in the Fisheries Management and Evaluation Plans (FMEP's: Chinook ODFW 2001a; steelhead 2001b), and the NMFS Harvest BiOps (NMFS 2008c, NMFS 2008f). Ocean fisheries affecting UWR spring Chinook salmon include Southeast Alaska and Canadian troll fisheries. Owing to their early run timing, numbers of UWR Chinook salmon taken in Oregon and Washington coastal sport and commercial fisheries are relatively low (ODFW 2001a). The various fisheries occur within the Lower Columbia River and Willamette River basin management area throughout the year. Fisheries in the estuary and freshwater impacting UWR Chinook are currently managed by ODFW to protect and recover wild populations. Mortality of released fish in Columbia River spring Chinook salmon sport fisheries (including the Lower Willamette) is estimated to be 10% (Lindsay et al. 2004). The Lower Willamette River sport fishery has historically had a very large impact on UWR Chinook salmon. The FMEP limits total freshwater fishery impact (commercial and recreational) on wild fish to 15% of the total number of unmarked fish returning to the Willamette River . Management under the Chinook FMEP began in 2001, and the regulation that only marked fish could be retained in fisheries managed under the FMEP began in 2002, the first year that almost all returning hatchery adults would have had such marks (except 6-year olds). This selective fishery has resulted in a 75% reduction in average fishery mortality compared to 1981-1997. The overall freshwater harvest impact on wild fish has been below 15% since implementation of the FMEP, and averaged 8-9% (Figure 5-2).

Because of the FMEP improvements, the harvest impacts of Lower Columbia commercial fisheries have become relatively greater. In 2002, new gear restrictions were initiated for these fisheries to reduce impacts on ESA-listed ESUs, meanwhile also increasing catch of UWR hatchery spring Chinook salmon. To minimize capture and handling of wild winter steelhead, >8"-9 ¾" mesh gillnets are required in February when UWR spring Chinook salmon are abundant in the Lower Columbia, with steelhead excluder panels (i.e., >12" mesh for top 5') also recommended. In March, tanglenets with a maximum mesh of 4 ¼" are used to reduce mortality of fish of ESA-listed populations. Release mortality for the tangle nets (25%) is about half that of the gill nets (50%). Fishing time is reduced in mid March or when wild steelhead are in greatest abundance. Finally, recovery boxes to resuscitate wild fish, short soak times, and reduced net lengths are now mandatory (Joint Staff Report 2011). In recent years, impacts to Chinook from the commercial fishery have been very low (<2%) because of fishery constraints on other ESA-listed stocks.

For steelhead populations, current freshwater harvest objectives and regulations are to provide maximum harvest opportunity on non-native hatchery summer steelhead to an extent that it does not jeopardize recovery of native winter steelhead in the UWR steelhead DPS (Molalla, North Santiam, South Santiam, Calapooia) (ODFW 2001b; Myers et al. 2006). Summer steelhead fisheries occur in both the lower and upper Willamette River mainstem, as well as in the Santiam River, which is home to the two "core" UWR steelhead populations as defined by the WLC-TRT (McElhany et al. 2006). In the Willamette basin, summer steelhead runs begin as early as March when winter steelhead are still in the rivers. Although the season extends from March through December, most effort directed at summer steelhead, and most catch, occurs from May through August.

A brief description follows of the harvest management system that UWR populations are subject to. Further information regarding the fisheries can be found in the Harvest BiOps (NMFS 2008c, NMFS 2008f):

- *Canada/Alaska ocean fisheries*. Numerous fisheries in Canada and Southeast Alaska harvest far-north migrating Chinook stocks from the Willamette River basin. Canadian marine fisheries include commercial troll and net fisheries, and recreational sport fisheries in Northern BC, Central BC, West Coast of Vancouver Island, Strait of Georgia, and Strait of Juan de Fuca. In Southeast Alaska, treaty marine Chinook fisheries include commercial troll and net fisheries, as well as recreational sport fisheries UWR Chinook are caught primarily in troll fisheries off of Southeast Alaska and Canada, because they return to the Columbia River from late February through April, and thus most have exited these areas before ocean fisheries off the Washington coast open on May 1 of each year. Winter steelhead are rarely encountered in Canadian and SE Alaska salmon fisheries, and for practical purposes, ocean fishing mortality on listed steelhead from the Columbia River (and presumably the Willamette) was assumed to be negligible (NMFS 2008c).
- *United States West Coast ocean fisheries*. Recreational and commercial ocean fisheries also occur along the U.S. West Coast and. although they do not account for significant harvest of UWR spring Chinook salmon, we describe them here because there may be some mortality. These fisheries are separated into four major management areas: 1) US/Canada border to Cape Falcon, Oregon; 2) Cape Falcon, Oregon to Humbug Mountain, Oregon; 3) Humbug Mountain, Oregon, to Horse Mountain, California; and 4) Horse Mountain, California to the US/Mexico border. These management areas are further divided into subareas depending on the type of fishery. Recreational fisheries are either selective for fin-clipped hatchery fish or non-selective depending on the species. Commercial fisheries are either selective or non-selective troll fisheries. Numerous treaty Indian commercial troll, non-Indian commercial troll, and recreational marine fisheries exist along the West Coast..
- *Lower Columbia River commercial fisheries*. Winter commercial fisheries occur from the mouth of the Columbia River to Kelly Point near the mouth of the Willamette River, with peaks in Feb-March (ODFW 2001a). The spring fisheries are mark selective for finclipped fish. Commercial fishing seasons in the mainstem Columbia River are established by the Columbia River Compact Select Area terminal fisheries (select off-channel fishing areas) produced from net pen programs have a goal of 100% harvest. Although Select Area fishing effort is relatively small, some incidental take of wild Chinook salmon can occur. Select Area seasons are established by the Columbia River Compact for concurrent waters and by the individual states for state waters. A winter sturgeon fishery extends

from the Columbia River mouth to just below Bonneville Dam, with most effort upstream of the mouth of the Willamette River. Gill net provisions in that fishery limit impacts to spring Chinook. The FMEP's for UWR Chinook and steelhead have summary tables of the timing of different fisheries to which UWR populations are exposed.

- *Lower Columbia River, Mainstem Willamette, and Willamette tributary recreational fisheries*. The lower Columbia River mainstem between the mouth and the I-5 Bridge supports a sport mark selective fishery for Chinook and steelhead. A small Select Area sports fishery occurs in the Lower Columbia River basin. In the Willamette basin, this fishery occurs in the Multnomah Channel and lower Willamette River upstream to Willamette Falls, the lower Clackamas River from the mouth to River Mill Dam, upper Willamette River from the Falls to the mouth of the McKenzie River, Molalla River, Santiam River and Forks, McKenzie River, and the Middle Fork of the Willamette River (ODFW 2001a). In these zones, recreational fisheries may incidentally impact wild spring Chinook.

Types of Fishery Effects

Harvest decreases adult abundance, and thus the total number of spawners. The extent of this decrease in abundance is usually measured either as numbers of spawners or as an exploitation, rate. Harvest may be selective-either intentionally or unintentionally[40]-and influence diversity and spatial structure of populations, and the ESUs.

Fishery managers forecast annual abundance and adjust allowable harvest to achieve established escapement goals or to stay within specified exploitation rate limits on wild stocks. They generally try to manage the fisheries using a combination of gear, time, area, and mark-selective regulations to optimize the harvest of strong (generally hatchery) stocks within the series of constraints for weak (generally wild) stock protection. As a result, today's fishery impact rates for most hatchery-produced Chinook and steelhead are higher than for wild fish of the same species.

- *Directed Harvest Mortality*. Harvest mortality occurs in fisheries directed at a particular species or stock; this harvest can occur in single (terminal) or mixed (intercept) stock fisheries[41]. Single stock fisheries are the most effective method for targeting a specific stock and commonly occur in terminal harvest areas where one stock is known to be present.

  In mixed stock fisheries, the management challenge is to harvest from mixed populations having various available surpluses, sometimes including populations with no surplus, as the populations move through the fishery area at various rates and abundances. Harvest of a specific stock in the mix can be achieved by management decisions (e.g., fishery openings when the targeted stock is abundant relative to other stocks), fishery adaptations (e.g., gear designed to target specific stock/species), or fishery regulations (e.g., prohibitions of retaining certain species). Stock identification techniques are constantly being improved to assist managers in making informed and timely fishery decisions. For example, certain fisheries in the Columbia River focus on harvesting adipose fin-clipped, hatchery-reared fish only by targeting marked hatchery fish while utilizing gear modifications to allow protected stocks to be released. Regulations prohibiting retention of wild fish (i.e., non-adipose fin-clipped fish) have been relatively successful, especially with regards to the impact of recreational fisheries on wild fish.

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[40] There is "mark-selective" where only hatchery marked fish are supposed to be harvested. There is also "phenotypic selection", "genetic selection" or "evolutionary selection" caused by the fishery preferentially taking certain phenotypes (e.g. size, age, run time).
[41] In reality nearly all salmon fisheries are to some degree "mixed stock" fisheries. Even fisheries that take place close to spawning grounds may encounter strays from other areas. The closer the fishery is to the spawning grounds the less impact there generally is on other stocks, but it is shades of gray, not black and white

- *Incidental Harvest Mortality.* Despite the various methods used to target a specific stock and minimize effects on weak stocks, the incidental harvest of non-targeted stocks, still occurs, largely because salmonid migration timing and routes can vary considerably from year to year. Most commercial fisheries have specific reporting requirements and limits for incidental bycatch and "drop off mortality[42]" that are intended to lessen the harvest impacts to non-targeted stocks. For the Columbia River, specific incidental harvest percentages are set for protected stocks; fisheries are managed so as not to exceed these harvest limits of protected stocks. Access to strong stocks in the Columbia River and ocean fisheries is regulated by impact limits on the weak populations mixed with the strong populations.
- *Catch and Release Mortality.* Catch and release regulations have been used for years to manage sport fisheries. Generally, catch and release restrictions allow resident fish to grow older and larger, thereby creating improved angling opportunities. More recently, catch and release has been employed in anadromous fish management practices to enable retention of hatchery salmon and steelhead and release of wild fish in mixed-stock fisheries. Because of the wide range of knowledge among sport anglers regarding proper fish handling techniques and the different degrees of how fish species react to handling stress, mortality occurs as a result of catch and release.
- *Size, Age, Timing Selection* Harvest may selectively remove fish based on size, age, distribution or run timing, depending on the gear, timing and location of the fishery. Commercial fishing gear can be size-selective, depending on the type of gear (i.e., gill net vs. troll) or the size of gear (i.e., mesh size). As mentioned in the mixed stock fishery discussion for direct harvest mortality, size selectivity can be a desired result if the gear is designed to harvest a specific size stock or species. However, commercial fishing gear size selectivity can also be undesirable. For example, if a fishery disproportionately harvests the larger individuals in a population, the remaining smaller individuals comprise the effective population (i.e., those individuals that spawn in any given year). If this process is repeated annually, the effect on the adult population is a decreased average size at maturity, which can also modify a stock's age composition. Even when fisheries are not size selective, ocean fisheries harvesting immature fish alter the age structure of the spawning escapement of species with multiple age classes in the spawning population toward younger age classes, and thus exert selective pressure for younger maturation. This happens because fish that would mature at an older age must survive the risk of harvest for more years than fish that mature at younger ages.

Fisheries may also be selective for a particular timing or segment of the run, depending on management practices. For example, a fishery may disproportionately harvest the early portion of a run because of market- or industry-driven needs, or because of the timing of hatchery fish runs. Because run timing is heritable (Garrison and Rosentreter 1981), fisheries may alter run timing traits due to systematic temporal removals from populations over time. Although there is evidence that run timing alterations have occurred in certain stocks (e.g. some Lower Columbia River coho stocks), it is not a forgone outcome for all stocks exposed to fisheries.

Hatchery Management

Hatchery programs have the potential to benefit or harm salmonid population viability by affecting abundance, productivity, distribution, and/or diversity. A number of new studies, including Araki et al. (2008) and Chilcote et al. (2011), support earlier studies that hatchery programs can cause significant risks to salmon population viability including genetic changes that reduce fitness of wild fish, increase risk of disease outbreaks, and/or alter life history traits, and ecological effects—such as increased

[42] Drop off mortality can occur when a fish his hooked but not landed.

competition for food and space or amplified predation—that reduce population productivity and abundance (see review of ecological effects in Kostow (2009) and the Ecological Interactions Workshop 2010 (State of the Salmon 2010). Hatcheries can also impose environmental changes by creating migration barriers that reduce a population's spatial structure by limiting access to historical habitat. Conversely, in some circumstances, hatchery programs can benefit salmonid viability by supplementing natural spawning and thereby increasing natural-origin fish abundance and spatial distribution, by serving as a source population for re-populating unoccupied habitat, and by conserving genetic resources. Reviews of these various effects can be found in Araki et al. (2008), in the WP BiOp (NMFS 2008a), Kostow (2009) and Chilcote et al. (2011).

Releases of hatchery reared Chinook began in 1902 in the McKenzie River, 1918 in the Santiam River, 1920 in the Middle Fork Willamette River, 1939 in the Clackamas River, 1957 in the Molalla River. Currently there are hatchery programs for UWR spring Chinook salmon in all four of the historically most productive populations (core populations), including the McKenzie population that has also been designated a genetic legacy population (for definitions see McElhany et al. 2003). There is also a Chinook production program in the South Santiam basin that has hatchery releases of the South Santiam stock into the Molalla basin. The UWR spring Chinook hatchery programs are managed principally as harvest hatchery programs (see definition of program types in the ODFW's Fish Hatchery Management Policy[43]) for mitigation to replace or compensate lost habitat capacity of naturally produced fish. In the Willamette basin, this mitigation is due mostly to construction of dams and reservoirs for the Willamette River Basin Flood Control Project (NMFS 2008a). Today, hatchery fish continue to dominate UWR Chinook production, a source of concern noted in NOAA Fisheries Northwest Fisheries Science Center Status review update for Pacific salmon and steelhead listed under the Endangered Species Act Pacific Northwest (Ford et al 2010). Specifically, this review update stated in part for the UWR spring Chinook salmon ESU:

> New data collected since the last BRT report have verified the high fraction of hatchery origin fish in all of the populations all in the ESU (even the Clackamas and McKenzie have hatchery fractions above WLC-TRT viability thresholds). The new data have also highlighted the substantial risks associated with pre-spawning mortality. Although regional recovery plans are targeting key limiting factors for future actions, there have been no significant on-the-ground-actions since the last BRT report to resolve the lack of access to historical habitat above dams, nor have there been substantial actions removing hatchery fish from natural spawning grounds.

ODFW estimated that 85-95% of the spring Chinook passing Willamette Falls in 2001 were of hatchery origin (ODFW 2001a). Recent evaluations show that some steps have been taken to provide better protection for wild populations, but more improvements are needed (HSRG 2007). Many UWR Chinook populations are characterized by high proportions of hatchery fish on the spawning grounds. The major concern with these hatchery programs is the negative effect hatchery fish spawning in the natural environment have on productivity and long-term fitness of naturally spawning populations (HSRG 2007).The major concern with these hatchery programs is the negative effect hatchery fish spawning in the natural environment have on productivity and long-term fitness of naturally spawning populations (HSRG 2007).

The available data on stock transfers between UWR spring Chinook populations (Kostow 1995) and some supporting genetic data suggested that the current populations represent a single gene pool (Myers et al. 2006). Release of hatchery reared fish from outside the ESU into the Willamette basin ended in the early 1990's, but it is thought that (with the exception of Clackamas Spring Chinook) the existing hatchery

[43] As of December 2010: http://www.dfw.state.or.us/fish/nfcp/rogue_river/docs/hatchery_mgmt.pdf

broodstocks were founded from their respective local populations at the time Willamette Project dams were built (NMFS 2008a). In most cases broodstock collection occurred at facilities built near the base of the dams, and presumably a mix of returning natural-origin and hatchery-origin fish were incorporated into the subsequent hatchery broodstock. As natural-origin populations declined, the proportion of natural-origin fish in the broodstock declined as well, so that hatchery-origin fish currently make up the majority fish in the broodstock (NMFS 2008a). NMFS concluded that hatchery Chinook salmon are part of the UWR spring Chinook ESU (NMFS 2004).

In recent years, most of these mitigation harvest programs have incorporated some proportion of natural origin fish into the hatchery brood stock in an effort to enhance the hatchery stock for harvest production goals. During this time a multiagency coordination group developed short and long term visions for hatchery management in the Willamette basin. One of the program elements was to adopt principles of conservation hatchery programs in order to conserve some natural genetic resources for future recovery efforts, namely eventual reintroduction above dams. Because so few natural-origin fish are available for reintroductions, the coordination group supported some level of integration of some natural-origin fish into the broodstock, with the objective of using subsequent generations of hatchery fish for reintroduction purposes. Recent analyses have indicated some concerns with the level of integration, and there have been recommendations for looking at alternatives.

One outcome of the hatchery influence has been that the proportions of UWR Chinook with various life history characteristics are different than the historic populations in the Willamette Basin. Most hatchery juveniles are released as age-1 smolts in the spring, whereas a more continuous migration of naturally produced smolts through the fall and spring periods was observed in the historic populations (Willis et al. 1995, cited in NMFS 2004; see also Schroeder et al. 2007). Hatchery Chinook return at an earlier age than the historic populations. Most of the returns now are age-4 fish instead of age-5 (Willis et al. 1995, cited in NMFS 2004). It is unknown if younger adults is the result of genetic changes as the result of hatchery operations or fisheries, or simply the result of releasing larger smolts than occurred naturally.

Hatchery production of UWR steelhead began in 1930 and persisted until 1999. Non-native summer steelhead programs began as early as 1926, and currently summer steelhead of Skamania stock are raised at most of the rearing facilities in upper Willamette River subbasins, and released as smolts in the North and South Santiam, McKenzie and Middle Fork Willamette subbasins. The summer steelhead program is currently a mitigation program to provide replacement of fisheries lost due to habitat and production loss in the Willamette as well as other lower Columbia basins. Differences in spawn timing among these stocks may limit (but not eliminate) the potential for interbreeding. Genetic analysis indicates a close affinity between winter steelhead populations in the Santiam, Molalla (North Fork), and Calapooia Rivers. Skamania summer-run are genetically distinct from presumptive native steelhead.

The negative effects of releasing large numbers of an out-of-ESU steelhead stock are not limited to the potential effects on genetic diversity, but include ecological impacts as well (see review in Kostow 2009). While most insight regarding ecological effects on steelhead has come from steelhead populations outside the UWR ESU (Chilcote 2003, Kostow et al. 2003, Kostow 2004, Kostow and Zhou 2006), the impacts are likely relevant to the UWR ESU as well. For example, Kostow and Zhou (2006; citing references therein) suggested that because adults hatchery summer steelhead typically spawn earlier than do wild winter steelhead and their offspring emerge earlier, they may have a competitive advantage in occupying choice feeding territories prior to the emergence of winter steelhead. In addition, when large hatchery releases result in the localized carrying capacity to be exceeded-which is presumed to be the case in UWR sub-basins-there is increased potential for density-dependant mortality on wild fish for early life stages. If a significant number of summer steelhead juveniles residualize in the UWR sub-basins, they could compete with native wild steelhead parr, which have a 1-2 year residence time in freshwater. These potential sources of juvenile hatchery steelhead competition were identified as key LFT for the North and South Santiam winter steelhead populations.

Residualized summer steelhead may also prey upon juvenile Chinook salmon, and this has been identified as a secondary LFT in the Santiam populations, as well as the McKenzie population where releases support a sports fishery. Additional information on hatchery programs in the Willamette basin that may impact UWR Chinook and steelhead can be found in the draft HGMPs[44] and recent HSRG reviews[45].

5.3 Threats from Climate Change and Human Population Increases

Climate change and increases in human population in the Willamette basin will likely intensify and broaden the limiting factors already impacting UWR Chinook and steelhead populations. This will likely require increased intensity, persistence, and continued implementation of the recovery actions in this Plan, as well as identifying additional new actions as RME and adaptive management proceed. Success of this plan requires improvement on the status quo for major LFTs, and preventing other potential impacts from becoming LFTs. In this section we summarize some of the broader projected impacts of these emerging threats, and address them within strategies and actions in subsequent Plan chapters.

Climate Change

Although the impacts of climate change are difficult to project at the population scale, climate change will likely make it more difficult to meet the recovery goals for UWR Chinook and steelhead. The UWR ESUs have presumably persisted through past climatic extremes, but this was prior to the recent overlay of human-induced LFTs, and it is unclear how these populations will respond to the future effects of human-induced climate change. For example, the effects of degraded and lost habitat quality and complexity in the estuary and the ESU tributaries—which already limit the viability of all UWR Chinook and steelhead populations—could be amplified through climate change. With the anticipated negative changes in altered hydrology and higher seasonal water temperatures, there will likely be further losses of backwater, sloughs, and other off-channel areas that provide cool water refugia and resting habitat important to salmonid survival. Degraded riparian habitat conditions may exacerbate altered hydrology and water temperatures by reducing stream shading, bank stabilization, aquatic food production, and nutrient and chemical mediation. While the impacts of global climate change are less clear in the ocean environment, early modeling efforts suggest that warmer temperatures are likely to increase ocean stratification, which in the past has coincided with relatively poor ocean habitat for most Pacific Northwest salmon, herring, anchovies, and smelt populations (CIG 2004).

There are many recent efforts to project the effects of climate change on fish and wildlife in the Pacific Northwest using global emission scenarios and regional and global climate change models (ISAB 2007a, CIG[46], OCCRI[47]). The Independent Scientific Advisory Board recently completed a review of climate change impacts on Columbia River basin fish and wildlife (ISAB 2007a). Although the potential ecological responses and management approaches are complex and not precisely predictable, the projected regional trajectories of increased winter flooding, decreased summer and fall streamflows (and the related effects on stream temperature), and elevated temperatures in streams, rivers, and the estuary are likely to compound already degraded habitat conditions. Some observed and projected regional impacts of climate change relevant to Pacific Northwest salmonids are summarized in Table 5-5.

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[44] http://www.dfw.state.or.us/HGMP/final.asp
[45] http://www.hatcheryreform.us/hrp/reports/appendixe/welcome_show.action
[46] http://cses.washington.edu/cig/fpt/fpt.shtml
[47] http://occri.net/

For recovery planning efforts, there is a need to further down-scale these regional projections and to assess them in terms of ESU and population-scale vulnerabilities. The Oregon Climate Change Research Institute (OCCRI) and Climate Leadership Initiative (CLI[48]) recently conducted a downscaling process from global models to assess a range of possible outcomes from climate change in the Willamette basin (CLI & OCCRI 2010[49]). Briefly, these projections show:

1. *Streamflows:* UWR streams are likely to become flashier in the winter and early spring, and of the three models used (PCM, CSIRO, HadCM),
    a. All showed severe increase in winter flow, probably due to increased winter air temperatures
        i. As noted in CLI-NCCSP-USFS (2009), if winter storm intensity increases, the basin will experience higher runoff and more flooding in winter/spring, and "Greater sediment input, debris flow, and landslide risks are likely, especially in areas with road networks, extensive timber harvest, and other intense land uses. While periodic floods are necessary for maintaining stream health because they create and maintain deep pools, clean spawning gravels, and recruit large wood to the stream, floods that are too frequent or intense can cause shortages of woody debris and increase sparseness of wood distribution, scour gravel deposits and dislodge the egg masses of salmonids, or otherwise compromise stream structure and function." Main effects will be on egg and other early life stages, but change in peak discharge may also influence Chinook juvenile migration.
    b. All showed a moderate decrease in historical summer flows, probably influenced by reduction of "effective precipitation" where: 1) higher winter/spring air temperatures will result in less snowpack and earlier snowmelt in upper drainages that supply flow to lower catchments, and 2) higher air temperatures in summer will increase evapo-transpiration of riparian vegetation, decrease moisture content is soils, and increase evaporation in streams. Together these may lead to lower base flows and expansion of the low flow period in spring and fall, and to warmer water temperatures. With higher water temperature and subsequent degradation in other water quality attributes (algal blooms, lower DO), tolerance ranges for UWR ESUs may be exceeded, leading to direct mortality in some cases (or complete avoidance of the area) or indirect mortality associated with spread and stress associated with disease. In addition, expansion of range or increase in metabolic efficiency of warm-water fish may lead to greater predation on juvenile Chinook and steelhead. Main effects will be on late juvenile life stages, particularly for steelhead.
    c. As noted in CLI-NCCSP-USFS (2009), "spring-fed streams and riparian areas will be buffered somewhat from climate change due to mediated shifts in flow and temperature. The McKenzie is likely to remain the best stronghold for fish in the Upper Willamette. The Middle Fork also may see more moderate changes in flow."
2. *Air Temperature*: The three models consistently show an annual average increase in temperature for all seasons under both the B1 (green) and A1b (business as usual) emissions scenarios (5-8 degrees F). The most severe change in temperature is during the late summer months of August and September. The HadCM model shows the greatest increase in temperature of up to 10-15 degrees F in the summer months by the end of the century.
    a. Associated with low summer stream flows, populations of warm-water predaceous fishes may increase, leading to declines in juvenile survival of UWR Chinook and steelhead.

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[48] a program with Resource Innovation Group (TRIG) affiliated with the Institute for a Sustainable Environment (ICE) at the University of Oregon
[49] http://www.theresourceinnovationgroup.org/climate-preparedness-pubs/

3. *Precipitation:* The PCM1 and HadCM models project slightly less precipitation in summer and winter, with little change during the fall and spring months. The CSIRO model shows a slight increase in precipitation in the winter months. The decrease in precipitation for summer months in the Willamette basin is not shown to be as severe as in other parts of the state. The CLI-NCCSP-USFS (2009) report noted that climate scientists have suggested a potential "shift to extended periods of wet weather followed by extended periods of drought on an approximately inter-decadal schedule." And:
   a. "Such a pattern of precipitation would make it more difficult for stream systems to maintain their structure and function. River systems would be susceptible to severe erosion, loss of riparian cover, and isolation from an effective floodplain. These climate change susceptibilities, in combination with the effects of expanded human development of the floodplain, are likely to severely degrade the natural capacity of the land to store excess water during flood and slowly release it during drought."
4. *Snow Water Equivalent:* Under the A1b scenario, the model projects a severe decrease in snow water equivalent with near disappearance (greater than 80% loss) by the end of the century. As noted above for streamflows, lack of snowpack will influence summer streamflows, with subsequent impacts on the UWR ESUs.

The above effects will likely play out regardless of actions in this Recovery Plan. An RME need is a more detailed risk assessment that can identify management strategies for specific watersheds in the ESUs where there is opportunity to build population resilience to climate change.

Table 5-5. Observed and Projected Impacts of Climate Change in Major Climate/Hydrologic Indicators for the Pacific Northwest (from multiple sources, including: Mote et al. 1999; Miles et al. 2000; Mote 2003; Snover et al. 2003; Steward et al. 2004; Wiley 2004 as cited in CIG, 2004; CLI-NCCSP- USFS 2009).

Indicator	Observed 20th century changes	Projected changes during 21st century
Air Temperature	Region-wide warming of about 1.5°F (1920-2003). 2000-2009 was the warmest decade on record, and each of the last three decades has been much warmer than the decade before[50]	Average Annual Temperature 2040: increase of 2-4°F 2080: increase of 6-8°F Average Summer Temperature 2040: increase of 4-6°F 2080: increase of 4-8°F Average Winter Temperature 2040: increase of 1-2°F 2080: increase of 2-4°F
Precipitation	Region-wide increase in precipitation since 1920.	Mean Annual Precipitation By 2040: less in spring, summer, and fall, more in winter By 2080: from slight year round decrease to larger shifts that include monsoon patterns in the spring coupled with increased seasonal drought in the summer

50 http://www.nasa.gov/home/hqnews/2010/jan/HQ_10-017_Warmest_temps.html

Snowpack	Substantial declines of April 1 snowpack (>30%) at most monitoring stations below 6,000 feet. Data collected during the 20th century revealed widespread increases in average annual temperature and precipitation, and decreases in the April 1 snow water equivalent.	Projected decrease in April 1 snowpack for the Cascades Mountains in Washington and Oregon relative to 20th century climate: 44% by the decade of the 2020s based on +3^{o}F avg. temp change. 58% by the decade of the 2040s based on +4.5^{o}F avg. temp change. Snowpack is likely to decline in PNW by 60% by 2040, and 80-90% by 2095 from current levels.
Timing of peak spring runoff	Advanced 10-30 days earlier during the last 50 years, with greatest trends in the PNW.	With earlier snowmelt in spring, stream flows will peak earlier but at lower levels than typical flows in recent years, depending on the geology of the particular stream reach. Earlier peak spring runoff is expected
Storms and Flooding		With warmer oceans and more available moisture in the atmosphere, storm events could increase in intensity, resulting in more flooding in all rivers in the Basin
Summer streamflow	Declining in sensitive PNW basins. Example: May-Sept inflows into Chester Morse Lake in the Cedar River watershed (WA) as a fraction of annual flows have decreased 34% since 1946.	Continued and more wide-spread declines.

Future Human Population Growth and Development

As of 2004, an estimated 2.5 million people lived in Oregon counties with stream and river reaches that support UWR Chinook and steelhead (Benton, Clackamas, Lane, Linn, Marion, Multnomah, Polk, Washington and Yamhill counties; State of Oregon DAS Office of Economic Analysis 2004[51]). The certified population estimate for these counties as of July 1, 2010 is 2,677,150 million people (DAS-OEA). The population is expected to increase at about an average rate of 1.24% through 2040, with a projected population of 3.85 million people at the end of this time period (Table 5-6).

Table 5-6. Projected human population estimates for selected Oregon counties. Table uploaded and adapted from website of Office of Economic Analysis, Department of Administrative Services, State of Oregon.

	Total Population Projection						
County	**2010**	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**
Oregon	3,843,900	4,095,708	4,359,258	4,626,015	4,891,225	5,154,793	5,425,408
Benton	85,721	88,995	91,982	94,549	96,517	98,235	99,886
Clackamas	391,536	424,648	460,323	497,926	536,123	576,231	620,703
Lane	347,494	365,639	387,574	409,159	430,454	451,038	471,511

[51] http://oregon.gov/DAS/OEA/demographic.shtml

Linn	110,123	115,156	120,465	126,140	132,133	138,717	146,260
Marion	323,128	344,443	367,018	388,898	410,022	429,824	448,671
Multnomah	711,909	735,445	756,390	778,028	800,565	821,768	842,009
Polk	72,845	83,338	95,594	107,118	117,557	127,019	135,937
Washington	542,678	599,377	660,367	723,669	788,162	854,164	920,852
Yamhill	98,932	108,812	119,011	129,850	141,505	153,549	166,776
County Total	2,684,366	2,865,854	3,058,724	3,255,338	3,453,038	3,650,545	3,852,605

In general terms, an increasing human population puts further stress on aquatic resources. Examples include those summarized by the ISAB (2007b) for trends in the Columbia River basin:

- Population growth will increase demand for resources key to fish and wildlife populations: water, land, and forests.
- Increased demand for residential land is accelerating the rate of conversion of forest and agricultural lands.
- Changes in land use will affect water use and management and, ultimately, fish and wildlife habitat.
- The effects of climate change and population growth will combine to increase pressure on fish and wildlife habitats.
- The dominant ongoing pattern of settlement in the Columbia River basin is exurban sprawl which causes loss, degradation, and fragmentation of habitat. It also increases infrastructure costs, social conflict, and harmful interactions among people and wildlife.
- Demands for fresh water from surface and groundwater will increase. Decreases in the snow pack at higher elevations, resulting from climate change, will exacerbate this situation especially during low-flow summer and fall seasons.
- Urbanization will increase the amount of impervious surfaces in watersheds (pavement, roofs etc.), causing an increase in surface runoff during storm events and a reduction base flows due to reduced groundwater recharge.
- Population-related factors external to the Columbia River basin will affect fish and wildlife habitat. These include international trade, shipping, dredging, hazardous material transport, and airborne pollution.

Similar trends are projected to occur in the Willamette basin, and it should be stressed that it is the trajectory of land use development to accommodate population growth that will have the largest influence on LFTs for Chinook and steelhead. For example, Baker et al. (2004; see also related material of the Pacific Northwest Ecosystem Research Consortium[52]) noted that Willamette stakeholders did not see a plausible “futures scenario” where future landscape changes and environmental effects would be of the same magnitude as what occurred between the years 1850-1990. Rather, among three futures scenarios, future landscape changes reflect mostly “a shifting from past resource uses to new uses, rather than a substantial expansion of human use of land and water into relatively intact, natural ecosystems.” However, significant differences in environmental attributes could occur at smaller scales among three different futures scenarios (Hulse et al. 2002), and under both a Plan Trend and Development scenario extended out to year 2050, there will be: 1) large increases in urbanized acres, water consumed in dry summers, miles of dry 2^{nd}-4^{th} order streams, and 2) decreases in conifer canopy cover, forested riparian areas, and indices of aquatic biota health.

[52] http://oregonstate.edu/dept/pnw-erc/

A key component of impacts on aquatic resources is the amount of future human population density in urban growth boundaries and in rural-residential areas (Figures 168 and 169 and Table 49 in Hulse et al. 2002). Greater expansion of urban and rural residential development will have a suite of impacts on water quality, fish passage, riparian and aquatic physical habitat, hydrology, and stormwater and wastewater management. Details of these impacts and how they affect watershed health and salmonid recovery in Oregon can be found in the extensive review of the IMST (2010).

5.4 Threats and Associated Limiting Factors for UWR Chinook and Steelhead Populations

The key and secondary LFTs that contribute to the current status of UWR Chinook and steelhead populations at each life stage and geographic location are shown in Tables 5-7 (Chinook) and 5-8 (steelhead), followed by a description of LFT codes in Table 5-9. These tables are intended to help scope the threats affecting all populations in the ESUs. Further details on the geographic locations are in Table 5-4. The subsections that follow (and LFT tables therein) provide population-specific[53] details of the LFTs.

[53] In the population subsections the abbreviation "CHS" represents spring Chinook salmon, and "STW" represents winter steelhead.

Table 5-7. Key and secondary LFTs to the recovery of all populations in the UWR Chinook ESU. Bolded codes are key concerns and non-bolded codes are secondary concerns. Codes are in Table 5-9. The codes for Clackamas Chinook are subordinate to the codes used for this population in the OrLCR Plan; the code usage here is for tracking purposes of the LFTs. Black cells indicate where life stage is not present. Abbreviations for populations are: Clackamas=CM, Molalla=MO, North Santiam=NS, South Santiam=SSA, Calapooia=CA, McKenzie=MK, Middle Fork Willamette= MF.

Threats	Population	Natal Subbasin (Tributaries and lakes within population area)							West-side tributaries	Mainstem Willamette (Above falls)			Estuary (Below Bonneville Dam and Willamette Falls)			Ocean
		Egg / Alevin	Fry	Summer parr	Winter parr	Smolt	Adult	Spawner	Parr	Parr	Smolt	Adult	Parr	Smolt	Adult	Sub-adult
Flood control/ hydropower Management	CM	7i	8a	8a 9k		**1a**	9k						5ab,7h,8a,10f 9j			
	MO															
	NS	**9b**, 7bc	**10d**			**1d**	**2b,** 2k			**10d**						
	SSA	**9e,** 7d				**1e**	**2c,** 2l									
	CA															
	MK	7e, 9g	**10d**			1b	**2d**									
	MF	**9f, 7f,** 7g				**1f**	**2e2m**									
Land Management	CM		8a	9ai	**8a,** 9hi	9hi							**5a** 8a,9ahi			
	MO	7a		**9ah,** 8a, 9i,10b			**8b, 9c**			9hi						
	NS			**9ah,** 8a, 9i			**2f**		8a	**9hi** 8a		9hi				
	SSA						**2g**									
	CA	7a		**9ah,** 8a, 9i,10b			**2h, 8b, 9c**									
	MK			8a, 9ahi						**8a, 9hi**						
	MF															
Other Species	CM												6e			
	MO															
	NS															
	SSA															
	CA															
	MK															
	MF															
Harvest Management	CM														11g	11a
	MO															
	NS															
	SSA															
	CA															
	MK															
	MF															
Hatchery Management	CM							**3a**					4a			
	MO															
	NS		6c													
	SSA															
	CA															
	MK		6cd													
	MF															

Table 5-8. Key and secondary limiting factors to the recovery of all populations in the UWR Steelhead DPS. Bolded codes are key concerns and non-bolded codes are secondary concerns. Codes are in Table 5-9. Abbreviations for populations are: Molalla=MO, North Santiam=NS, South Santiam=SSA, Calapooia=CA.

Threats	Population	Natal Subbasin (Tributaries and lakes within population area)								West-side tributaries	Mainstem Willamette (Above falls)			Estuary (Below Bonneville Dam and Willamette Falls)			Ocean
		Egg / Alevin	Fry	Summer parr	Winter parr	Smolt	Adult	Spawner	Kelt	Parr	Parr	Smolt	Adult	Parr	Smolt	Adult	Adult
Flood control/ hydropower Management	MO														**5ab** **7h, 8a, 10f,** 9j		
	NS	**10a,** 7bc, 9d	**10d**			**1d**	**2b**		2i			10d	**10c**				
	SSA	**10e,** 7d, 9e				**1e**	**2c**		2j			10d	**10c**				
	CA											10d	**10c**				
Land Management	MO	7a	9ah, 10b		**8a,** 9hi	9hi					9hi				**5a,** 8a, 9ahi		
			2a														
	NS		9ah 10b		**8a,** 9hi	9hi					**9hi,** 8a		9hi				
			2a														
	SSA		9ah, 10b		**8a,** 9hi	9hi											
			2a														
	CA		9ah, 10b		**8a,** 9hi	9hi		2h									
			2a														
Other Species	MO														6e		
	NS																
	SSA		**6b**														
	CA																
Harvest Management	MO																
	NS																
	SSA																
	CA																
Hatchery Management	MO														4a		
	NS		**4c**					**3a**									
				4d													
	SSA		**4c**														
				4d													
	CA																

Table 5-9. Codes used for summarizing UWR limiting factors in Tables 5-7 and 5-8 and subsection tables below.

Code	Limiting Factor	Specific Threat
1	Habitat access (impaired downstream passage of juveniles at water control facilities, leading to direct and delayed mortality)	a: due to Clackamas subbasin dams
		b: due to McKenzie subbasin dams
		d: due to NS subbasin dams
		e: due to SSA subbasin dams
		f: due to MF Willamette subbasin dams
2	Habitat access (impaired adult access to holding and spawning habitat due to migration barriers)	a: to wadeable streams from road crossings, small dams, and diversion structures
		b: to habitat above NS dams
		c: to habitat above SSA dams
		d: to habitat above McKenzie dams
		e: to habitat above MF Willamette dams
		f: to habitat above Upper and Lower Bennett dams
		g: to habitat above Lebanon dam
		h: to habitat above small Calapooia dams
2	Habitat access (impaired downstream passage of STW kelts at water control facilities, leading to direct and delayed mortality)	i: due to NS subbasin dams.
		j: due to SSA subbasin dams
2	Habitat access (lack of spawning opportunity due to pre-spawning mortality impacts associated with handling stresses at sorting facilities and altered hydrology/WQ below dams.	k: crowding below NS dams.
		l: crowding below SSA dams.
		m: crowding and high water temperatures below Middle Fork Willamette dams.
3	Population traits (impaired productivity and diversity)	a: hatchery fish interbreeding with wild fish on the spawning grounds.
4	Competition (due to hatchery programs)	a: out-of-basin competition due to high density of juvenile hatchery fish in the estuary from composite Columbia basin hatchery releases
		c: in-basin competition with naturally produced progeny of hatchery summer steelhead
		d: in-basin competition with residualized hatchery summer steelhead smolts
5	Food web (impaired growth and survival from changes to estuarine food web)	a: reduced macrodetrital inputs due to 1) Columbia Basin hydropower habitat effects (reservoirs, revetments, disposal of contaminated dredge material), and 2) floodplain development
		b: increased microdetrital inputs due Columbia Basin hydropower and flood control reservoirs
6	Predation (multiple sources)	b: (by native and non-native fish species that are not associated with hatchery programs). Documented abundance of largemouth bass in Green Peter reservoir. Emerging concern of pikeminnow, centrarchid, and walleye impacts in other reservoirs and warm water reaches
		c: (by non-ESU/DPS hatchery species-smolts). Hatchery summer steelhead releases within subbasins
		d: (by hatchery rainbow trout). Hatchery rainbow trout programs within subbasins
		e: (birds in estuary). Land use practices that create favorable conditions in estuary for Caspian terns and cormorants to prey on salmonid juveniles
7	Physical habitat quality	a: excessive fine sediment in natal basin due to non-flood control land

Code	Limiting Factor	Specific Threat
	(multiple sources)	use practices, leading to impaired incubation gravel.

Table 5-9. Continued.

Code	Limiting Factor	Specific Threat
7	Physical habitat quality (flood control/hydropower sources)	b: flood control operations that reduce peak flows, leading to streambed coarsening below North Santiam dams.
		c: impaired gravel recruitment leading to lack of incubation gravel below North Santiam flood control facilities
		d: flood control operations that reduce peak flows, leading to streambed coarsening below South Santiam dams.
		e: impaired gravel recruitment leading to lack of incubation gravel below McKenzie flood control facilities
		f: impaired gravel and wood recruitment leading to lack of incubation gravel below Middle Fork Willamette flood control facilities
		g: flood control operations that reduce peak flows, leading to streambed coarsening below Middle Fork Willamette dams.
		h: impaired fine sediment/sand recruitment and routing in the estuary due to trapping of sediments behind flood control/hydropower facilities .
		i: impaired gravel recruitment leading to lack of incubation gravel below Clackamas flood control/hydro facilities.
8	Physical habitat quality (impaired habitat complexity and diversity)	a: land use practices including stream cleaning, straightening and channelization, revetments, riparian area degradation, lack of large wood recruitment, and/or loss of floodplain connectivity and access to off-channel habitat.
		b: land use practices (non-hydro) resulting in loss of summer holding pools of sufficient depth and structure, aggravated by human harassment issues: contributing to high pre-spawn mortality, loss of off-channel and side channel areas for resting and feeding as a consequence of floodplain development and channelization and loss of seasonal and shallow rearing habitat due to dredging, filling and placement of culverts in streams..
9	Water quality/quantity (effects on temperature within subbasins)	a: high summer water temperatures due to water and land use practices that impair riparian condition shading function, or practices that reduce summer streamflows (e.g., water withdrawals for agricultural, industrial, or municipal uses: leading to reduced growth and survival of juveniles.
		b: elevated fall water temperature below NS flood control facilities due to flow alterations: leading to premature hatching/emergence of CHS produced below dams.
		c: elevated water temperatures throughout the adult migration and holding window due to water land use practices that impair riparian condition shading function, or practices that reduce streamflows (e.g., water withdrawals for agricultural, industrial, or municipal uses, high temperatures and exposure to contaminants in urban areas such as the lower Willamette River.) contributing to poor adult condition and high pre-spawn mortality.
		d: decreased winter/spring water temperatures below NS flood control facilities due to flow alterations: impeding hatching/emergence of STW produced below dam.
		e: elevated fall water temperature below SSA flood control facilities due to flow alterations: leading to premature hatching/emergence of CHS produced below dams.

Code	Limiting Factor	Specific Threat
		f: elevated fall water temperature below MF Willamette flood control facilities due to flow alterations: leading to premature hatching/emergence of CHS produced below dams.
		g: elevated fall water temperature below McKenzie flood control facilities due to flow alterations: leading to premature hatching/emergence of CHS produced below dams.
		k: elevated spring and summer water temperatures in the Clackamas subbasin due to reservoir heating at large hydroelectric facilities.
9	Water quality (input of toxins)	h: Non-point sourcing of inputs of agricultural chemicals used throughout the Columbia and Willamette river basins
		i: Point and non-point sourcing of runoff and lack of treatment from urban, industrial, rural and agricultural practices, including presence of legacy contaminants in sediments downstream of industrial and urban areas.
9	Water quality (effects on temperature outside of subbasins)	j: elevated spring water temperatures in the estuary due to reservoir heating at large Columbia mainstem hydro facilities.
10	Hydrograph/water quantity (altered hydrology below dams)	a: Elevated flows during fall and winter from operations of North Santiam flood control/hydropower dams, and subsequent dewatering of steelhead redds below dams.
		c: reduced mainstem Willamette flows due to spring reservoir filling at subbasin flood control facilities: leading to increased water temperature and subsequent disease vulnerability.
		d: reduced occurrence of peak flows that maintain and create habitat; resulting in decreased channel complexity and habitat diversity in lower subbasins and mainstem Willamette River.
		e: elevated flows during fall and winter from operations of South Santiam flood control/hydropower dams, and subsequent dewatering of steelhead redds below dams
		f: operations at Columbia Basin hydropower dams that modulate flow and sourcing of materials, leading to degraded estuarine conditions such as impaired access to off-channel habitat, creation or maintenance of estuarine habitat, altered plume dynamics, and changes in the food web structure and function.
10	Hydrograph/water quantity (insufficient stream flows and floodplain storage from land use practices)	b: water withdrawals leading to insufficient stream flows, resulting in reduced habitat availability and impaired water quality.
11	Population traits	a: Mortality from targeted fishery
		g: Mortality due to gill net bycatch

5.4.1 Factors and Threats Limiting Viability of Clackamas Chinook

The following descriptions of the LFTs are specific to the Clackamas Chinook salmon population. Table 5-10 summarizes the key and secondary LFTs to recovery of the population at different life stages and locations, and the subsequent LFT descriptions in text are organized in a similar fashion. The LFTs for Clackamas spring Chinook were identified as part of the development of the OrLCR Plan (ODFW & NMFS 2010).

Table 5-10. The key and secondary LFTs to the recovery of the Clackamas Chinook salmon population. The LFTs are organized by limiting factor (column 1), within which the general threat categories are nested (column 2). Life stages are organized by three general life history modes (row 1), geographic areas where those modes are expressed (row 2), and specific life stage within that geographic area where the LFT is having an impact (row 3). Bolded codes are key concerns and non-bolded codes are secondary concerns. Codes are further defined in Table 5-9. Stippled cells indicate geographic areas where the population does not occur or life stage is not expressed (e. g. kelts for Chinook salmon).

Clackamas Spring Chinook		**Rearing and Downstream Migration**											**Marine Foraging**	**Upstream Migration and Spawning**		
		Natal Subbasin						**Mainstem Willamette**		**West-side Tribs**	**Estuary**		**Ocean**	**Estuary**	**Mainstem Willamette**	**Natal Subbasin**
Limiting Factor	**General Threat Category**	**Egg / Alevin**	**Fry**	**Summer Parr**	**Winter Parr**	**Smolt**	**Kelt**	**Parr**	**Smolt**	**Parr**	**Parr**	**Smolt**	**sub-adult/ Adult**	**Adult**	**Adult**	**Adult and Spawner**
Habitat Access	Flood Control/ Hydropower					**1a**										
Physical Habitat Quality	Flood Control/ Hydropower	7i	8a								**5ab,7h,8a**					
	Land Use		8a		**8a**						**5a,** 8a					
Water Quality / Quantity / Hydrograph	Flood Control/ Hydropower			9k							**10f,** 9j					9k
	Land Use			9ai	9hi						9ahi					
Predation	Land Use / Introductions										6e					
	Hatchery Management															
Competition	Land Use / Introductions															
	Hatchery Management										4a					
Population Traits	Hatchery Management															3a
	Harvest												11a	11g		

<u>Habitat Access</u>

Impaired downstream passage (1a). [Code 4b in the OrLCR Plan.].

Flood Control/Hydropower Management. *<u>Key threat</u>: CHS smolts.*

For juvenile Chinook salmon produced above the Portland General Electric (PGE) hydropower facilities, impaired downstream passage past these facilities the is a key concern for the Clackamas spring Chinook population. Mortality of juveniles migrating downstream occurs at North Fork Dam, Faraday Powerhouse and River Mill Dam. In a DEIS for the Clackamas Hydro Project, it was estimated the current average mortality for smolts passing through the hydro complex was 24.6% for Chinook (FERC 2006).

Physical Habitat Quality

Impaired gravel recruitment (7i). [Code 6d in the OrLCR Plan.].

Flood Control/Hydropower Management. Secondary threat: CHS eggs-alevins[54]

Impaired gravel recruitment behind dams affects Chinook spawning habitat quality in the Clackamas River. A geomorphic analysis of the Clackamas River downstream of River Mill Dam shows that gravel recruitment is impaired in the two-mile reach below River Mill Dam (Wampler and Grant 2003). Sediment trapping by the dams has resulted in coarsening of the grain size, channel incision and erosion of margin deposits.

Impaired habitat complexity and diversity of off-channel habitats (8a). [Code 6e in the OrLCR Plan.].

Flood Control/Hydropower Management. Secondary threat: CHS multiple juvenile freshwater life stages (subbasin). Key threat: juveniles (estuary).

Subbasin: Degraded rearing and migration habitat conditions in the lower Clackamas River subbasin resulting from development and operations of the PGE hydroelectric facilities pose a secondary concern to juvenile stages of the Clackamas spring Chinook population. It also reduced physical habitat complexity and diversity in the subbasin, in part by reducing the amount of large wood delivered to the lower subbasin. Project development and operations also inundated historical spawning and rearing habitats in the upper subbasin.

Estuary: In the Columbia River estuary, impaired physical habitat quality is due in part to altered flows related to hydroelectric development in the Columbia River Basin, and it presents a key threat to juvenile Clackamas spring Chinook. Altered flows changed estuarine habitat and plume conditions, and impaired access to off-channel habitat. Changes in the hydrograph have altered the natural pattern of flows over the seasons, causing inadequate flow, scouring flow, or other flow conditions. These changes affected habitat-forming processes and contributed to the loss of peripheral wetland, off-channel habitat and side channel habitat in the Columbia River estuary, including the lower Willamette River.

Land Use Management. Key threat: CHS winter parr (subbasin). Secondary threat: CHS fry (subbasin); CHS parr and smolts (estuary)

Subbasin: Impaired physical habitat quality due to stream cleaning, straightening and channelization, diking, wetland filling, and lack of large wood recruitment is a key concern for Clackamas spring Chinook winter parr and a secondary concern for fry. Changes in riparian condition, loss of large wood in tributary streams and the Clackamas River, and modified in-channel and side channel habitats limit Chinook production. The straightening and restricting of the stream channels has decreased channel complexity and connectivity to side channels and other off-channel areas that historically provided important overwintering habitat for juvenile Chinook. Several roads along streams in the upper Clackamas subbasin restrict and impinge on channel dynamics and also impact habitat quality (NPCC 2004). In the lower Clackamas subbasin, diking and channelization have

[54] The Planning Team for the OrLCR Plan identified this LFT as a concern for spring Chinook spawners in the Clackamas system. The Planning Team for the UWR Plan considers it a concern for spring Chinook eggs and alevins.

restricted the stream channel and reduced connectivity between the river and the floodplain (NPCC 2004).

Estuary: Degraded habitat quality in the lower Willamette River also impacts the population. Loss of habitat diversity and key habitat has resulted from channelization, the loss of wood and other structure, and elimination of much of the shallow water habitat. The loss of this historical habitat diversity and complexity in the lower Willamette River has reduced the amount of juvenile rearing habitat available in the reach for Clackamas Chinook (NPCC 2004).

In the lower Columbia River estuary, including the lower Willamette River, historically complex habitats have also been modified. Historically the estuary contained rich habitat for salmonid growth and survival, including a close proximity to high-energy areas with ample food availability and sufficient refuge habitat. Today many once important habitat areas in the estuary have been affected by land and water management activities. Complex habitats have been modified through channelization, diking, development and other practices. Jetties, pile dikes, tide gates, docks, breakwaters, bulkheads, revetments, seawalls, groins, ramps and other structures have changed circulation patterns, sediment deposition, sediment erosion, and habitat formation in the estuary (Williams and Thom 2001).

Together, habitat alteration through dredging, disposal of sand/gravel, wetland filling, instream and overwater structures, dikes and navigational structures have significantly altered estuary size/function, and reduced connectivity with peripheral wetland and side channel habitat. As a result of these changes, the surface area of the estuary has decreased by approximately 20% over the past 200 years (Fresh et al. 2005). This loss of access to historical spawning and rearing habitats has restricted the populations to sometimes sub-optimal habitat.

Impaired food web. Reduced macrodetrital input in the estuary due to Columbia Basin hydropower reservoir, and disposal of dredge material and other land use (5a). [Code 3a in the OrLCR Plan.]

Flood Control/Hydropower and Land Use Management. Key threat: CHS juveniles (estuary)

Reduced macrodetrital-based input in the Columbia River estuary affects the viability of the Clackamas Chinook population. Historically, the estuarine food web was based primarily on a large macrodetrital component, derived from course plant materials that originated from the floodplain and other zones in the in the estuary. As such, the food web was broad-based, seasonally dynamic, and distributed throughout the estuary. The basal features of the food web are much different today, primarily due to changes in flow patterns, loss of wetland and side channel habitat that reduced floodplain inputs, combined with channel alterations that changed saltwater intrusion patterns and interrupted nutrient cycles. Today, detrital sources from emergent wetlands in the estuary are approximately 84% less than they were historically (Bottom et al. 2005), and the shift from a macrodetritus-based source to a microdetritus-based source has lowered the productivity of the estuary.

Impaired food web. Increased microdetrital input due to Columbia Basin hydropower reservoirs (5b). [Code 3b in the OrLCR Plan.]

Flood Control/Hydropower. Key threat: CHS juveniles (estuary)

The estuary's current food web is microdetrital-based, made up of decaying phytoplankton delivered from upstream reservoirs. The substitution of this microdetrital-based food web for the historic macrodetrital-based web reduces Chinook productivity in the estuary. Unlike the historic macrodetritus-based food web, which was distributed evenly throughout the estuary, the contemporary microdetrital food web is concentrated within the estuarine turbidity maximum, an area in the middle region of the Columbia River estuary where circulation traps higher levels of suspended particulate material (Bottom et al. 2005). The estuarine turbidity maximum is thought to contain bacteria that attach to detritus. Together, these represent the primary food source in the estuary today (LCREP 2004).

Impaired sediment/sand routing (7h). [Code 6c in the OrLCR Plan.]

Flood Control/Hydropower. Key threat: CHS juveniles (estuary)

Changes in hydrology have impaired the routing and recruitment of fine sediment and sands. This change has contributed to impaired physical habitat quality in the estuary; and therefore constitutes a key impact on Clackamas Chinook. The force of historical spring freshets in the Columbia River moved sand into the estuary where it helped form shallow-water habitats that are thought vital for juvenile salmonids (LCREP 2006). Today, due to changes in hydrology and sequestering of sediment behind hydropower dams, spring freshet flows have been altered and sand discharge into the Columbia River estuary has been reduced to 70% of nineteenth-century levels (Jay and Kukulka 2002). The magnitude of change in sand transport contributed to changes in habitat forming processes. It also likely reduced turbidity, leaving juvenile fish more exposed to avian and fish predators.

Water Quality / Quantity / Hydrograph

Water quality. Elevated summer water temperature from land use practices (9a). [Same code in the OrLCR Plan.]

Land Use Management. Secondary threat: CHS

Subbasin: High summer water temperatures are considered a secondary concern for Clackamas spring Chinook. EDT results identify summer water temperature in the Clackamas subbasin as limiting summer rearing for juvenile spring Chinook (NPCC 2004). The high water temperatures are primarily the result of decreased riparian forest in the tributaries and the mainstem Clackamas River, ponding in reservoirs behind the hydroelectric dams, and other upriver factors. Riparian and upslope conditions in the lower Clackamas subbasin have only a minor impact on the elevated temperatures conditions (NPCC 2004).

Estuary: In the Columbia River estuary, land use practices that degraded riparian conditions or reduced streamflows have contributed to elevated water temperatures. In conjunction with water withdrawals, elevated stream temperatures often exist because of a lack of intact, functional and contiguous riparian management zones and sufficient streamside buffers. Channel widening may also be a contributing factor.

Water quality. Elevated spring and summer water temperatures in the Clackamas subbasin due to reservoir heating at large hydroelectric facilities (9k). [Code 9b in the OrLCR Plan.]

Flood Control/Hydropower. Secondary threat: CHS summer parr and adults

Water impoundment in reservoirs above Clackamas hydropower dams results in solar heating and elevated river water temperatures below these hydropower facilities. The warmer water temperatures in the lower Clackamas River limit juvenile spring Chinook summer rearing (NPCC 2004). High temperatures are also a concern for spring Chinook adults in the lower subbasin as they migrate into and hold over summer in this area.

Water quality. Elevated water temperatures in the estuary due to reservoir heating at large *hydropower reservoirs in the Columbia Basin (9j). [Code 9b in the OrLCR Plan.]*

Flood Control/Hydropower. Secondary threat: CHS juveniles

Elevated water temperatures in the estuary due to reservoir heating in the Columbia Basin pose a secondary threat to Clackamas spring Chinook. Flow regulation and reservoir construction on the Columbia have caused average water temperatures to increase. Water quality measurements at Bonneville Dam indicate that periods of increased temperatures are lasting longer than they did historically (National Research Council 2004). Current average and maximum values of Columbia River water temperatures are well above 20° C, which approaches the upper limits of thermal tolerance for cold-water fishes such as salmon (National Research Council 2004). Altered water temperatures can affect migration of Chinook destined to headwater holding and spawning areas. Cool temperatures in the winter can delay migration, warm summer temperatures can increase susceptibility to disease.

Water quality. Toxins from urban and industrial sources (9i). [Code 9d in the OrLCR Plan.]

Land Use Management. Secondary threat: CHS juveniles in subbasin and estuary

Toxic contaminants from urban and industrial practices reduce habitat quality for spring Chinook parr and smolts. Toxic contaminants are a problem in the lower Willamette River and other sites of intense urban or industrial development. An intensive study of sediments in Portland Harbor (the stretch of the Willamette River from Sauvie Island to the Fremont Bridge) has reported pesticides, polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbon (PAHs), and other chemicals at levels that exceed State and Federal sediment quality screening levels, and are harmful to the ecosystem.[55]

The Columbia River downstream of Bonneville Dam is the most urbanized stretch in the entire basin. In a study by Loge et al. (2005), cumulative delayed disease-induced mortalities were estimated at 3 percent and 18 percent for juvenile Chinook residing in the Columbia River estuary for 30 to 120 days, respectively, with about 50 percent of that mortality estimated to be due to effects of toxic contaminants such as PCBs and PAHs. Generally studies have shown that PCB and PAH concentrations in salmon and their prey in the lower Columbia and lower Willamette are comparable to those in organisms in other moderately to highly urbanized areas (Fresh et al. 2005; LCREP 2007; Johnson et al. 2007), and in some cases are above estimated threshold levels for toxic effects (et al. 2002, 2006, 2008). Trace metals, PCBs, dioxins, PAHs, and other compounds have been detected in this reach of the estuary (Fresh et al. 2005), and the U.S. Environmental Protection Agency has identified several PCB and DDT hot spots within the estuary, including near Longview, West Sand Island, the Astoria Bridge, and Vancouver (Fresh et al. 2005; Hayslip et al. 2006). Copper, used in brake pads for motor vehicles and often found in stormwater samples, has also been measured in the estuary at concentrations shown to interfere with the olfactory function in salmon (Baldwin et al. 2003; Sandahl et al. 2007; LCREP 2007). The Portland and Vancouver sewage treatment plants are large sources of effluent in this area (Fresh et al. 2005). Contaminants from industrial point sources and urban stormwater runoff in the area also affect water quality (USEPA 2009). Some contaminants are also transported downstream to the estuary from areas above Bonneville Dam and Willamette Falls..

Water quality. Toxins from agricultural pesticide sources (9h). [Code 9c in the OrLCR Plan.]

Land Use Management. Secondary threat: CHS juveniles in subbasin and estuary

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[55] http://yosemite.epa.gov/r10/cleanup.nsf/sites/ptldharbor.

Contaminants from agricultural practices found throughout the Columbia River estuary pose a threat to Clackamas spring Chinook. The U.S. Geological Survey's National Stream Quality Accounting Network program reported that a wide range of commonly used pesticides have been detected at sampling sites near Bonneville Dam and at the confluence of the Willamette and Columbia rivers (LCREP 2007a,b; Fresh et al. 2005). Detected water-soluble pesticides include simazine, atrazine, chlorpyrifos, metolachlor, diazinon, and carbaryl. Short-term exposure to these types of pesticides at environmentally relevant concentrations has been associated with disruption of olfactory function in salmonids; leading to difficulty in homing, predator avoidance, and finding prey (Scholz et al. 2000; Sandahl et al. 2002, 2005; Tierney et al. 2008). Moreover, mixtures of some of these pesticides (e.g., malathion and diazinon or chlorpyriphos) may be acutely lethal to salmonids (Laetz et al. 2009). Certain trace metals, such as lead and arsenic, have also been introduced to the environment through pesticides, such as lead arsenate, which is used as an insecticide for apples (Fresh et al. 2005). Additionally, a number of chlorinated pesticides, including dichlorodiphenyltrichloroethanes (DDTs), chlordanes, and endosulfans, are still present in soils and sediments in the Columbia Basin, even though they were banned in the United States in the 1970s (USEPA 2009). These compounds have been observed in tissues and stomach contents of juvenile Chinook salmon from the lower Columbia River and estuary and, in some cases, DDTs have accumulated in salmon tissues to concentrations above estimated toxic effects thresholds (Beckvar et al. 2005; Johnson et al. 2007)

Hydrology/water quantity. Altered hydrology from Columbia Basin hydroelectric operations (10f). [Code 5b in the OrLCR Plan.]

Flood Control/Hydropower. Key threat: CHS

Management of the Columbia River hydropower system alters the timing and magnitude of spring freshets, and thereby contributes to impairment of habitat quality and access in the estuary. Reduction of maximum flow levels, along with deposit of dredged material and diking, has all but eliminated overbank flows in the Columbia River (Bottom et al. 2001). The loss of overbank flows has restricted access to off-channel areas that historically contained seasonal wetlands and forested backwaters, and has also reduced large woody debris recruitment to the estuary and contributed to a change in food web structure and function. Artificial regulation of flow, especially rapid diurnal flow fluctuations, can strand juveniles in shallow water areas.

Predation

Predation by birds in the estuary due to land use practices (6e). [Code 8b in the OrLCR Plan.]

Land Use Management. Secondary threat: CHS juveniles

Modification of estuarine habitats has increased the number and/or predation effectiveness of Caspian terns, double-crested cormorants, and a variety of gull species in the Columbia River estuary (LCREP 2006; Fresh et al. 2005). For example, new islands formed through the disposal of dredged materials have attracted terns away from traditional habitats, especially those that are degraded. The new islands are often well-positioned for terns preying on migrating salmonids. Stream-type juvenile salmonids are most vulnerable to avian predation by Caspian terns because the juveniles use deep-water habitat channels that have relatively low turbidity and are close to island tern habitats. For this reason, the USACE began reducing the area available for tern nesting in 1999, and under the 2008 FCRPS RPA (action 45), has further reduced available area (to 1.5 to 2 acres by 2010). The USACE is also examining the feasibility of reducing predation levels of double-crested cormorants (RPA action 46), which consume a large number of juvenile salmonids (approximately 3.6 million juveniles) from their East Sand Island nesting grounds (Collis and Roby 2006).

Competition

Competition with hatchery fish in the estuary (4a). [Code 1a in the OrLCR Plan.]

Hatchery Management. Secondary Threat: CHS

Competition with hatchery fish from all Columbia River hatcheries for limited habitat and food supplies in the Columbia River estuary affects productivity of the Clackamas spring Chinook population. In recent years, approximately 1.7 million adult salmon and steelhead have returned annually to the Columbia River. To achieve these returns, an estimated 200 million juveniles are produced each year, 50-95% of which are of hatchery origin, depending on the species (LCREP 2006; CBFWA 1990; Genovese and Emmett 1997 as cited in Bottom et al. 2005). Hatchery fish are often released within a short period of time, causing large pulses of hatchery fish that ultimately compete with naturally produced fish for limited habitat and associated resources in the estuary at key times. This can result in stressors that translate into reduced salmonid survival (LCREP 2006). Hatchery fish are often larger than naturally produced counterparts, and may have a competitive advantage. This competition may result in density-dependent mortality for natural origin fish, limiting the number that can enter the plume. The intensity and magnitude of competition, however, has not been quantitatively documented and depends in part on when hatchery and natural juvenile salmonids enter the estuary and how long they stay.

Population Traits

Loss of population traits due to mortality from targeted fisheries (11a). [Code 7a in the OrLCR Plan.]

Harvest Management. Secondary threat: CHS sub-adults (ocean, estuary)

Incidental or direct mortality from targeted ocean troll fisheries poses a secondary threat to Clackamas spring Chinook. The spring Chinook population is exposed to ocean fisheries off the coast of Washington and as far north as Alaska. The harvest impact on the wild component population from ocean and mainstem Columbia fisheries, as well as those that occur in the Clackamas, has averaged about 25% in recent years[56].

Loss of population trait due to indirect mortality from gill net bycatch (11g). [Code 7b in the OrLCR Plan.]

Harvest Management. Secondary threat: CHS adults (estuary)

Incidental catch and mortality from gill net fisheries targeting other stocks in the Columbia River estuary also threatens the viability of Clackamas spring Chinook. The gill net fishery targets hatchery produced spring Chinook, but incidentally catches wild spring Chinook.

Loss of population traits due to hatchery fish interbreeding with wild fish on spawning grounds (3a). [Code 7c in the OrLCR Plan.]

Hatchery Management. Secondary threat: CHS adults (subbasin)

[56] Limiting factors and threats for this population were identified during the planning process for the OrLCR Plan. Harvest was identified as a key concern for a population if the estimated average harvest rate was 35% or higher, and as a secondary concern if it was between 10-35%. As this impact is currently estimated at 25%, targeted fishery and bycatch mortality was identified as secondary concern.

Hatchery fish interbreeding with wild fish on natural spawning grounds can lead to genetic introgression and other attributes that compromise genetic diversity and other population traits, and presents is a key concern for Clackamas spring Chinook. Hatchery fish comprise an estimated 42% (average) of the spring Chinook on natural spawning areas in the Clackamas basin[57].

[57] Limiting factors and threats for this population were identified during the planning process for the OrLCR Plan. Hatchery strays are identified as a key concern for a population if the estimated percentage of hatchery fish on local spawning grounds has likely averaged 30% or higher, and as a secondary concern if the proportion averaged between 10-30%.

5.4.2 Factors and Threats Limiting Viability of Molalla Chinook and Steelhead

The following descriptions of the LFTs are specific to the Molalla Chinook salmon and steelhead populations. Tables 5-11 and 5-12 summarize the key and secondary LFTs to recovery of the populations at different life stages and locations, and subsequent LFT descriptions are organized in a similar fashion. Harvest is not considered a key or secondary threat at any life stage of Mollala Chinook or steelhead populations.

Table 5-11. The key and secondary LFTs to the recovery of the Molalla Chinook salmon population. See caption in Table 5-10 for explanation table organization, LFT bolding, cell shading and cell patterning. Codes are further defined in Table 5-9.

Molalla Spring Chinook		Rearing and Downstream Migration											Marine Foraging	Upstream Migration and Spawning		
		Natal Subbasin						Mainstem Willamette		West-side Tribs	Estuary		Ocean	Estuary	Mainstem Willamette	Natal Subbasin
Limiting Factor	**General Threat Category**	**Egg / Alevin**	**Fry**	**Summer Parr**	**Winter Parr**	**Smolt**	**Kelt**	**Parr**	**Smolt**	**Parr**	**Parr**	**Smolt**	**sub-adult/ Adult**	**Adult**	**Adult**	**Adult and Spawner**
Habitat Access	Flood Control/ Hydropower															
Physical Habitat Quality	Flood Control/ Hydropower										**5ab,7h,8a**					
	Land Use	7a	8a		**8a**						**5a,** 8a					**8b**
Water Quality / Quantity / Hydrograph	Flood Control/ Hydropower										**10f,** 9j					
	Land Use			**9ah,** 9i, 10b	9hi						9ahi				9hi	**9c**
Predation	Land Use / Introductions										6e					
	Hatchery Management															
Competition	Land Use / Introductions															
	Hatchery Management										4a					
Population Traits	Hatchery Management															**3a**
	Harvest															

Table 5-12. The key and secondary LFTs to the recovery of the Molalla steelhead population. See caption in Table 5-10 for explanation table organization, LFT bolding, cell shading and cell patterning. Codes are further defined in Table 5-9.

Molalla Winter Steelhead		Rearing and Downstream Migration											Marine Foraging	Upstream Migration and Spawning		
		Natal Subbasin						Mainstem Willamette		West-side Tribs	Estuary		Ocean	Estuary	Mainstem Willamette	Natal Subbasin
Limiting Factor	**General Threat Category**	**Egg / Alevin**	**Fry**	**Summer Parr**	**Winter Parr**	**Smolt**	**Kelt**	**Parr**	**Smolt**	**Parr**	**Parr**	**Smolt**	**sub-adult/ Adult**	**Adult**	**Adult**	**Adult and Spawner**
Habitat Access	Flood Control/ Hydropower															
Physical Habitat Quality	Flood Control/ Hydropower											**5ab,7h 8a**				
	Land Use	7a	2a		**8a,** 2a	2a						**5a,** 8a				2a
Water Quality / Quantity / Hydrograph	Flood Control/ Hydropower											**10f,** 9j				
	Land Use		9ah, 10b		9hi			9hi				9ahi			9hi	
Predation	Land Use / Introductions											6e				
	Hatchery Management															
Competition	Land Use / Introductions															
	Hatchery Management											4a				
Population Traits	Hatchery Management															**3a**
	Harvest															

Habitat Access

Habitat access. Impaired access to wadeable streams due to barriers (2a).

Land Use Management. Secondary threat: STW multiple life stages

Small dams, irrigation diversions, road crossings and other passage impediments related to land use restrict juvenile and adult steelhead access to habitat on wadeable-sized tributaries.

Physical Habitat Quality

Physical habitat quality. Excessive fine sediment (7a)

Land Use Management. Secondary threat: CHS, STW

Subbasin channels in the lower Molalla River, particularly near the city of Molalla (RM 20), and in some tributaries have been simplified through revetments, roads, riprap and other actions that restrict channel movement. High erosion and destabilized stream banks release excess sediment, causing turbid water and silt deposits that harm aquatic life and violate water quality standards.

Impaired habitat complexity and diversity, off-channel habitats (8a)

Land Use Management. Key threat: CHS, STW winter parr; Secondary threat: CHS fry, summer parr; CHS, STW (estuary)

Subbasin: Habitat degradation is considered the primary factor limiting future production and recovery of the Chinook population in the Molalla River. Impaired physical habitat degrades rearing potential for the winter parr life stage of both species. Aquatic habitat in the forested upper Molalla/Pudding subbasin remains closer to the historical baseline, with the highest proportion of functioning riparian areas, the largest amounts of large wood in the river and tributary channels, and higher quality aquatic habitats.

Historical and, in some place continued, wood removal from streams and riparian harvest has reduced large wood in the channels, though riparian areas in the forested upper subbasin have more conifer trees than in the lower subbasin. Reduced wood in stream channels limits pool formation, thus reducing hiding areas for adult fish and restricting the quality and quantity of juvenile rearing habitat. There has also been an extensive loss of wetlands throughout the subbasin. Loss of connectivity to floodplain and wetland habitats has affected juvenile rearing and refuge habitat, particularly in the lower subbasin. Backwater habitats, including pool margins, side channels and alcoves, are below historical levels (WRI 2004).

Channels in the lower Molalla River, particularly near the city of Molalla (RM 20), and in some tributaries have been simplified through revetments, roads, riprap and other actions that restrict channel movement. High erosion and destabilized stream banks release excess sediment, causing turbid water and silt deposits that harm aquatic life and is a contributing source to the exceedence of water quality standards. Revetments have also simplified channels throughout the lower Pudding River and tributaries. Actions to stabilize the lower river through the placement of riprap along banks (and other actions) and limited large wood in the channel have also interacted to reduce the quantity and quality of backwater habitats (WRI 2004).

Estuary: The limiting factors in the estuary are the same as those discussed for Clackamas Chinook in Section 5.4.1.

Flood Control/Hydropower Management. Key threat: CHS and STW juveniles (estuary).

The limiting factors in the estuary associated with flood control/hydropower are the same as those discussed for Clackamas Chinook in Section 5.4.1.

Impaired food web. Reduced macrodetrital input in the estuary due to Columbia Basin hydropower reservoir, and disposal of dredge material and other land use (5a).

Flood Control/Hydropower and Land Use Management. Key threat: CHS and STW juveniles (estuary)

The limiting factors are the same as those discussed for Clackamas Chinook in Section 5.4.1.

Impaired food web. Increased microdetrital input due to Columbia Basin hydropower reservoirs (5b).

Flood Control/Hydropower. Key threat: CHS and STW juveniles (estuary)

The limiting factors are the same as those discussed for Clackamas Chinook in Section 5.4.1.

Impaired fine sediment and sand recruitment and routing (7h).

Flood Control/Hydropower. Key threat: CHS and STW juveniles (estuary)

The limiting factors are the same as those discussed for Clackamas Chinook in Section 5.4.1.

Loss of summer holding pools (8b)

Land Use Management. Key threat: CHS adults

Loss of holding pools, which provided cover and relief from high water temperatures, increases pre-spawning mortality of adult Chinook. Loss of wetland, floodplain and off-channel habitats has affected the quantity and quality of adult holding areas. Habitat degradation has also reduced availability of suitable Chinook spawning areas in the Molalla.

Water Quality / Quantity / Hydrograph

Water quality. Elevated summer water temperature from land use practices. (9a)

Land Use Management. Key threat: CHS juveniles (subbasin); Secondary Threat: STW juveniles (subbasin and estuary) and CHS juveniles (estuary)

Subbasin: Elevated water temperatures from land use practices decrease survival and/or growth of juvenile Chinook and steelhead. High water temperatures are common in the lower Molalla subbasin and are aggravated by loss of riparian cover, reduced wetland areas, channel simplification and increased impervious surfaces (WRI 2004). The stretch of the Molalla River from the mouth to RM 48.2 is included on the State 303(d) list for water temperature impairment (ODEQ 2006).

Water temperatures also exceed water quality criteria throughout the Pudding drainage. The Pudding River from the mouth to RM 61.7 is included on the State 303(d) list for water temperature impairment (ODEQ 2006). Water temperatures are elevated in many of the tributaries, particularly in the lower subbasin. In the Pudding River, low summertime flows contribute to concentrating nonpoint-source runoff (toxics and nutrients) and aggravate naturally higher water temperatures. Nutrient and toxic runoff, along with erosion of sediment containing legacy pesticides and background concentrations of iron, from agricultural and urban areas is also an issue in the Pudding drainage (WRI 2004).

Estuary: Effects from elevated water temperatures in the Columbia River estuary are the same as those discussed in for Clackamas Chinook in Section 5.4.1.

Water quality. Elevated water temperature from land uses, leading to prespawning mortality (9c)

Land Use Management. Key threat: CHS adults

Elevated water temperatures during the late spring and early summer associated with LFTs 8a (habitat modification) and 10b (insufficient stream flows) contribute to poor adult condition and increase pre-spawning mortality of adult Chinook in the Molalla River system.

Water quality. Toxins from agricultural pesticide sources (9h).

Land Use Management. Key threat: CHS summer parr; Secondary threat: CHS and STW juveniles in subbasin, juveniles and adults in the mainstem Willamette, and juveniles in the estuary

Threats in the estuary are the same as those described for Clackamas Chinook in Section 5.4.1. Several members of the Planning Team indicated that UWR populations were exposed to these toxins within the subbasin and to some extent in the mainstem Willamette River as well. Several subbasin stream reaches are listed as 303 (d) streams for pesticides (see Table 4-2 in the Molalla/Pudding Subbasin TMDL report, ODEQ 2008[58]), and past monitoring has found a suite of pesticides and other pollutants in surface waters (Wentz et al. 1998[59]).

Water quality. Toxins from urban and industrial sources (9i).

Land Use Management. Secondary threat: CHS and STW juveniles in subbasin, juveniles and adults in the mainstem Willamette, and juveniles in the estuary

Threats in the estuary are the same as those described for Clackamas Chinook in Section 5.4.1. Although the subbasins and upper mainstem Willamette River have less dense urbanization and industrial development than the Portland metro area, UWR Chinook and steelhead are exposed to some extent to some or all of these toxins in the subbasin and mainstem Willamette during rearing and migration .

Hydrograph/water quantity. Insufficient stream flows (10b)

Land Use Management. .Secondary threat: CHS and STW juveniles

Naturally low summertime flows in the lower Pudding drainage are aggravated by water withdrawals, channelization of tributaries, and modification of runoff patterns as a result of agriculture, impervious surfaces, and urban/residential development. In addition, a loss of storage capacity in floodplains and wetlands, particularly in the Pudding drainage, has accelerated runoff and increased peak flows. Small diversions, ditches, and drainage tiling in the lower subbasin have reduced storage capacity, contributing to flashy peak flows and lower flows during the summer and early fall (WRI 2004).

Water quality. Elevated water temperatures in the estuary due to reservoir heating at large hydropower reservoirs in the Columbia Basin (9j).

Flood Control/Hydropower. Secondary threat: CHS and STW juveniles

Threats in the estuary are the same as those described for Clackamas Chinook in Section 5.4.1.

Hydrology/water quantity. Altered hydrology in the estuary (10f).

Flood Control/Hydropower. Key threat: CHS and STW juveniles

Predation

Predation by birds in the estuary due to land use practices (6e).

Land Use Management. Secondary threat: CHS and STW juveniles

The limiting factors in the estuary are the same as those described for Clackamas Chinook in Section 5.4.1.

Competition

Competition with hatchery fish in the estuary (4a).

Hatchery Management. Secondary Threat: CHS and STW juveniles

[58] http://www.deq.state.or.us/wq/TMDLs/docs/willamettebasin/MolallaPudding/MoPudChapter4Pesticides.pdf
[59] http://pubs.usgs.gov/circ/circ1161/circ1161.pdf

The limiting factors are the same as those discussed for Clackamas Chinook in Section 5.4.1.

Population Traits

Loss of population traits due to hatchery fish interbreeding with wild fish on spawning grounds (3a).

Hatchery Management. Key threat: CHS and STW adults (subbasin)

Hatchery fish interbreeding with wild Molalla populations presents a significant risk of genetic introgression and associated loss in VSP attributes. About 100,000 Chinook smolts from South Santiam Hatchery are released annually into the Molalla. These fish represent about 90% of the naturally spawning adults. Few redds have been observed from natural or hatchery fish. There is current no hatchery steelhead releases in the basin, but there is a potential risk from out-of-ESU summer steelhead (broodstock program from the South Santiam) straying into the subbasin.

5.4.3 Factors and Threats Limiting Viability of North Santiam Chinook and Steelhead

The following descriptions of the LFTs are specific to the North Santiam Chinook salmon and steelhead populations. Tables 5-13 and 5-14 summarize the key and secondary LFTs to recovery of the populations at different life stages and locations, and subsequent LFT descriptions are organized in a similar fashion. Harvest is not considered a key or secondary threat at any life stage of North Santiam Chinook or steelhead populations.

Table 5-13. The key and secondary LFTs to the recovery of the North Santiam Chinook salmon population. See caption in Table 5-10 for explanation table organization, LFT bolding, cell shading and cell patterning. Codes are further defined in Table 5-9.

North Santiam Spring Chinook		Rearing and Downstream Migration											Marine Foraging	Upstream Migration and Spawning		
		Natal Subbasin						Mainstem Willamette		West-side Tribs	Estuary		Ocean	Estuary	Mainstem Willamette	Natal Subbasin
Limiting Factor	**General Threat Category**	**Egg / Alevin**	**Fry**	**Summer Parr**	**Winter Parr**	**Smolt**	**Kelt**	**Parr**	**Smolt**	**Parr**	**Parr**	**Smolt**	**sub-adult/ Adult**	**Adult**	**Adult**	**Adult and Spawner**
Habitat Access	Flood Control/ Hydropower					**1d**										**2b,** 2k
Physical Habitat Quality	Flood Control/ Hydropower	7bc									**5ab,7h,8a**					
	Land Use		8a		**8a**			8a			**5a,** 8a					
Water Quality / Quantity / Hydrograph	Flood Control/ Hydropower	**9b**	**10d**					**10d**			**10f,** 9j					
	Land Use			**9ah,** 9i	9hi			**9hi**			9ahi				9hi	**2f**
Predation	Land Use / Introductions										6e					
	Hatchery Management		6c													
Competition	Land Use / Introductions															
	Hatchery Management										4a					
Population Traits	Hatchery Management															**3a**
	Harvest															

Table 5-14. The key and secondary LFTs to the recovery of the North Santiam steelhead population. See caption in Table 5-10 for explanation table organization, LFT bolding, cell shading and cell patterning. Codes are further defined in Table 5-9.

North Santiam Winter Steelhead		Rearing and Downstream Migration											Marine Foraging	Upstream Migration and Spawning		
		Natal Subbasin						Mainstem Willamette		West-side Tribs	Estuary		Ocean	Estuary	Mainstem Willamette	Natal Subbasin
Limiting Factor	**General Threat Category**	**Egg / Alevin**	**Fry**	**Summer Parr**	**Winter Parr**	**Smolt**	**Kelt**	**Parr**	**Smolt**	**Parr**	**Parr**	**Smolt**	**sub-adult/ Adult**	**Adult**	**Adult**	**Adult and Spawner**
Habitat Access	Flood Control/ Hydropower					**1d**	2i									**2b**
Physical Habitat Quality	Flood Control/ Hydropower	7bc										**5ab,7h 8a**				
	Land Use	7a	2a		**8a,** 2a	2a		8a				**5a,** 8a				2a
Water Quality / Quantity / Hydrograph	Flood Control/ Hydropower	**10a**, 9d	**10d**						10d			**10f,** 9j			**10c**, 10d	
	Land Use		9ah, 10b		9hi			9hi				9ahi			9hi	
Predation	Land Use / Introductions											6b?, 6e				
	Hatchery Management															
Competition	Land Use / Introductions															
	Hatchery Management		**4c**	**4cd**								4a				
Population Traits	Hatchery Management															**3a**
	Harvest															

Habitat Access

Impaired downstream passage due to North Santiam subbasin dams (1d).

Flood Control/Hydropower Management. Key threat: CHS and STW smolts.

Migration delay and direct mortality of Chinook and steelhead smolts results from the lack of downstream passage provisions at the North Santiam dams. Lack of defined and prolonged flows can not only obscure principal passage routes through reservoirs, but also influence migration behavior of fish below these projects. Any juveniles produced above these facilities must first find attraction flows at the face of the dams, then pass through available routes. Direct and delayed mortality occurs with passage over spillways, through turbines, or through or other project structures not designed for fish passage.

Impaired downstream passage of STW kelts at North Santiam dams (2i).

Flood Control/Hydropower Management. Secondary threat: STW

Mortality of steelhead kelts occurs during downstream passage through turbines or because they are not able to locate downstream passage routes. Many of the same issues regarding juveniles above barriers apply to kelts.

Impaired adult access to habitat above North Santiam dams (2b).

Flood Control/Hydropower Management. Key threat: CHS, STW

Detroit and Big Cliff dams are complete barriers to upstream adult migration, and block access to an estimated 71% of the historical production area for Chinook and 55–65% of historical spawning habitat for winter steelhead. Non-volitional upstream access can be partially achieved if natural origin fish are safely trapped and hauled from the Minto facility to habitats above Detroit dam. The current Minto facility cannot achieve this.

Impaired adult access to habitat above Upper and Lower Bennett dams (2f).

Flood Control/Hydropower Management. Key threat: CHS

Upper Bennett Dam (RM 31.5) and lower Bennett Dam (RM 29) impair adult spring Chinook access to habitat upstream of the dams.

Impaired adult access leading to pre-spawning mortality (2k).

Flood Control/Hydropower Management. Secondary threat: CHS

Water temperatures in the river below Big Cliff dam are cooler in the summer from pre-project levels (see NMFS 2008a, section 4.6.3.3.1), potentially delaying the upstream movement of Chinook adults to the extent that they are not able to cope with other significant sources of stress. As spring Chinook attempt to migrate to the upper subbasin, they experience high pre-spawn mortality associated with crowding, sorting, delay, and stress at the outdated Minto trapping facility.

Physical Habitat Quality

Streambed coarsening due to reduced peak flows (7b).

Flood Control/Hydropower Management. Secondary threat: CHS and STW eggs and alevins

Flood control operations at Big Cliff and Detroit dams have reduced the frequency and magnitude of peak flows, and are not sufficient to create and maintain channel complexity and to provide nutrients, organic matter, and sediment inputs from floodplain areas (WRI 2004). Modification of the flow regime has changed delivery and transport of large wood (particularly the formation of large jams), and reduced and modified the recruitment and deposition of gravels and small cobbles. This has led to reduced pool frequency and depth, and reduced flow refugia for juvenile fish.

Impaired gravel recruitment due to flood control facilities (7c).

Flood Control/Hydropower Management. Secondary threat: CHS and STW eggs and alevins

Modification of the flow regime downstream of Big Cliff Dam has impaired gravel recruitment and deposition in the lower river, and together with gravel entrapment above dams, has resulted in reduced quantity and quality of spawning and incubation substrates in the lower mainstem of the North Santiam River.

Excessive fine sediment leading to impaired incubation gravels (7a).

Land Use Management. Secondary threat: STW eggs and alevins

High erosion and destabilized stream banks from past and current land uses have released excess sediment, causing turbid water and silt deposits that settle in spawning beds and harm winter steelhead eggs and alevins.

Impaired access to wadeable streams due to barriers (2a).

Land Use Management. Secondary threat: STW juveniles and adults

Road crossings and other land use related passage impediments restrict steelhead access to spawning and rearing habitat on wadeable-sized tributaries. Partial barriers include unscreened diversions, Santiam Water Control District power and irrigation canals, road culverts, the Salem ditch, and Sidney ditch (WRI 2004). Habitat conditions may further exclude winter steelhead from some lower tributaries (McElhany et al. 2004).

Physical habitat quality. Impaired habitat complexity/diversity, off-channel habitats (8a).

Land Use Management. Key threat: CHS and STW winter parr (subbasin); Secondary threat: CHS fry and summer parr (subbasin); CHS and STW parr-smolt (mainstem Willamette and Westside tributaries); CHS and STW juveniles (estuary)

Subbasin: Impaired physical habitat in the North Santiam drainage has significantly degraded rearing potential for Chinook and steelhead during the winter parr life stage. The lower portion of the subbasin contains only 25% of the original extent of floodplain forest, and there has been significant loss of wetland, floodplain, and off-channel habitats and associated habitat complexity. The floodplain is not inundated frequently, and reduced over-bank flow and side channel connectivity limit rearing and refuge habitat (WRI 2004).

Reaches of the North Santiam River below Detroit and Big Cliff dams have limited supplies of large wood. Reduced recruitment of large wood has reduced the formation of pools and side channels, and the capture of spawning gravels. It has also limited the creation of new gravel bars, resulting in a decrease in cool water rearing habitats. Limited wood supplies reduce hiding areas for adult fish, and restrict the quality and quantity of juvenile rearing habitat (WRI 2004).

The mainstem Willamette River and Westside tributaries also support juvenile life stages of winter steelhead and spring Chinook throughout the entire year. Habitat degradation in these areas affects rearing potential and migration characteristics for North Santiam Chinook and steelhead parr and smolts.

Estuary: In the Columbia River estuary, many once important habitat areas have been affected by land and water management activities. Along the lower Columbia, complex habitats have been modified through channelization, diking, development and other practices. Physical habitat quality in the lower Willamette River has also been reduced through land use practices. Loss of habitat diversity and key habitat has resulted from channelization, the loss of wood and other structure, and elimination of much of the shallow water habitat (McConnaha 2002). The limiting factors in the estuary are the same as those discussed for Clackamas Chinook in Section 5.4.1.

Flood Control/Hydropower Management. Key threat: CHS and STW juveniles

The limiting factors in the estuary are the same as those discussed for Clackamas Chinook in Section 5.4.1.

Impaired food web. Reduced macrodetrital input in the estuary due to Columbia Basin hydropower reservoir, and disposal of dredge material and other land use (5a).

Flood Control/Hydropower and Land Use Management. Key threat: CHS and STW juveniles

(estuary)

The limiting factors are the same as those discussed for Clackamas Chinook in Section 5.4.1.

Impaired food web. Increased microdetrital input due to Columbia Basin hydropower reservoirs (5b).

Flood Control/Hydropower. Key threat: CHS and STW juveniles (estuary)

The limiting factors are the same as those discussed for Clackamas Chinook in Section 5.4.1.

Impaired fine sediment and sand recruitment and routing (7h).

Flood Control/Hydropower. Key threat: CHS and STW juveniles (estuary)

The limiting factors are the same as those discussed for Clackamas Chinook in Section 5.4.1.

Water Quality / Quantity / Hydrograph

Water quality. Elevated water temperatures due to flow alterations at dams (9b).

Flood Control/Hydropower. Key threat: CHS eggs and alevins

Operations at Detroit and Big Cliff dams have altered water temperature patterns. Water temperatures in the river below the dams are warmer in the fall and winter than they were historically. This shortens the period of egg incubation, and results in premature hatching and emergence for fish produced below the dams.

Altered hydrology; elevated fall flows below dam (10a).

Flood Control/Hydropower. Key threat: STW eggs and alevins

Operations at Detroit and Big Cliff dams have changed flow regimes in the North Santiam River below Big Cliff dam. Increased flows in the fall from Detroit and Big Cliff dams may allow winter steelhead to spawn in areas that are then dewatered during active flood control operations (WRI 2004). This poses a risk to early life stages.

Decreased water temperatures due to dam operations (9d).

Flood Control/Hydropower. Secondary threat: STW eggs and alevins

Operations at Detroit and Big Cliff dams have altered water temperature patterns. Cooler temperatures in the spring and early summer are thought to impede hatching and delay the emergence of steelhead fry (NMFS 2008a) thereby reducing development or growth (WRI 2004).

Altered hydrology; reduced peak flow (10d).

Flood Control/Hydropower. Key threat: CHS juveniles (tributaries and mainstem Willamette), STW juveniles (tributaries); Secondary threat: STW adults (mainstem Willamette)

Operations at Detroit and Big Cliff dams have changed flow regimes in the North Santiam River, degrading habitat conditions for juvenile spring Chinook and steelhead. Reduced magnitude and occurrence of peak flows reduce channel movement that is important for recruitment of gravel and large wood, and maintaining varying seral stages of riparian vegetation. This in turn reduces the maintenance and formation of channel complexity and diversity of fish habitat. Lower peak flows also reduces the functioning of scouring to form pools. These effects extend to the mainstem Willamette River, where flood control (and reduced peak flows) omits the dynamic hydrologic conditions needed to support quality rearing habitat.

Water quality. Elevated water temperature from land uses (9a).

Land Use Management. Key threat: CHS (subbasin), Secondary threat: STW subbasin and estuary); CHS (estuary)

Effects from elevated water temperatures in the Columbia River estuary are the same as those discussed in for Clackamas Chinook in Section 5.4.1. The elevated water temperatures particularly decrease survival and/or growth of Chinook summer parr and steelhead fry and summer parr.

Water quality. Toxins from agricultural pesticide sources (9h).

Land Use Management. Key threat: CHS summer parr (subbasin and mainstem Willamette); Secondary threat: CHS and STW juveniles in subbasin, juveniles and adults in the mainstem Willamette, and juveniles in the estuary

Threats in the estuary are the same as those described for Clackamas Chinook in Section 5.4.1. Several members of the Planning Team indicated that UWR populations were exposed to these toxins within the subbasin and to some extent in the mainstem Willamette River as well.

Water quality. Toxins from urban and industrial sources (9i).

Land Use Management. Key threat: CHS parr (subbasin and mainstem Willamette); Secondary threat: CHS and STW juveniles in subbasin, juveniles and adults in the mainstem Willamette, and juveniles in the estuary

Threats in the estuary are the same as those described for Clackamas Chinook in Section 5.4.1. Although the subbasins and upper mainstem Willamette River have less dense urbanization and industrial development than the Portland metro area, UWR Chinook and steelhead are exposed to some extent to some or all of these toxins in the subbasin and mainstem Willamette.

Hydrograph/water quantity. Insufficient stream flows (10b).

Land Use Management. Secondary threat: STW fry-summer parr

Substantial water appropriations and withdrawals from the North Santiam River occur at and below the community of Stayton. During low flow months (July through October), domestic water use, combined with irrigation withdrawals in the lower elevations of the watershed, may significantly reduce stream flows. In 1990, approximately 55% of the population of Marion County received its water supply from the North Santiam River. The communities of Idanha, Gates, Mill City, Stayton, Salem, Turner and Jefferson all divert their supplies from the lower or middle reach of the river (or in the case of Jefferson, just below the confluence of the North and South Santiam Rivers) (Snyder et al. 2002). Above Stayton, appropriated water in the North Santiam River watershed represents only a small fraction of average flows, therefore surface water withdrawals are generally believed to have little or no effect on current in-stream habitats in the middle reach (Snyder et al. 2002).

Hydrology/water quantity. Altered hydrology (10f).

Flood Control/Hydropower. Key threat: CHS and STW juveniles

The limiting factors are the same as those discussed for Clackamas Chinook in Section 5.4.1.

Water quality. Elevated water temperatures due to reservoir heating (9j).

Flood Control/Hydropower. Secondary threat: CHS and STW juveniles

The limiting factors are the same as those discussed for Clackamas Chinook in Section 5.4.1.

Hydrograph/water quantity. Reduced flow in mainstem Willamette during spring reservoir filling (10c).

Flood Control/Hydropower. Key threat: STW adults

Reduced flows in the Willamette River during spring reservoir filling result in increased water temperatures that lead to increased disease vulnerability.

Predation

Predation by birds in the estuary due to land use practices (6e).

Land Use Management. Secondary threat: CHS and STW juveniles

The limiting factors in the estuary are the same as those described for Clackamas Chinook in Section 5.4.1.

Predation by non ESU-DPS hatchery fish species (6c).

Hatchery Management. Secondary threat: CHS juveniles

Hatchery summer steelhead smolts released in the subbasin can prey on North Santiam Chinook fry and parr.

Competition

Competition with hatchery fish in the estuary (4a).

Hatchery Management. Secondary threat: CHS and STW juveniles

The limiting factors are the same as those discussed for Clackamas Chinook in Section 5.4.1.

Competition with naturally produced progeny of hatchery summer steelhead (4c).

Hatchery Management. Secondary threat: STW

Natural production resulting from hatchery releases of non-native South Santiam stock summer steelhead is a risk to the viability of the North Santiam steelhead population (NMFS 2004). This hatchery stock originated from Skamania stock and is not part of the UWR steelhead DPS. Releases of thousands of hatchery smolts annually result in competition with juvenile UWR North Santiam steelhead. While most adult summer steelhead in the basin are harvested by anglers or removed at the Minto trap, ODFW has observed summer steelhead spawning in the mainstem North Santiam River, and Rock, Mad, Elkhorn and Sinker creeks. The North Santiam River had the highest densities of summer steelhead redds observed in any of the indigenous steelhead populations in the DPS. Studies in the Clackamas River have shown adverse effects from non-native Skamania summer steelhead on native winter steelhead (Chilcote 2003, Kostow and Zhou 2006). One ecological factor that may impact juvenile winter steelhead is the earlier emergence of summer steelhead, which may impart a competitive disadvantage to native fish if choice feeding territories are already occupied by summer steelhead (Kostow and Zhou 2006).

Competition with residualized hatchery summer steelhead smolts (4d).

Hatchery Management. Secondary threat: STW

Releases of non-native South Santiam stock summer steelhead also results in competition between juvenile North Santiam steelhead and residual hatchery summer steelhead smolts. See discussion above for 4c.

Population Traits

Loss of population traits due to hatchery fish interbreeding with wild fish on spawning grounds (3a).

Hatchery Management. Key threat: CHS and STW

Hatchery fish breeding with natural origin spawners represents a key threat to the genetic characteristics of the wild Chinook and steelhead populations.

Chinook. Hatchery operations on the North Santiam River began nearly 100 years ago. Today, hatchery fish account for approximately 90% of the natural spawners, due in part to low natural production.

Steelhead. Releases of hatchery produced of native North Santiam steelhead smolts in the North Santiam River system ended in 1998; however, the legacy of past hatchery releases is unknown. ODFW continues to release thousands of hatchery produced South Santiam stock summer steelhead smolts annually. This hatchery stock originated from Skamania stock and is not part of the UWR DPS. Impact from genetic introgression with summer steelhead is unknown.

5.4.4 Factors and Threats Limiting Viability of South Santiam Chinook and Steelhead

The following descriptions of the LFTs are specific to the South Santiam Chinook salmon and steelhead populations. Tables 5-15 and 5-16 summarize the key and secondary LFTs to recovery of the populations at different life stages and locations, and subsequent LFT descriptions are organized in a similar fashion. Harvest is not considered a key or secondary threat at any life stage of South Santiam Chinook or steelhead populations.

Table 5-15. The key and secondary LFTs to the recovery of the South Santiam Chinook salmon population. See caption in Table 5-10 for explanation table organization, LFT bolding, cell shading and cell patterning. Codes are further defined in Table 5-9.

South Santiam Spring Chinook		Rearing and Downstream Migration											Marine Foraging	Upstream Migration and Spawning		
		Natal Subbasin						Mainstem Willamette		West-side Tribs	Estuary		Ocean	Estuary	Mainstem Willamette	Natal Subbasin
Limiting Factor	**General Threat Category**	**Egg / Alevin**	**Fry**	**Summer Parr**	**Winter Parr**	**Smolt**	**Kelt**	**Parr**	**Smolt**	**Parr**	**Parr**	**Smolt**	**sub-adult/ Adult**	**Adult**	**Adult**	**Adult and Spawner**
Habitat Access	Flood Control/ Hydropower					**1e**										**2c,** 2l
Physical Habitat Quality	Flood Control/ Hydropower	7d									**5ab,7h,8a**					
	Land Use		8a		**8a**			8a			**5a,** 8a					
Water Quality / Quantity / Hydrograph	Flood Control/ Hydropower	**9e**	**10d**					**10d**			**10f,** 9j					
	Land Use			**9ah,** 9i	9hi			**9hi**			9ahi				9hi	**2g**
Predation	Land Use / Introductions										6e					
	Hatchery Management		6c													
Competition	Land Use / Introductions															
	Hatchery Management										4a					
Population Traits	Hatchery Management															**3a**
	Harvest															

Table 5-16. The key and secondary LFTs to the recovery of the South Santiam steelhead population. See caption in Table 5-10 for explanation table organization, LFT bolding, cell shading and cell patterning. Codes are further defined in Table 5-9.

South Santiam Winter Steelhead		Rearing and Downstream Migration											Marine Foraging	Upstream Migration and Spawning		
		Natal Subbasin						Mainstem Willamette		West-side Tribs	Estuary		Ocean	Estuary	Mainstem Willamette	Natal Subbasin
Limiting Factor	**General Threat Category**	**Egg / Alevin**	**Fry**	**Summer Parr**	**Winter Parr**	**Smolt**	**Kelt**	**Parr**	**Smolt**	**Parr**	**Parr**	**Smolt**	**sub-adult/ Adult**	**Adult**	**Adult**	**Adult and Spawner**
Habitat Access	Flood Control/ Hydropower					**1e**	2j									**2c**
Physical Habitat Quality	Flood Control/ Hydropower	7d										**5ab,7h 8a**				
	Land Use	7a	2a		**8a,** 2a	2a						**5a,** 8a				2ah
Water Quality / Quantity / Hydrograph	Flood Control/ Hydropower	**10a**, 9d	**10d**						10d			**10f,** 9j			**10c**, 10d	
	Land Use		9ah, 10b		9hi			9hi				9ahi			9hi	
Predation	Land Use / Introductions		**6b**									6e				
	Hatchery Management															
Competition	Land Use / Introductions															
	Hatchery Management		**4c**	**4cd**								4a				
Population Traits	Hatchery Management															**3a**
	Harvest															

<u>Habitat Access</u>

Impaired downstream passage at South Santiam dams (1e).

Flood Control/Hydropower Management. <u>Key threat</u>: CHS, STW smolts

Mortality of Chinook and steelhead juveniles occurs during downstream passage through turbines and other outlets at South Santiam dams or because they are not able to locate downstream passage routes. Fish are not currently outplanted above Green Peter dam because of poor passage survival and related problems with predation.

Impaired access to wadeable streams due to barriers (2a).

Land Use Management. <u>Secondary threat</u>: STW fry and summer parr

Small dams, irrigation diversions, road crossings and other land use related passage impediments restrict steelhead access to habitat on wadeable-sized tributaries. A number of irrigation diversions and push-up dams pose migration barriers to adult Chinook in the lower tributaries of Crabtree and Thomas creeks (E&S 2000). Numerous partial and complete fish passage barriers at culverts on tributary streams limit juvenile upstream movement into rearing and refuge habitat.

Impaired adult access to habitat above South Santiam dams (2c).

Flood Control/Hydropower Management. Key threat: CHS, STW adults

Green Peter and Foster dams block or limit access to an estimated 85% of the historical production area for Chinook and steelhead. Both dams have poorly performing passage provisions and current access is provided with experimental trap-and-haul methods.

Impaired adult access to habitat above Lebanon Dam (2g).

Land Use Management. Key threat: CHS adults

The eight-foot high Lebanon Dam at RM 21 impairs adult Chinook passage. The dam is equipped with several new fish ladders that allow passage of adult fish, but the dam may still delay some migration or injure adult fish seeking the entrances.

Impaired downstream passage of kelts at South Santiam dams (2j).

Flood Control/Hydropower Management. Secondary threat: STW kelts

Mortality of steelhead kelts occurs during downstream passage through turbines or because they are not able to locate downstream passage facilities.

Impaired adult access; pre-spawning mortality (2l).

Flood Control/Hydropower Management. Secondary threat: CHS adults

South Santiam spring Chinook are subject to pre-spawning mortality due to crowding below South Santiam dams.

Physical Habitat Quality

Impaired food web. Reduced macrodetrital input in the estuary due to Columbia Basin hydropower reservoirs, and disposal of dredge material (5a).

Flood Control/Hydropower and Land Use Management. Key threat: CHS, STW parr and smolts

The limiting factors are the same as those discussed for Clackamas Chinook in Section 5.4.1.

Impaired food web. Increased microdetrital input in the estuary due to Columbia Basin hydropower reservoirs (5b).

Flood Control/Hydropower Management. Key threat: CHS, STW juveniles

The estuary's current food web is microdetrital-based, made up of decaying phytoplankton delivered from upstream reservoirs. The limiting factors are the same as those discussed for Clackamas Chinook in Section 5.4.1.

Excessive fine sediment (7a).

Land Use Management. Secondary threat: STW eggs/alevin

High erosion and destabilized stream banks from past and current land uses have released excess sediment, causing turbid water and silt deposits that settle in spawning beds and harm winter steelhead eggs and alevins.

Streambed coarsening due to reduced peak flows (7d).

Flood Control/Hydropower Management. Secondary threat: CHS, STW eggs/alevin

Changes in the frequency and magnitude of high flow events downstream of Green Peter and Foster dams have caused a reduction of channel complexity and diversity of downstream rearing habitat. The frequency of large magnitude flows is not sufficient to create and maintain channel complexity, or to provide nutrient, organic matter, and sediment inputs from floodplain areas. Loss of frequent floodplain inundation has reduced overbank flow and side-channel connectivity, nutrient exchange, sediment exchange, and flood refugia for fish. Reduced pool frequency, depth, and cover have affected the quality of adult habitat in the river and tributaries. The dams also block transport of large wood from 50% of the subbasin (USACE 2001). Limited wood in the river and tributaries has affected the quality of pools and backwater habitats (WRI 2004).

Impaired sediment/sand routing (7h).

Flood Control/Hydropower Management. Key threat: CHS and STW juveniles

Impaired physical habitat quality in the estuary due to changes in sediment and sand routing has a key impact on South Santiam Chinook and steelhead. The limiting factors are the same as those discussed for Clackamas Chinook in Section 5.4.1.

Impaired habitat complexity/diversity, off-channel habitats (8a).

Land Use Management. Key threat: CHS, STW winter parr (subbasin); Secondary threat: CHS fry and summer parr (subbasin); CHS and STW parr-smolt (mainstem Willamette and Westside tributaries); CHS and STW juveniles (estuary)

Subbasin: Impaired physical habitat has significantly degraded rearing potential for Chinook and steelhead during the winter parr life stage in the South Santiam Basin. Past management of riparian areas and stream cleaning practices have led to reduced large wood in streams. Mature riparian forests now make up a very small proportion of the floodplain and riparian vegetation along the river and tributaries in the lower basin, particularly in areas where there is the largest amount of agricultural use. Riparian conditions are better in the upper subbasin than in the lower, but proportions of mature and old-growth coniferous forests are reduced (USACE 2001, cited in WRI 2004).

The mainstem Willamette River and South Santiam basin supports both winter steelhead and spring Chinook at various life stages throughout the entire year. Habitat degradation in the mainstem Willamette and South Santiam affects rearing potential and migration characteristics for South Santiam Chinook and steelhead parr and smolts. Juveniles of both species also use Westside tributaries for rearing, and habitat degradation in these drainages can limit this use.

Estuary: In the Columbia River estuary, many once important habitat areas have been affected by land and water management activities. Along the lower Columbia, complex habitats have been modified through channelization, diking, development and other practices. Physical habitat quality in the lower Willamette River has also been reduced through land use practices. The limiting factors in the estuary are the same as those discussed for Clackamas Chinook in Section 5.4.1.

Flood Control/Hydropower Management. Key threat: CHS, STW winter parr; Secondary threat: CHS fry, summer parr

The limiting factors are the same as those discussed for Clackamas Chinook in Section 5.4.1.

Water Quality / Quantity / Hydrograph

Water Quality. Elevated water temperature from land uses (9a).

Land Use Management. Key threat: CHS (subbasin); Secondary threat: STW (tributaries and estuary); CHS (estuary)

Temperatures exceed water quality criteria in the South Santiam River and in many tributaries. These elevated water temperatures decrease survival and/or growth of Chinook and steelhead juveniles in the river system. High water temperatures in the lower subbasin are aggravated by low streamflows, as well as land use practices that result in the loss of riparian cover, reduced wetland areas, and channel simplification (E&S 2000). Water temperatures are generally lower in the forested upper subbasin.

Effects from elevated water temperatures in the Columbia River estuary are the same as those discussed in for Clackamas Chinook in Section 5.4.1.

Water Quality. Elevated water temperatures due to flow alterations at dams (9e).

Flood Control/Hydropower Management. Key threat: CHS eggs/alevin; Secondary threat: STW eggs/alevin

Altered flow regimes downstream of Green Peter and Foster dams have changed water temperature patterns. Compared to historical conditions, water temperatures in the river below the dams are cooler in the summer and warmer in the fall and winter, which alters the timing of spawning, and affects the period of egg incubation (USACE 2001, cited in WRI 2004). Maximum temperatures for incubation and emergence have been exceeded in the lower South Santiam River, and cause premature hatching and emergence, especially for Chinook. Water temperatures in the South Santiam River exceed water quality criteria for summer maximums for juvenile rearing and migration, and have also exceeded water quality criteria for summer maximum adult migration (WRI 2004).

Water Quality. Toxins from agricultural sources (9h).

Land Use Management. Key Threat: CHS summer parr in subbasin, parr and smolts in mainstem Willamette); Secondary threat: CHS, STW juveniles in subbasin, juveniles and adults in mainstem Willamette, juveniles in estuary

Contaminants from agricultural practices found throughout the Columbia River estuary pose a threat to South Santiam Chinook and steelhead. The limiting factors are the same as those discussed for Clackamas Chinook in Section 5.4.1.

Water Quality. Toxins from urban and industrial sources (9i).

Land Use Management. Secondary threat: CHS, STW

Toxic contaminants from urban and industrial practices reduce habitat quality for Chinook parr and smolts, and steelhead smolts from the South Santiam River system. The limiting factors are the same as those discussed for Clackamas Chinook in Section 5.4.1.

Water Quality. Elevated water temperatures due to reservoir heating (9j).

Flood Control/Hydropower Management. Secondary threat: CHS parr and smolts, STW smolts

Elevated water temperatures in the estuary due to reservoir heating in Columbia Basin pose a secondary threat to South Santiam Chinook and steelhead. The limiting factors are the same as those discussed for Clackamas Chinook in Section 5.4.1.

Hydrology/water quantity. Altered hydrology; elevated flows (10e10a).

Flood Control/Hydropower Management. <u>Key threat</u>: STW eggs and alevin

Flow fluctuations due to operations at Green Peter and Foster dams can elevate flows during the winter steelhead spawning period and reduce flows during egg incubation, allowing the dewatering of steelhead redds.

Hydrograph/water quantity. Insufficient stream flows (10b).

Land Use Management. <u>Secondary threat</u>: STW fry-summer parr

Water withdrawals for irrigation, domestic and industrial water uses contribute to low flow conditions in the South Santiam River and its tributaries, particularly in late summer and early fall. The loss of streamflow affects steelhead productivity by reducing rearing habitat availability and quality for fry and summer parr.

Hydrology/water quantity. Reduced flow in mainstem Willamette during spring reservoir filling (10c).

Flood Control/Hydropower Management. <u>Key threat</u>: STW adults

Reduced flows in the Willamette River during spring reservoir filling result in increased water temperatures that lead to increased disease.

Hydrology/water quantity. Altered hydrology; reduced peak flow (10d).

Flood Control/Hydropower Management. <u>Key threat</u>: CHS (fry and parr in tributaries and smolts in mainstem Willamette), STW (fry and parr in tributaries); <u>Secondary threat</u>: STW smolts (mainstem Willamette)

Operations at Green Peter and Foster dams have changed the flow regime in the South Santiam River, degrading habitat conditions for juvenile spring Chinook and steelhead. Reduced peak flow decreases channel complexity and diversity of downstream rearing habitat. Reduced peak flows in the mainstem Willamette River due to flood control and hydro operations cause a reduction of channel complexity and diversity of rearing habitat for Chinook and steelhead smolts from the South Santiam system.

Hydrology/water quantity. Altered hydrology (10f).

Flood Control/Hydropower Management. <u>Key threat</u>: CHS parr and smolts, STW smolts

Management of the Columbia River hydro system alters the timing and magnitude of spring freshets, and impairs estuarine habitat quality and access. The limiting factors are the same as those discussed for Clackamas Chinook in Section 5.4.1.

<u>Predation</u>

Predation by non-native fish species (6b).

Land Use Management, Hatchery Management, and Species Introductions. <u>Key threat</u>: STW juveniles in subbasin;

Non-native largemouth bass are present in Green Peter Reservoir and are thought to prey on juvenile Chinook and steelhead that are progeny of outplanted fish.

Predation by non ESU-DPS fish species (6c).

Hatchery Management. Secondary threat: CHS juveniles

Hatchery summer steelhead smolts prey on South Santiam Chinook fry and parr.

Predation by birds in the estuary (6e).

Land Use Management. Secondary threat: CHS, STW juveniles

The limiting factors are the same as those discussed for Clackamas Chinook in Section 5.4.1.

Competition

Competition with hatchery fish in the estuary (4a).

Hatchery Management. Secondary threat: CHS, STW juveniles

The limiting factors are the same as those discussed for Clackamas Chinook in Section 5.4.1.

Competition with naturally produced progeny of hatchery summer steelhead (4c).

Hatchery Management. Secondary threat: STW

The naturally produced progeny of non-native summer steelhead released in the subbasin are thought to compete with juvenile South Santiam steelhead for habitat and food (NMFS 2004). This hatchery stock was introduced into the Willamette Basin from Skamania stock and is not part of the UWR steelhead DPS. Not all of the adult summer steelhead are harvested by anglers or removed at the Foster trap, and some summer steelhead have been observed spawning in the mainstem South Santiam River, Wiley, Crabtree, and Thomas Creeks. Studies in the Clackamas River have shown adverse effects from non-native Skamania summer steelhead on native (Chilcote 2003, Kostow and Zhou 2006). One ecological factor that may impact juvenile winter steelhead is the earlier emergence of summer steelhead, which may impart a competitive disadvantage to native fish if choice feeding territories are already occupied by summer steelhead (Kostow and Zhou 2006).

Competition with residualized hatchery summer steelhead smolts (4d).

Hatchery Management. Secondary threat: STW

Releases of non-native summer steelhead in the basin also results in competition between juvenile South Santiam steelhead and residual hatchery summer steelhead smolts. See discussion above for 4c.

Population Traits

Loss of Population traits due to hatchery fish interbreeding with wild fish on spawning grounds (3a).

Hatchery Management. Key threat: CHS and STW

Hatchery fish breeding with natural origin spawners continues to present a key threat to the genetic characteristics of the wild Chinook and steelhead populations.

Chinook: The large number of hatchery fish on natural spawning beds compared to the number of natural-origin spawning fish is a major concern for South Santiam Chinook. In recent years the proportion of naturally spawning Chinook in the South Santiam that are of hatchery origin has been over 80% (ODFW 2005a). The contribution of natural-origin fish to the broodstock is thought to be small (McElhany et al. 2007).

The proportions of Chinook with various life history characteristics are different than the historic populations in the Willamette Basin. Most hatchery produced juveniles are released as age-1 smolts in the spring, whereas a more continuous migration of naturally produced smolts through the fall and spring periods was observed in the historic populations (Willis et al. 1995, cited in NMFS 2004). Hatchery Chinook return at an earlier age than the historic populations. Most of the returns now are age-4 fish instead of age-5 (Willis et al. 1995, cited in NMFS 2004). It is unknown if the return of younger adults is the result of genetic changes due to hatchery operations or fisheries, or simply the result of releasing larger smolts than occurred naturally.

Steelhead: Hatchery releases of North Santiam steelhead were discontinued in the South Santiam in 1986. ODFW released North Santiam hatchery stock steelhead from 1979 through 1986 as part of a research study to improve downstream passage of smolts at Foster and Green Peter dams. The proportion of hatchery-reared fish that currently spawn naturally in the South Santiam River is believed to be less than 5% (Chilcote 1997); prior to 1989 it was more than 40% (ODFW 2005a). The legacy of past hatchery operations in combination with the continued release of summer-run steelhead presents risks to the viability of the steelhead population.

5.4.5 Factors and Threats Limiting Viability of Calapooia Chinook and Steelhead

The following descriptions of the LFTs are specific to the Calapooia Chinook salmon and steelhead populations. Tables 5-17 and 5-18 summarize the key and secondary LFTs to recovery of the populations at different life stages and locations, and subsequent LFT descriptions are organized in a similar fashion. Harvest is not considered a key or secondary threat at any life stage of Calapooia Chinook or steelhead populations.

Table 5-17. The key and secondary LFTs to the recovery of the Calapooia Chinook salmon population. See caption in Table 5-10 for explanation table organization, LFT bolding, cell shading and cell patterning. Codes are further defined in Table 5-9.

Calapooia Spring Chinook		**Rearing and Downstream Migration**											**Marine Foraging**	**Upstream Migration and Spawning**		
		Natal Subbasin						**Mainstem Willamette**		**West-side Tribs**	**Estuary**		**Ocean**	**Estuary**	**Mainstem Willamette**	**Natal Subbasin**
Limiting Factor	**General Threat Category**	**Egg / Alevin**	**Fry**	**Summer Parr**	**Winter Parr**	**Smolt**	**Kelt**	**Parr**	**Smolt**	**Parr**	**Parr**	**Smolt**	**sub-adult/ Adult**	**Adult**	**Adult**	**Adult and Spawner**
Habitat Access	Flood Control/ Hydropower															
Physical Habitat Quality	Flood Control/ Hydropower										**5ab,7h,8a**					
	Land Use	7a	8a		**8a**			8a			**5a,** 8a					**2h,8b**
Water Quality / Quantity / Hydrograph	Flood Control/ Hydropower							**10d**			**10f,** 9j					
	Land Use			**9ah,** 9i, 10b	9hi			**9hi**			9ahi				9hi	**9c**
Predation	Land Use / Introductions										6e					
	Hatchery Management															
Competition	Land Use / Introductions															
	Hatchery Management										4a					
Population Traits	Hatchery Management															**3a**
	Harvest															

Table 5-18 The key and secondary LFTs to the recovery of the Calapooia steelhead population. See caption in Table 5-10 for explanation table organization, LFT bolding, cell shading and cell patterning. Codes are further defined in Table 5-9.

Calapooia Winter Steelhead		**Rearing and Downstream Migration**											**Marine Foraging**	**Upstream Migration and Spawning**		
		Natal Subbasin						**Mainstem Willamette**		**West-side Tribs**	**Estuary**		**Ocean**	**Estuary**	**Mainstem Willamette**	**Natal Subbasin**
Limiting Factor	**General Threat Category**	**Egg / Alevin**	**Fry**	**Summer Parr**	**Winter Parr**	**Smolt**	**Kelt**	**Parr**	**Smolt**	**Parr**	**Parr**	**Smolt**	**sub-adult/ Adult**	**Adult**	**Adult**	**Adult and Spawner**
Habitat Access	Flood Control/ Hydropower															
Physical Habitat Quality	Flood Control/ Hydropower											**5ab,7h 8a**				
	Land Use	7a	2a		**8a,** 2a	2a						**5a,** 8a				2ah
Water Quality / Quantity / Hydrograph	Flood Control/ Hydropower								10d			**10f,** 9j			**10c**, 10d	
	Land Use		9ah, 10b		9hi			9hi				9ahi			9hi	
Predation	Land Use / Introductions											6e				
	Hatchery Management															
Competition	Land Use / Introductions															
	Hatchery Management											4a				
Population Traits	Hatchery Management															**3a**
	Harvest															

Habitat Access

Impaired access to wadeable streams due to barriers (2a).

Land Use Management. Secondary threat: STW multiple life stages

Numerous unscreened small diversions impair steelhead access to historical habitat within the Calapooia subbasin (WRI 2004). Land management practices also restrict access to off-channel areas and the floodplain.

Impaired adult access to habitat above Calapooia dams (2h).

Land Use Management. Key threat: CHS adults; Secondary threat: STW adults

Fish passage barriers are an issue throughout the subbasin. Currently, access is blocked to more than half of the stream length historically accessible to Chinook. Several dams and diversions limit upstream migration. The dams and diversions within the Thompson’s Mill complex (RM 19.5 to 28.5) have the greatest impact on fish passage. While Sodom Dam is equipped with a fish ladder, migrating Chinook are delayed at the base of the dam, which subjects them to additional stress and possible harassment and poaching (Runyon et al. 2004).

Physical Habitat Quality

Impaired food web. Reduced macrodetrital input in the estuary due to Columbia Basin hydropower reservoir, and disposal of dredge material and other land use (5a).

Flood Control/Hydropower and Land Use Management. Key threat: CHS, STW juveniles (estuary)

Reduced macrodetrital-based input in the Columbia River estuary affects viability of Calapooia Chinook and steelhead populations. The limiting factors are the same as those discussed for Clackamas Chinook in Section 5.4.1.

Impaired food web. Increased microdetrital input due to Columbia Basin hydropower reservoirs (5b).

Flood Control/Hydropower Management. Key threat: CHS, STW juveniles (estuary)

The limiting factors are the same as those discussed for Clackamas Chinook in Section 5.4.1.

Physical habitat quality. Excessive fine sediment (7a)

Land Use Management. Secondary threat: CHS, STW eggs and alevin

High erosion and destabilized stream banks from past and current land uses have released excess sediment, causing turbid water and silt deposits that settle in spawning beds and harm winter steelhead eggs and alevins.

Physical habitat quality. Impaired sediment/sand routing (7h).

Flood Control/Hydropower Management. Key threat: CHS, STW parr and smolts

Impaired physical habitat quality in the estuary due to changes in sediment and sand routing has a key impact on Calapooia Chinook and steelhead. The limiting factors are the same as those discussed for Clackamas Chinook in Section 5.4.1.

Impaired habitat complexity and diversity, off-channel habitats (8a)

Land Use Management. Key threat: CHS, STW winter parr; Secondary threat: CHS fry, summer parr (subbasin), parr and smolts (mainstem Willamette, West-side tributaries); CHS, STW juveniles (estuary)

Subbasin: Modifications to key habitats and the natural processes that form and maintain them affect viability of Calapooia Chinook and steelhead. Impaired physical habitat conditions particularly reduce rearing potential for the populations during the winter parr life stage. Habitat quality has declined through changes in interactions between stream systems and their floodplain that have reduced the delivery and transport of large wood, modified gravel deposition, reduced the frequency and depth of pools, minimized hiding cover for adult and juvenile fish, and reduced spawning areas. Flow alteration, channel confinement and in-stream barriers have reduced access to off-channel habitats essential for juvenile rearing and winter refuge and decreased connectivity between habitats throughout the watershed and the dynamic processes needed to form and maintain habitat diversity (WRI 2004).

The mainstem Willamette River and Calapooia subbasin support both winter steelhead and spring Chinook at various life stages throughout the entire year. Habitat degradation in the mainstem

Willamette and Calapooia affects rearing potential and migration characteristics for Calapooia Chinook and steelhead parr and smolts. Juveniles of both species also use Westside tributaries for rearing, and habitat degradation in these drainages can limit this use.

Estuary: In the Columbia River estuary, many once important habitat areas have been affected by land and water management activities. Along the lower Columbia, complex habitats have been modified through channelization, diking, development and other practices. Physical habitat quality in the lower Willamette River has also been reduced through land use practices. The limiting factors in the estuary are the same as those discussed for Clackamas Chinook in Section 5.4.1.

Flood Control/Hydropower Management. <u>Key threat</u>: CHS and STW juveniles (estuary).

The limiting factors in the estuary associated with flood control/hydropower are the same as those discussed for Clackamas Chinook in Section 5.4.1.

Loss of summer holding pools (8b)

Land Use Management. <u>Key threat</u>: CHS adults

Loss of holding pools increases pre-spawning mortality of adult Chinook; a survey of 27 female carcasses in the Calapooia in 2003 found 100% pre-spawning mortality (Schroeder and Kenaston 2004).

<u>Water Quality / Quantity / Hydrograph</u>

Water quality. Elevated summer water temperature from land use practices (9a)

Land Use Management. <u>Key threat</u>: CHS summer parr (subbasin); <u>Secondary threat</u>: STW fry and summer parr (subbasin); CHS, STW juveniles (estuary)

Subbasin: Naturally low flows in the Calapooia basin are aggravated by water withdrawals, which increase water temperatures. Water temperatures exceed State criteria in the Calapooia River and some tributaries, particularly in the lower subbasin. In general, water temperatures are lower in the forested upper subbasin than in the lower subbasin (Runyon et al. 2004).

Estuary: Effects from elevated water temperatures in the Columbia River estuary are the same as those discussed in for Clackamas Chinook in Section 5.4.1.

Water quality. Elevated water temperature from land uses, leading to pre-spawning mortality (9c)

Land Use Management<u>. Key threat:</u> CHS adults

Elevated water temperatures decrease survival and/or growth of juvenile Chinook, and increase pre-spawning mortality of adult Chinook.

Water quality. Toxins from agricultural pesticide sources (9h).

Land Use Management. <u>Key threat</u>: CHS summer parr (subbasin),CHS parr and smolts (mainstem Willamette); <u>Secondary threat</u>: CHS and STW juveniles in subbasin, STW juveniles and CHS and STW adults in mainstem Willamette, and CHS and STW juveniles in estuary

Contaminants from agricultural practices found throughout the Columbia River estuary pose a threat to Calapooia Chinook and steelhead. The limiting factors are the same as those discussed for

Clackamas Chinook in Section 5.4.1.

Water quality. Toxins from urban and industrial sources (9i).

Land Use Management. Key threat: CHS parr and smolts (mainstem Willamette); Secondary threat: CHS and STW juveniles in subbasin, STW juveniles and CHS and STW adults in the mainstem Willamette, and CHS and STW juveniles in the estuary

Toxic contaminants from urban and industrial practices reduce habitat quality for Chinook parr and smolts, and steelhead smolts from the Calapooia River system. The limiting factors are the same as those discussed for Clackamas Chinook in Section 5.4.1.

Water quality. Elevated water temperatures in the estuary due to reservoir heating at large hydropower reservoirs in the Columbia Basin (9j).

Flood Control/Hydropower Management. Secondary threat: CHS and STW juveniles

Elevated water temperatures in the estuary due to reservoir heating in Columbia Basin pose a secondary threat to Calapooia Chinook and steelhead. The limiting factors are the same as those discussed for Clackamas Chinook in Section 5.4.1.

Hydrograph/water quantity. Insufficient stream flows (10b)

Land Use Management. .Secondary threat: CHS and STW juveniles

Insufficient streamflow restricts steelhead in the Calapooia basin during fry and summer parr life stages. The low flows result primarily from water withdrawals and because of land use practices that have accelerated runoff and increased peak flows. These practices include channelization of tributaries in the lower subbasin; modification of runoff patterns as a result of agriculture, impervious surfaces, and residential development; and loss of storage capacity in floodplains and wetlands (WRI 2004). Water withdrawals from the Calapooia include operational rights for Thompson Mill and municipal water for the City of Brownville.

Hydrograph/water quantity. Reduced flow in mainstem Willamette during spring reservoir filling (10c).

Flood Control/Hydropower Management. Key threat: STW

Reduced flows in the Willamette River during spring reservoir filling result in increased water temperatures that lead to increased disease.

Hydrograph/water quantity. Altered hydrology; reduced peak flow in mainstem Willamette River (10d).

Flood Control/Hydropower Management. Key threat: CHS juveniles; Secondary threat: STW juveniles and adults

Reduced peak flows in the mainstem Willamette River due to flood control and hydro operations cause a reduction of channel complexity and diversity of rearing habitat for Chinook and steelhead smolts from the Calapooia system.

Hydrology/water quantity. Altered hydrology in the estuary (10f).

Flood Control/Hydropower. Key threat: CHS and STW juveniles

Management of the Columbia River hydro system alters the timing and magnitude of spring freshets, and impairs estuarine habitat quality and access. The limiting factors are the same as those discussed for Clackamas Chinook in Section 5.4.1.

Predation

Predation by birds in the estuary due to land use practices (6e).

Land Use Management. Secondary threat: CHS and STW juveniles

Modification of estuarine habitats has increased the number and/or predation effectiveness of Caspian terns, double-crested cormorants, and a variety of gull species in the Columbia River estuary (LCREP 2006; Fresh et al. 2005). The limiting factors are the same as those discussed for Clackamas Chinook in Section 5.4.1.

Competition

Competition with hatchery fish in the estuary (4a).

Hatchery Management. Secondary Threat: CHS and STW juveniles

Competition with hatchery fish from all Columbia River hatcheries for limited habitat and food supplies in the Columbia River estuary affects productivity of Calapooia Chinook and steelhead populations. The limiting factors are the same as those discussed for Clackamas Chinook in Section 5.4.1.

Population Traits

Loss of population traits due to hatchery fish interbreeding with wild fish on spawning grounds (3a).

Hatchery Management. Key threat: CHS and STW adults (subbasin)

Hatchery fish interbreeding with wild Molalla populations presents a significant risk of genetic introgression and associated loss in VSP attributes. About 100,000 Chinook smolts from South Santiam Hatchery are released annually into the Molalla. These fish represent about 90% of the naturally spawning adults. Few redds have been observed from natural or hatchery fish. There is current no hatchery steelhead releases in the basin, but there is a potential risk from out-of-ESU summer steelhead (broodstock program from the South Santiam) straying into the subbasin.

5.4.6 Factors and Threats Limiting Viability of McKenzie Chinook

The following descriptions of the LFTs are specific to the McKenzie Chinook salmon population. Table 5-19 summarizes the key and secondary LFTs to recovery of the population at different life stages and locations, and subsequent LFT descriptions are organized in a similar fashion.

Table 5-19. The key and secondary LFTs to the recovery of the McKenzie Chinook salmon population. See caption in Table 5-10 for explanation table organization, LFT bolding, cell shading and cell patterning. Codes are further defined in Table 5-9.

McKenzie Spring Chinook		**Rearing and Downstream Migration**											**Marine Foraging**	**Upstream Migration and Spawning**		
		Natal Subbasin						**Mainstem Willamette**		**West-side Tribs**	**Estuary**		**Ocean**	**Estuary**	**Mainstem Willamette**	**Natal Subbasin**
Limiting Factor	**General Threat Category**	**Egg / Alevin**	**Fry**	**Summer Parr**	**Winter Parr**	**Smolt**	**Kelt**	**Parr**	**Smolt**	**Parr**	**Parr**	**Smolt**	**sub-adult/ Adult**	**Adult**	**Adult**	**Adult and Spawner**
Habitat Access	Flood Control/ Hydropower					**1b**										**2d**
Physical Habitat Quality	Flood Control/ Hydropower	7e									**5ab,7h,8a**					
	Land Use		8a		**8a**			8a	**8a**		**5a,** 8a					
Water Quality / Quantity / Hydrograph	Flood Control/ Hydropower	9g	**10d**					**10d**			**10f,** 9j					
	Land Use			9ahi	9hi			**9hi**			9ahi				9hi	
Predation	Land Use / Introductions										6e					
	Hatchery Management		6cd													
Competition	Land Use / Introductions															
	Hatchery Management										4a					
Population Traits	Hatchery Management															**3a**
	Harvest															

<u>Habitat Access</u>

Impaired downstream passage at McKenzie dams (1b).

Flood Control/Hydropower Management. <u>Key threat</u>: CHS smolts

Mortality of Chinook and steelhead juveniles occurs during downstream passage through turbines at McKenzie dams or because they are not able to locate downstream passage routes.

Impaired adult access to habitat above McKenzie dams (2d).

Flood Control/Hydropower Management. <u>Key threat</u>: CHS adults

Construction of Cougar Dam on the South Fork blocked fish access to a significant amount of historically productive Chinook habitat above the dam. Blue River Dam was built without fish passage facilities, but only two miles of Chinook spawning habitat was lost because a falls already limited distribution. EWEB's Trail Bridge Dam blocks access to the uppermost three miles of the mainstem McKenzie River and a portion of the Smith River.

Physical Habitat Quality

Impaired food web. Reduced macrodetrital input in the estuary due to Columbia Basin hydropower reservoirs, and disposal of dredge material (5a).

Flood Control/Hydropower and Land Use Management. Key threat: CHS parr and smolts

The limiting factors are the same as those discussed for Clackamas Chinook in Section 5.4.1.

Impaired food web. Increased microdetrital input in the estuary due to Columbia Basin hydropower reservoirs (5b).

Flood Control/Hydropower Management. Key threat: CHS juveniles

The limiting factors are the same as those discussed for Clackamas Chinook in Section 5.4.1.

Impaired gravel recruitment due to McKenzie flood control facilities (7e)

Flood Control/Hydropower Management. Secondary threat: CHS eggs/alevin

Reduced peak flows in the McKenzie Basin due to flood control operations cause a reduction of channel complexity and diversity of rearing habitat for juvenile Chinook. The dams also capture large wood that historically created complex habitat conditions. Trail Bridge Dam and, to a greater extent, Cougar Dam and Blue River Dam, intercept large wood and sediment from 35% of the McKenzie's headwaters (WRI 2004). Together, reductions in the peak flows and reduced delivery of large wood in the channel have also resulted in fewer side channels and other backwater features, and reduce recruitment of gravel and other substrates. The mainstem McKenzie below Deerhorn Park (RM 32) has lost most of its islands and side channels (WRI 2004).

Impaired sediment/sand routing (7h).

Flood Control/Hydropower Management. Key threat: CHS juveniles

Impaired physical habitat quality in the estuary due to changes in sediment and sand routing has a key impact on McKenzie Chinook. The limiting factors are the same as those discussed for Clackamas Chinook in Section 5.4.1.

Impaired habitat complexity/diversity, off-channel habitats (8a).

Land Use Management. Key threat: CHS winter parr(subbasin), smolts (mainstem Willamette and Westside tributaries; Secondary threat: CHS fry and summer parr (subbasin); CHS parr (mainstem Willamette); CHS juveniles (estuary)

Subbasin: Altered habitat diversity (loss of channel confinement, riparian function, wood in the channel, and other attributes) has affected all of the Chinook life stages in the geographic areas, with larger impacts in the Blue River watershed, lower McKenzie River, lower subbasin tributaries, and Mohawk watershed (WRI 2004). Impacts have particularly degraded rearing potential for Chinook juveniles during the winter parr life stage.

The mainstem Willamette River and McKenzie basin supports spring Chinook at various life stages throughout the entire year. Habitat degradation in the mainstem Willamette and McKenzie affects rearing potential and migration characteristics for McKenzie Chinook parr and smolts. Juveniles also use Westside tributaries for rearing, and habitat degradation in these drainages can limit this use.

Estuary: In the Columbia River estuary, many once important habitat areas have been affected by land and water management activities. Along the lower Columbia, complex habitats have been modified through channelization, diking, development and other practices. Physical habitat quality in the lower Willamette River has also been reduced through land use practices. The limiting factors in the estuary are the same as those discussed for Clackamas Chinook in Section 5.4.1.

Flood Control/Hydropower Management. Key threat: CHS juveniles.

The limiting factors are the same as those discussed for Clackamas Chinook in Section 5.4.1.

Water Quality / Quantity / Hydrograph

Water Quality. Elevated water temperature from land uses (9a).

Land Use Management. Secondary threat: CHS summer parr in subbasin and CHS juveniles in estuary

Elevated water temperatures from past and/or present land management practices decrease survival and/or growth for McKenzie Chinook summer parr.

Effects from elevated water temperatures in the Columbia River estuary are the same as those discussed in for Clackamas Chinook in Section 5.4.1.

Water Quality. Elevated water temperatures due to flow alterations at dams (9g).

Flood Control/Hydropower Management. Secondary threat: CHS eggs/alevin

Elevated water temperatures below McKenzie hydropower/flood control dams result in premature hatching and emergence of Chinook. A temperature control tower has been operational at Cougar Dam since 2005. Evaluation of that facility relative to emergence timing and other effects is ongoing as described and proposed in the WP BiOp (NMFS 2008a; RPA 5.4).

Water Quality. Toxins from agricultural sources (9h).

Land Use Management. Key Threat: CHS parr and smolts in mainstem Willamette; Secondary threat: CHS juveniles in subbasin and estuary, adults in mainstem Willamette

Contaminants from agricultural practices found throughout the Columbia River estuary pose a threat to McKenzie Chinook. The limiting factors are the same as those discussed for Clackamas Chinook in Section 5.4.1.

Water Quality. Toxins from urban and industrial sources (9i).

Land Use Management. Key threat: CHS parr and smolts in mainstem Willamette; Secondary threat: CHS juveniles in subbasin and estuary, adults in mainstem Willamette

Toxic contaminants from urban and industrial practices reduce habitat quality for Chinook parr and smolts from the McKenzie River system and in the Willamette River. The limiting factors are the same as those discussed for Clackamas Chinook in Section 5.4.1.

Water Quality. Elevated water temperatures due to reservoir heating (9j).

Flood Control/Hydropower Management. Secondary threat: CHS parr and smolts

Elevated water temperatures in the estuary due to reservoir heating in Columbia Basin pose a secondary threat to McKenzie Chinook. The limiting factors are the same as those discussed for Clackamas Chinook in Section 5.4.1.

Hydrology/water quantity. Altered hydrology; reduced peak flow (10d).

Flood Control/Hydropower Management. Key threat: CHS fry and parr in subbasin, CHS parr and smolt in mainstem Willamette

Peak flows have been greatly diminished by Cougar and Blue River dams. Average annual peak flows after the dams were completed in 1968 are only 60% of the average annual peak flows that occurred before dam construction (Alsea Geospatial et al. 2000). Reduced peak flows cause a reduction of channel complexity and diversity of rearing habitat for juvenile Chinook.

Hydrology/water quantity. Altered hydrology (10f).

Flood Control/Hydropower Management. Key threat: CHS parr and smolts

Management of the Columbia River hydro system alters the timing and magnitude of spring freshets, and impairs estuarine habitat quality and access. The limiting factors are the same as those discussed for Clackamas Chinook in Section 5.4.1.

Predation

Predation by non ESU-DPS fish species (6c).

Hatchery Management. Secondary threat: CHS juveniles

Hatchery steelhead smolts prey on Chinook fry and summer parr.

Predation by rainbow trout (6d).

Hatchery Management. Secondary threat: CHS juveniles

Hatchery rainbow trout prey on Chinook fry and summer parr.

Predation by birds in the estuary (6e).

Land Use Management. Secondary threat: CHS juveniles

The limiting factors are the same as those discussed for Clackamas Chinook in Section 5.4.1.

Competition

Competition with hatchery fish in the estuary (4a).

Hatchery Management. Secondary threat: CHS juveniles

Competition with hatchery fish from all Columbia River hatcheries for limited habitat and food supplies in the Columbia River estuary affects productivity of McKenzie Chinook. The limiting factors are the same as those discussed for Clackamas Chinook in Section 5.4.1.

Population Traits

Loss of Population traits due to hatchery fish interbreeding with wild fish on spawning grounds (3a).

Hatchery Management. Key threat: CHS spawners

The risk of genetic introgression from interbreeding with hatchery Chinook represents a key threat to the McKenzie Chinook population. The McKenzie Hatchery Chinook program increases the number of natural spawners below and above Leaburg Dam. From 2001 to 2004, hatchery fish comprised 30 to 34% of the natural spawners above Leaburg Dam (Schroeder et al. 2007). Below Leaburg Dam, hatchery fish comprised more than 70% of the natural spawners in 2003 (Firman et al. 2004, cited in NMFS 2004). It is believed the high level of hatchery fish on the spawning grounds in recent years is representative of what occurred over the last few decades. The hatchery program also outplants adults above Cougar and Trail Bridge dams.

5.4.7 Factors and Threats Limiting Viability of Middle Fork Willamette Chinook

The following descriptions of the LFTs are specific to the McKenzie Chinook salmon population. Table 5-20 summarizes the key and secondary LFTs to recovery of the population at different life stages and locations, and subsequent LFT descriptions are organized in a similar fashion.

Table 5-20. The key and secondary LFTs to the recovery of the Middle Fork Willamette Chinook salmon population. See caption in Table 5-10 for explanation table organization, LFT bolding, cell shading and cell patterning. Codes are further defined in Table 5-9.

Middle Fork Willamette Spring Chinook		**Rearing and Downstream Migration**											**Marine Foraging**	**Upstream Migration and Spawning**		
		Natal Subbasin						**Mainstem Willamette**		**West-side Tribs**	**Estuary**		**Ocean**	**Estuary**	**Mainstem Willamette**	**Natal Subbasin**
Limiting Factor	**General Threat Category**	**Egg / Alevin**	**Fry**	**Summer Parr**	**Winter Parr**	**Smolt**	**Kelt**	**Parr**	**Smolt**	**Parr**	**Parr**	**Smolt**	**sub-adult/ Adult**	**Adult**	**Adult**	**Adult and Spawner**
Habitat Access	Flood Control/ Hydropower					**1f**										**2me**
Physical Habitat Quality	Flood Control/ Hydropower	7fg									**5ab,7h,8a**					
	Land Use		8a		**8a**			8a	**8a**		**5a,** 8a					
Water Quality / Quantity / Hydrograph	Flood Control/ Hydropower	**9f**	**10d**					**10d**			**10f,** 9j					
	Land Use			9ahi	9hi			**9hi**			9ahi				9hi	
Predation	Land Use / Introductions										6e					
	Hatchery Management															
Competition	Land Use / Introductions															
	Hatchery Management										4a					
Population Traits	Hatchery Management															**3a**
	Harvest															

<u>Habitat Access</u>

Impaired downstream passage at Middle Fork Willamette dams (1f).

Flood Control/Hydropower Management. <u>Key threat</u>: CHS smolts

Chinook smolts die while passing through turbines or because they are unable to locate downstream passage at dams and become trapped in the reservoirs.

Impaired adult access to habitat above Middle Fork Willamette dams (2e).

Flood Control/Hydropower Management. Key threat: CHS adults

Dexter, Lookout Point and Hills Creek dams were built without upstream fish passage facilities and block access by adults to an estimated 80% of the historical production area for Chinook (USACE 2001, cited in WRI 2004). ODFW began trucking adult Chinook trapped at Dexter Dam to above Hills Creek Reservoir in 1993 and later expanded the program to include areas above Lookout Point Reservoir.

Fall Creek Dam is also a barrier to fish movement. A trapping facility is in place but upstream migrants may experience abrasion, mechanical injury, and stress, and experience delay in migration and disease when water temperatures are above maximum (WRI 2004).

Impaired adult access and altered hydrology (2m).

Flood Control/Hydropower Management. Key threat: CHS adults

Prespawning mortality occurs due to crowding and high water temperatures below Middle Fork Willamette dams.

Physical Habitat Quality

Impaired food web. Reduced macrodetrital input in the estuary due to Columbia Basin hydropower reservoirs, and disposal of dredge material (5a).

Flood Control/Hydropower and Land Use Management. Key threat: CHS parr and smolts

Reduced macrodetrital-based input in the Columbia River estuary affects viability of the Middle Fork Willamette Chinook population. The limiting factors are the same as those discussed for Clackamas Chinook in Section 5.4.1.

Impaired food web. Increased microdetrital input in the estuary due to Columbia Basin hydropower reservoirs (5b).

Flood Control/Hydropower Management. Key threat: CHS juveniles

The estuary's current food web is microdetrital-based, made up of decaying phytoplankton delivered from upstream reservoirs. The limiting factors are the same as those discussed for Clackamas Chinook in Section 5.4.1.

Impaired gravel and large wood recruitment due to Middle Fork Willamette flood control facilities (7f).

Flood Control/Hydropower Management. Secondary threat: CHS eggs/alevin

The physical presence of Dexter, Lookout Point, Hills Creek and Fall Creek dams reduce transport and delivery of large wood and gravel to downstream reaches. Because the dams capture material in their reservoirs, delivery of large wood to the lower Middle Fork Willamette River is blocked from 90% of the subbasin (USACE 2001, cited in WRI 2004). Loss of gravel recruitment has reduced suitable spawning areas. In addition, the effect of flow management limits the erosional sourcing and distribution of these materials from floodplain reaches below these facilities.

Streambed coarsening due to reduced peak flows (7g).

Flood Control/Hydropower Management. Secondary threat: CHS eggs/alevin

Flood control operations reduce peak flows, and the resulting frequency of large magnitude flows is not sufficient to create and maintain channel complexity and to provide nutrients, organic matter, and sediment inputs from floodplain areas (WRI 2004). Resulting losses in abundance and distribution of gravels, small cobbles, and large wood (particularly in large jams) have reduced habitat for juvenile rearing.

Impaired sediment/sand routing (7h).

Flood Control/Hydropower Management. Key threat: CHS juveniles

Impaired physical habitat quality in the estuary due to changes in sediment and sand routing has a key impact on Middle Fork Willamette Chinook. The limiting factors are the same as those discussed for Clackamas Chinook in Section 5.4.1.

Impaired habitat complexity/diversity, off-channel habitats (8a).

Land Use Management. Key threat: CHS winter parr (tributaries), CHS parr, smolts (mainstem Willamette); Secondary threat: CHS fry and summer parr (subbasin); CHS parr (mainstem Willamette); CHS juveniles (estuary)

Subbasin: Loss of habitat complexity and diversity in the Middle Fork Willamette River system has a key effect on the Middle Fork Willamette Chinook population during the winter parr life stage. The historical removal of large wood from tributary streams and degradation of riparian vegetation have interacted to reduce the quantity and distribution of large wood in the river and tributaries. Limited wood in the river and tributary channels limits the formation of pools, thus reducing the quality and quantity of juvenile rearing habitat (WRI 2004).

Loss of connectivity to historical floodplains also reduces habitat quality for Chinook. Revetments line half of the lower eight miles of the Middle Fork Willamette, which limits habitat complexity. Lower river reaches have lost sinuosity, side-channel length, alcoves, and gravel bars.

The lower subbasin contains only a small fraction of the original floodplain forest. Remaining floodplain forests are interspersed with areas of farmland, pastureland, highways, residences and other development. Roads next to stream channels have increased channel confinement and reduced riparian vegetation and canopy cover. As a result of these land alterations, riparian vegetation within 100 feet of the small tributaries of the lower Middle Fork Willamette is generally in poor condition. Changes in riparian canopy cover have increased summer high water temperatures on some tributary streams (WRI 2004).

The mainstem Willamette River and Middle Fork Willamette basin supports spring Chinook at various life stages throughout the entire year. Habitat degradation in the mainstem Willamette and Middle Fork affects rearing potential and migration characteristics for Middle Fork Willamette Chinook parr and smolts. Juveniles also use Westside tributaries for rearing, and habitat degradation in these drainages can limit this use.

Estuary: In the Columbia River estuary, many once important habitat areas have been affected by land and water management activities. Along the lower Columbia, complex habitats have been modified through channelization, diking, development and other practices. Physical habitat quality in the lower Willamette River has also been reduced through land use practices. The limiting factors in the estuary are the same as those discussed for Clackamas Chinook in Section 5.4.1.

Flood Control/Hydropower Management. Key threat: CHS juveniles.

The limiting factors are the same as those discussed for Clackamas Chinook in Section 5.4.1.

Water Quality / Quantity / Hydrograph

Water Quality. Elevated water temperature from land uses (9a).

Land Use Management. Secondary threat: CHS summer parr in subbasin and CHS juveniles in estuary

Reduced habitat quality, including changes in riparian canopy cover, contributes to increased water temperatures in some Middle Fork Willamette tributaries. Maximum temperatures for adult Chinook migration have been exceeded in the Middle Fork Willamette River and Fall Creek below the dams, the upper Middle Fork Willamette River above Hills Creek Reservoir, Salt Creek, the North Fork of the Middle Fork Willamette, Lost Creek, Fall Creek above Fall Creek Dam, and other tributaries.

Water quality. Elevated water temperatures due to flow alterations at dams (9f).

Flood Control/Hydropower Management. Key threat: CH eggs/alevin

Reduced flows below the Middle Fork Willamette dams during spring result in increased water temperatures in the mainstem Willamette. Premature hatching of eggs and emergence of Chinook fry due to high water temperatures below the dams in the fall are key impacts on population viability.

Water Quality. Toxins from agricultural sources (9h).

Land Use Management. Key Threat: CHS parr and smolts in mainstem Willamette; Secondary threat: CHS juveniles in subbasin and estuary, adults in mainstem Willamette

Contaminants from agricultural practices found throughout the Columbia River estuary pose a threat to Middle Fork Willamette Chinook. The limiting factors are the same as those discussed for Clackamas Chinook in Section 5.4.1.

Water Quality. Toxins from urban and industrial sources (9i).

Land Use Management. Key threat: CHS parr and smolts in mainstem Willamette; Secondary threat: CHS juveniles in subbasin and estuary, adults in mainstem Willamette

Toxic contaminants from urban and industrial practices reduce habitat quality for Chinook parr and smolts. The limiting factors are the same as those discussed for Clackamas Chinook in Section 5.4.1.

Water Quality. Elevated water temperatures due to reservoir heating (9j).

Flood Control/Hydropower Management. Secondary threat: CHS parr and smolts

Elevated water temperatures in the estuary due to reservoir heating in Columbia Basin pose a secondary threat to Middle Fork Willamette Chinook. The limiting factors are the same as those discussed for Clackamas Chinook in Section 5.4.1.

Hydrology/water quantity. Altered hydrology; reduced peak flow (10d).

Flood Control/Hydropower Management. Key threat: CHS fry and parr in subbasin, CHS parr and smolt in mainstem Willamette

Dam operations alter downstream flow regimes. Elevated flows to draft the reservoirs in preparation for flood control season occur in the fall during spawning. Reduced flows after drawdown if the fall is dry or during flood control operations can dewater redds. Flow fluctuations can occur at rates rapid enough to entrap and strand juvenile anadromous fish (WRI 2004).

Hydrology/water quantity. Altered hydrology (10f).

Flood Control/Hydropower Management. Key threat: CHS parr and smolts

Management of the Columbia River hydro system alters the timing and magnitude of spring freshets, and impairs estuarine habitat quality and access. The limiting factors are the same as those discussed for Clackamas Chinook in Section 5.4.1.

Predation

Predation by non-native fish species (6b).

Land Use Management, Hatchery Management, and Species Introductions. CHS juveniles in the estuary

In the estuary this threat is the same as described for Clackamas Chinook in Section 5.4.1.

Predation by birds in the estuary (6e).

Land Use Management. Secondary threat: CHS juveniles

Modification of estuarine habitats has increased the number and/or predation effectiveness of Caspian terns, double-crested cormorants, and a variety of gull species in the Columbia River estuary (LCREP 2006; Fresh et al. 2005). The limiting factors are the same as those discussed for Clackamas Chinook in Section 5.4.1.

Competition

Competition with hatchery fish in the estuary (4a).

Hatchery Management. Secondary threat: CHS juveniles

Competition with hatchery fish from all Columbia River hatcheries for limited habitat and food supplies in the Columbia River estuary affects productivity of Middle Fork Willamette Chinook. The limiting factors are the same as those discussed for Clackamas Chinook in Section 5.4.1.

Population Traits

Loss of Population traits due to hatchery fish interbreeding with wild fish on spawning grounds (3a).

Hatchery Management. Key threat: CHS spawners

The small number of naturally-produced Chinook in the Middle Fork Willamette (the population was considered extirpated by ODFW) coupled with the preponderance of hatchery fish in the naturally spawning population represents a key concern to the population’s viability. The Willamette Hatchery Chinook program increases the number of spawners downstream and upstream of Dexter Dam and in Fall Creek. Interbreeding between hatchery Chinook and natural origin spawners alters the genetic characteristics of the wild population.

Chapter 6: Delisting Goals, Criteria and Scenarios

Chapter 6 describes scenarios in which the desired status of individual Chinook salmon and steelhead populations combine to achieve the desired status (delisting goals) of the ESU and DPS, and an approach to achieving the desired status through threat reductions. The chapter outlines a set of threat reduction options (scenarios) that illustrate how to achieve these population goals. As noted in Chapter 3, this Plan recommends recovery goals that are believed to be consistent with ESA delisting. As noted in Chapter 3, this Plan has two broad recovery goals, and therefore different levels of desired status:

1. an ESU-level desired status that is consistent with ESA delisting of an ESU (see details of NMFS delisting framework and criteria in Chapter 1).
    a. Tiered within this desired status for the ESUs, this Plan also identifies desired statuses for individual populations within the context of this broader ESU delisting goal, as described in this chapter.
2. a level of desired status for individual populations that is consistent with the State of Oregon's vision of broad sense recovery. A description of Oregon's broad sense recovery vision and approach is described in Chapter 10 of this Plan

In the first section of this chapter we describe an ESU-level desired status scenario, consistent with viability criteria for a viable ESU (see Chapter 3 regarding delisting criteria in an ESA framework for each ESU). Since a viable ESU can consist of different combinations of populations at different risk levels, this section also identifies one example of how the desired status for individual populations could combine to meet the desired status scenario for the ESU. We also assume that achieving some combination of viable populations (as outlined by the WLC-TRT viability criteria; McElhany et al. 2003) would meet the biological criteria for an ESU to be evaluated within the context of an ESU delisting decision. Given that the population extinction risk analyses were based on biological criteria and summarized in units of extinction risk based on the VSP parameters (Chapter 4), a population's desired status was also defined in terms of extinction risk. For the threat criteria it was assumed that the Limiting Factors and Threats assessment (Chapter 5) characterized sufficiently the factors impeding viable populations.

In the second section of this chapter, two independent approaches are used to analyze population-level demographic parameters within an extinction risk framework. The first approach used the conservation gaps developed in Chapter 4 to establish some VSP recovery targets, and applied some threat reduction scenarios to portray ways to functionally achieve a desired status for a population. The analyses did this by combining the LFT organizational framework (Chapter 5 LFTs) with classes of key actions (Chapter 7) that address specific LFTs. The major objective of these population-specific threat reduction scenarios was to conceptualize how a suite of actions addressing LFTs could recover a population to a desired status that is founded on VSP criteria. The scenarios help scope the likelihood of actually achieving desired status for a population, based on an understanding of the types of actions (and their relationships) that would reduce the impact of specific LFTs.

The second approach used an analytical platform from the Species Life-cycle Analysis Modules (SLAM, developed by NOAA's Northwest Fisheries Science Center - NWFSC) to provide a more explicit analysis of life stage demographic parameters. SLAM was used in this Plan as a provisional cross test of the threat reduction scenario analyses, where improvements in limiting factors are modeled with population dynamics in explicit life stages to produce levels of extinction risk. This analysis is designed to add to the "weight of evidence" that the overall approach to achieving desired status for populations is sound.

6.1 Scenario Options for Meeting Biological Delisting Goals and Criteria

The WLC-TRT viability criteria for a viable ESU and DPS as outlined in Chapter 3 and detailed in the WLC-TRT report (McElhany et al. 2003) provided the framework for how to meet the desired status of the ESU/DPS, by considering the desired risk statuses for individual populations. Therefore the desired status for individual populations in the following population sections represents a desired status for a population within the broader ESU and DPS viability context and delisting goals. Table 6-1 presents some options/combinations of UWR population statuses (expressed as risk classes and scores; see Chapter 4) that could be used to meet an ESU/DPS-level desired status of biological viability for the Chinook salmon ESU and steelhead DPS

Chinook

The desired status of each UWR Chinook population for ESU desired status (meeting ESU biological viability goals) is shown under "ESU Scenario 1" in Table 6-1. Although some of the other ESU scenarios were discussed with the Planning and Stakeholder teams, Scenario 1 represented the most balanced approach given limitations in some populations. The approach in this Plan to achieve ESU delisting of UWR Chinook salmon is to recover the McKenzie (core and genetic legacy population) and the Clackamas populations to an extinction risk status of very low risk (beyond minimal viability thresholds), to recover the North Santiam and Middle Fork Willamette populations (core populations) to an extinction risk status of low risk, to recover the South Santiam population to moderate risk, and improve the status of the remaining populations from very high risk to high risk.

Steelhead

The desired status of each UWR steelhead populations for DPS viability goals is shown under "ESU/DPS Scenario 1" in Table 6-1. The most current PVA simulations of biological viability criteria indicated this DPS as viable, and for DPS delisting purposes it is assumed that what remains is to address the threats criteria. This Plan's approach to ESU delisting of UWR steelhead is to assure no population has a higher extinction risk than currently, and to maintain or improve all core populations and one non-core population to a viable level. To the extent that actions that benefit UWR Chinook salmon will also increase the viable abundance/productivity and spatial structure parameters for steelhead, it s projected that most or all steelhead populations could achieve a very low risk level.

Table 6-1. A summary of different combinations of population-level desired statuses (expressed as extinction risk classes and scores based on VSP criteria; see Chapter 4 for scoring thresholds), to meet ESU/DPS **-level desired status based on** ESU/DPS **viability criteria (see Chapter 3 for the ESU delisting criteria).** ESU/DPS **scenario 1 (shaded) was chosen as the** ESU/DPS **-level desired status goal for this Plan. * indicates core population, and ** indicates genetic legacy population.**

Population	Current Extinction Risk-all VSP factors (score)	ESU Scenario Options for meeting UWR ESU viability criteria				
		1	2	3	4	5
Chinook						
Clackamas*	Moderate (2)	Very Low (4)	VL (4)	VL (4)	VL (4)	VL (4)
Molalla	Very High (0)	High (1)	H (1)	H (1)	VH (0)	VH (0)
North Santiam*	Very High (0)	L (3)	L (3)	L (3)	L (3)	L (3)
South Santiam	Very High (0)	M (2)	L (3)	L (3)	L (3)	H (1)
Calapooia	Very High (0)	H (1)	H (1)	H (1)	VH (0)	H (1)
McKenzie**	Low (3)	VL (4)	VL (4)	VL (4)	VL (4)	VL (4)
MF Willamette*	Very High (0)	L (3)	L (3)	M	L (3)	L (3)
N of viable Pops.	1	4	5	4	5	4
ESU Average Score	0.71	2.57	2.71	2.43	2.43	2.29
N of Viable Core pops.	1	4	4	3	4	4
Steelhead						
Molalla	L (3)	VL (4)	L (3)			
North Santiam*	L (3)	VL (4)	L (3)			
South Santiam*	L (3)	VL (4)	VL (4)			
Calapooia	M (2)	M (2)	L (3)			
N of viable Pops.	3	3	4			
DPS Average Score	2.75	3.5	3.25			
N of Viable Core pops.	2	2	2			

6.2 Threat Reduction Scenarios for Meeting Goals and Criteria

This section describes the development by ODFW of the population-level threat reduction and VSP scenarios that illustrate how to achieve the population-level desired statuses that were chosen under ESU-level desired status Scenario 1 in the previous section. This section also describes how scenario projections were evaluated with another viability model.

6.2.1 Methods

This section, along with Section 6.3, describes the technical approaches ODFW used to create the recovery scenarios that form the overall game plan for recovery of the UWR Chinook salmon ESU and steelhead DPS. We describe the specific scenarios in Section 6.2.2

To provide a logical framework for how threat reductions are manifested into different levels of reduced extinction risk, we partitioned the broad threats identified in Chapter 5 into sub-categories for which there was a reasonable assumption we could assign some index of current impact on abundance and productivity (A/P). The broad threats identified in Chapter 5 each had multiple limiting factors, had overlapping impacts on life history stages, and had potential cumulative and interactive effects on population viability. In addition, for many populations there were no life-stage specific data, and there was uncertainty of unknown magnitude for many population parameters and threat rates. Given these limitations, the threat categories chosen for our Scenario Analysis do not match the threat categories identified in Chapter 5. We refined this threat characterization by making sub-categories within a threat category, based on a significant life-stage or geographic area where an LFT was thought to have the most impact, and how it roughly corresponded to the entities that would implement actions to address a limiting factor. We ended up with ten sub-categories (Table 6-2), which to each was assigned estimates of current mortality rates, which was our index of current impact on A/P. Table 6-3 shows how the Chapter 5 threat categories were encompassed by the threat subcategories used for the threat reduction scenarios.

Table 6-2. Partitioning of Chapter 5 broad threat categories into subcategories for finer resolution of impact rates and to refine the association with threat reductions.

Broad Threat Categories	Threat Subcategories
Flood Control/Hydropower Management	Spawner Access Juvenile Passage Spawner Habitat Juvenile Habitat
Land Management	Freshwater Habitat Estuary Habitat
Other Species Management	Other Species-predation
Harvest Management	Harvest
Hatchery Management	Juveniles- competition Spawners

Table 6-3. The relation of Chapter 6 threat categories used for the Scenario Analysis to the threat categories used in Chapter 5. Chapter 6 subcategories are in capital letters and unique fill colors within the table. Black cells indicate that the threat for that life stage cannot exist or was not identified as a threat in Chapter 5.

		Life Stage									
	Threat Categories in Chapter 5	Egg / Alevin	Fry	Summer Parr	Winter Parr	Out of Basin Parr	Smolt	Sub adult	Adult	Spawner	Kelt
Natal Subbasins	Harvest Management									HARVEST	
Natal Subbasins	Flood Control/Hydro Management	JUVENILE HABITAT CONDITIONS							SPAWNER HABITAT CONDITIONS		PASSAGE
Natal Subbasins	Flood Control/Hydro Management		JUVENILE PASSAGE							SPAWNER ACCESS	
Natal Subbasins	Hatchery Management		HATCHERY-juvenile competition							HATCHERY-genetics	
Natal Subbasins	Hatchery Management		OTHER SPECIES-fish predation								
Natal Subbasins	Land Management (Non Hydro)	FRESHWATER HABITAT							FW HABITAT		
Natal Subbasins	Other Species		OTHER SPECIES-fish predation								
West Side Tributaries	Harvest Management										
West Side Tributaries	Flood Control/Hydro Management										
West Side Tributaries	Hatchery Management										
West Side Tributaries	Land Management (Non Hydro)	FRESHWATER HABITAT							FW HABITAT		
West Side Tributaries	Other Species										
Mainstem Willamette (above Will. Falls)	Harvest Management								HARVEST		
Mainstem Willamette (above Will. Falls)	Flood Control/Hydro Management		JUVENILE HABITAT CONDITIONS-out of basin effects								
Mainstem Willamette (above Will. Falls)	Hatchery Management										
Mainstem Willamette (above Will. Falls)	Land Management (Non Hydro)	FRESHWATER HABITAT							FW HABITAT		
Mainstem Willamette (above Will. Falls)	Other Species										
Estuary	Harvest Management								HARVEST		
Estuary	Flood Control/Hydro Management					JUVENILE HABITAT CONDITIONS-out of basin effects					
Estuary	Hatchery Management					HATCHERY-juvenile competition					
Estuary	Land Management (Non Hydro)					ESTUARY HABITAT					
Estuary	Land Management (Non Hydro)					OTHER SPECIES-bird and fish predation					
Estuary	Other Species										
Ocean	Harvest Management							HARVEST			
Ocean	Flood Control/Hydro Management										
Ocean	Hatchery Management										
Ocean	Land Use Management (Non Hydro)										
Ocean	Other Species										

In Chapter 4, abundance targets and conservation gaps at different extinction risk level were defined with a CATAS model, and those targets were used in threat reduction scenarios to help evaluate the extent to how much the threats should be reduced to meet these VSP targets. CATAS simulations established the increases in adult abundance for a population to achieve particular extinction risk levels (e.g., high, medium, low, or very low), therefore the conservation gap is the difference between a population's current modeled abundance and the abundance needed to achieve a desired level of extinction risk. Although CATAS functions to decrease extinction risk with increases in survival, conversely, closing conservation gaps to achieve desired risk levels for each population can be accomplished with mortality reductions.

We have extended the currency of a conservation gap and the VSP principles to the threat reduction scenarios below, where scenarios are essentially an heuristic approach to show how the threats could be reduced in a systematic fashion, based on professional opinion. This coupling of addressing the biological *and* threats criteria discussed in Chapter 3 is referred to as the "Scenario Analysis". The major objective of these population-specific threat reduction scenarios was to formulate how a suite of actions addressing LFTs could recover a population to a desired status that is founded on VSP criteria. The scenarios help scope the likelihood of actually achieving desired status for a population, based on an understanding of the types of actions that would reduce the impact of specific LFTs. Note that the simplicity of this approach and the treatment of threats are based on assumptions that all of the threats are density independent and act in some way on separate life stages or sequential groups of fish. In this analysis, we have accepted these simplifying assumptions in order to set some guidance for how to implement actions necessary to achieve desired statuses. We have tested the basic validity of this approach by using a more complicated model (SLAM, below) that allows for density dependence and life stage-specific mortality to compare the results of the Scenario Analysis.

The Scenario Analysis provides simple quantification of mortality influencing the A/P VSP criteria by LFT category, allowing a rapid assessment of different threat reduction hypotheses for achieving different extinction risk levels. For spatial structure and diversity VSP parameters there are no analogous PVA-derived numerical goals for different risk level conservation gaps. For the diversity parameter it was assumed that many diversity elements are partially determined by abundance, and the dominant threat to diversity is the impact of hatchery strays on genetic diversity. We concur with the WLC-TRT that viable populations would have low hatchery genetic influence, and based on the guidelines for the porportion of hathery fish spawning with wild fish (pHOS) in McElhany et al. (2007) we have adopted the following levels for the pHOS: If the overall desired status goal for a population is low risk or very low risk, then in addition to meeting the abundance and productivity targets for this designation, the diversity target is achieving an average pHOS of ≤10%, regardless of their spawn timing. Likewise, if the recovery goal risk category for a population is 'moderate' then the target average pHOS is ≤ 30%. Chapter 8 outlines the RME approach for assessing the proportion of naturally spawning hatchery fish (pHOS) in the future.

It was assumed that spatial structure attributes would be improved to viable levels principally by fish passage actions that resulted in significant access to and production within previously blocked habitat. It was also assumed that if the abundance and productivity risk level goals were met, they would augment the spatial connnectivity of a population to the extent that spatial structure risk is aligned with those of abundance and productivity.

The UWR Planning Team evaluated 1) the approach for assigning impact (mortality) rates within the ten threat subcategories, 2) what current impact rate to assign to each subcategory, and 3) what would be the assumptions regarding feasible reductions in those rates. Ultimately the evaluation process was constrained by uncertainty in impact rates for some of the subcategories, and what would be feasible improvements in some of the freshwater habitat impacts. The consensus of the Team was that the scenarios should be used to scope how reducing a few large impacts, using a range of impact values, would “close” a conservation gap. These adjustments were made and when feasible habitat impact reductions were considered, it resulted in very few scenario options. These options were presented to the Stakeholder Team to illustrate societal tradeoffs in threat reductions. The results are the threat reduction scenarios and choices below, which illustrate options for reducing anthropogenic threats to ESA-listed salmonids across several threat categories to achieve a desired risk class for individual populations, based on achieving a viable ESU.

A comprehensive evaluation of population status should also include an examination of the threats facing the population with an emphasis on future environmental conditions. As noted in Lindley et al. (2007), natural climate variability can have a large influence on whether viability criteria are being met. For example, the viability criteria we have proposed may not be protective enough if unfavorable climatic conditions persist over long periods. In addition, poor climatic conditions may mask actual improvements in the LFTs, and could curb the future efforts of implementers and the larger society. Conversely, prolonged periods of favorable climatic conditions may lead to greater population health and the achievement of A/P viability criteria, when in fact, serious problems remain with some LFTs. Therefore, understanding future climatic trends and conditions is necessary to address the stationarity assumption inherent in a biological factor analysis. This assumption would be violated if future environmental conditions were different from the recent past (where “environment” is defined broadly to include anything affecting salmonids). In developing the scenario analysis we did not conduct an assessment of likely future environmental conditions and their projected impacts on population biological status. Instead, we largely relied on the stationarity assumption[60], but made some precautionary adjustments to the abundance conservation gaps as a way of providing a buffer for these likely future impacts. For example, although there is uncertainty regarding the magnitude of the future effects of climate change and human population growth on these salmonid populations, we assume it will be negative. Therefore for each population we have provisionally embedded a conservation buffer in the scenarios by increasing the conservation gap mean abundances by 20%[61].

We reiterate that there is a fair amount of uncertainty in each mortality rate estimate assigned, as well as in the associated "conservation gaps" obtained from CATAS. In many cases values used in analyses were derived without strong empirical data, there is the potential for inaccurate assumptions, the potential for qualitative opinions to propagate uncertainty, and the potential for inter-related analyses to compound uncertainty. RME (Chapter 8) applied within an adaptive management framework (Chapter 9) will be used to reduce uncertainty and refine recovery actions as appropriate in the future. As noted earlier, in practical terms the adaptive management component of this Plan with review of regular population status updates allows evaluation of such potential future threats in a timely manner and subsequent revisions of recovery actions as needed.

Developing a Total Cumulative Mortality Expression and Assigning Current Impact Rates to Freshwater Habitat

The first step in developing threat reduction scenarios for the Scenario Analysis was to assign a current impact for each threat subcategory in Table 6-2. We chose to aggregate and characterize the subcategory

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[60] A “stationarity assumption” is that the recent past is a reasonable predictor of future fish performance

[61] The 20% increase in the abundance goal for each conservation gap was chosen as a temporary approach to address population growth and climate change. It is currently not possible to accurately estimate the level of productivity loss, if any, that steelhead populations will experience due to these factors. The 20% increase was added to ensure that an increasing trend in population health would occur at the initial implementation of the recovery Plan and allow for the science related to identifying the impacts of these factors to evolve. Once a more accurate estimate of the impacts of population growth and climate change can be made, it will be possible to adjust the scenario goals in the Recovery Plan.

impacts as mortality estimates. The cumulative mortality of the subcategory threats represents an anthropogenic mortality rate that is used to calculate the difference between a population's modeled current abundance (from stock-recruitment simulations; Chapter 4) and an estimate of abundance prior to European-derived impacts (historical abundance). With impact rates established for each threat category, reductions in them were evaluated to achieve the CATAS-derived abundance targets for a desired status risk level.

We used the following expression to represent a cumulative mortality impact from different mortality sources.

TCM = 1-((1-SAM)x(1-JHM)x(1-SHM)x(1-FWHM)x(1-EHM)x(1-OSM)x(1-HM)x(1-JCM)x(1-HFM))[62]

where: TCM = total cumulative mortality = current abundance/historic abundance

SAM = mortality associated with spawner access

SHM = mortality associated with spawner habitat conditions

JHM = mortality associated with juvenile habitat conditions due to flood control/hydro

FWHM = mortality associated with freshwater habitat conditions (non flood control/hydro)

EHM = mortality associated with estuary habitat conditions

OSM = mortality associated with other species

HM = mortality associated with harvest

JCM= mortality associated with juvenile competition

HFM = mortality associated with hatchery fish

We obtained estimates of historical abundance for the ESU and DPS from NMFS status reviews and the WLC-TRT documents. To obtain estimates of the historical abundance of individual Chinook populations we multiplied the Mattson's (1948) relative proportions of fish migrating over Willamette Falls and the WLC TRT's estimate for the ESU. For steelhead we used Howells et al. (1985) estimate of relative proportions and multiplied those by the WLC-TRT ESU estimate of historical run size. These steps apportioned the ESU/DPS abundance estimate between populations.

We were able to develop reasonable impact estimates of all the variables except the JHM and FWHM terms (see details below). Because we had little or no information on the current impact of freshwater habitat alterations, we assigned the current freshwater habitat impact as the remaining difference between the current modeled abundance and historical abundance after the other threat category impacts were removed (likewise, because of the lack of habitat-based data for most populations, a modeled approach was not used to determine whether specific habitat-based actions would provide the desired improvements in this area. Instead, professional judgment was used in this area to assess whether the proposed type, location, and amount of actions would achieve the desired statuses). The main assumption of this approach is that the difference in abundance from historic to current conditions is equal to the cumulative impact of all the threat subcategories. For example, a population with a current abundance that is 40% of historic abundance has lost 60% of its historic abundance. This 60% loss represents a cumulative impact to the survival of the population across all threat subcategories. The TCM equation was used to explore some test values for these two terms simultaneously. However, in the end, there was no clear basis to assign different values to these terms so the JHM and FWHM were assigned the same value, and both were used as separate terms in the TCM calculation. By equally adjusting these values in

[62] For the TCM equation there is no term for current mortality impact from lack of downstream passage (JPM in following tables). It was assumed that lack of spawner access above large flood control/hydropower projects precluded production of naturally produced juveniles, and that total above-barrier mortality was included in the spawner access category. Therefore the Juvenile Passage Mortality term (JPM) was combined with SAM in the TCM equation.

the TCM equation so that that TCM matched the current modeled abundance, we thereby obtained estimates of mortality associated with these freshwater habitat threats under current conditions (Table 6-4).

Table 6-4. Estimates for UWR Chinook and steelhead current and historical abundances, total cumulative mortality, estimated mortality rates, and calculated threat rates. Estimates include population current abundances based on modeled baseline (current) conditions (from Chapter 4), historic abundances, total cumulative mortality under current baseline conditions (current abundance / historic abundance), and estimates of mortality rates for threat subcategories based on analyses of available data ("known"). The calculated threat rate for freshwater habitat is partitioned between tributary habitat impacts due to flood control/hydropower on juvenile life stages, and tributary and mainstem Willamette River habitat impacts due to other land management impacts. See equation above for detail of acronyms.

				"Known" Mortality (threat) Rate								Calculated Threat Rate	
				Flood Control/Hydro			Land Use	Other Species	Harvest	Hatchery			
Population	Current Modeled Abundance	Historic Abundance	TCM (Cumulative Mortality)	SAM	Juvenile Passage	SHM	EHM (Juveniles)	OSM (adults and Juveniles)	HM (Adults)	JCM	HFM	JHM	FWHM
Chinook													
Clackamas	1,371	27,673	0.95	0.27	---	---	0.10	0.12	0.25	---	0.33	---	0.83
Molalla	0	13,750	1.0	0.00	---	0.00	0.10	0.16	0.25	0.05	0.95	0.00	1.00
N Santiam	0	56,100	1.0	0.71	---	0.60	0.10	0.17	0.25	0.05	0.90	0.97	0.97
S Santiam	1	37,400	>0.99	0.85	---	0.30	0.10	0.17	0.25	0.05	0.90	0.95	0.95
Calapooia	0	9,500	1.0	0.00	---	0.00	0.10	0.16	0.25	0.05	0.95	0.0	1.00
McKenzie	4,885	110,000	0.96	0.25	---	0.10	0.10	0.18	0.25	0.05	0.35	0.56	0.56
MF Will.	0	57,750	1.0	0.95	---	0.80	0.10	0.16	0.25	0.05	0.95	0.87	0.87
Steelhead													
Molalla	2,443	77,000	0.97	0.00	---	0.00	0.10	0.16	0.16	0.05	0.19	0.00	0.94
N Santiam	3,671	75,240	0.95	0.48	---	0.00	0.10	0.17	0.16	0.05	0.14	0.57	0.57
S Santiam	2,701	50,160	0.95	0.18	---	0.00	0.10	0.17	0.16	0.05	0.04	0.66	0.66
Calapooia	415	17,600	0.98	0.00	---	0.00	0.10	0.16	0.16	0.05	0.19	0.00	0.96

As an initial cross check for this approach to determining the impact of anthropogenic alterations to freshwater habitat, we compared our McKenzie River Chinook estimates to those estimated by summarizing the current and historic habitat potential in a draft Ecosystem Diagnosis and Treatment (EDT) analysis, reported in a draft Willamette Subbasin Plan (NPCC 2004). Preliminary EDT from that report noted that the current habitat potential is estimated about 18% of that under the reference (historic) habitat conditions. For purposes here it was assumed this also represents an 82% habitat mortality impact due to human influence. In the Scenario Analysis using the TCM equation above, we entered our best assumptions about other sources of mortality and the current abundance estimates, then solved the equation to find the estimated mortality impacts for JHM and FWHM, which were 56% for the McKenzie. Multiplicatively combining these two sources yielded a total freshwater habitat impact of 80%, a very close approximation to the EDT result (Table 6-5; 98% agreement). In addition, our comparison to EDT for Clackamas yielded a 92% agreement. In the absence of a more comprehensive method to determine freshwater impact rates, it is acknowledged there is potentially large uncertainty surrounding the impact of freshwater habitat conditions. One concern that emerged in light of comments received is that the process described above can produce a result that the JHM and FWHM multipliers (0.97) overshadow other potential sources of mortality. This could lead to the potentially erroneous conclusion that eliminating one or more of the other sources of mortality would have no significant beneficial effect on survival. For this reason, it is important to underscore the potential for misinterpretation of these model results.

Table 6-5. Comparison of mortality rates attributable to anthropogenic impacts on freshwater habitat as estimated by our Scenario Analysis and EDT.

Population	Current Threat Estimate	EDT estimate	Percent Agreement
Clackamas Chinook	84%	77%	92%
McKenzie Chinook	80%	82%	98%

Assigning Current Impact Rates with Mortality Estimates

The impact rates under current conditions for each threat subcategory and population were based on the information below.

Flood Control/Hydropower Management

Subcategory: Spawner Access

For populations where spawner access to historic habitat was limited by large flood control/hydropower facilities, we assumed the proportion of historic habitat blocked by these projects bore a 1:1 relationship with loss of production capacity, which by extension could be used as a mortality estimate for the flood control/hydropower impact for this life stage. Thus if a facility blocked 70% of the historic spawning habitat, we assumed a 70% mortality rate associated with lack of spawning access. We assumed that by providing access to these habitats the *loss of capacity* impact would be reduced by actions addressing pre-spawning mortality associated with providing spawner access, and by actions to reduce mortality of juveniles as they migrate downstream in the flood control/hydro system. Table 6-6 summarizes some estimates of the amount of freshwater habitat lost due to blockage by flood control/hydropower facilities for populations. For the current mortality rate for Chinook for this subcategory, we used the percent of historic production lost from dams as reported it the WP BiOp (NMFS 2008a; but see footnotes in Table 6-6 for modifiers to these estimates). For steelhead there were no pre-dam estimates of historic production lost, so we used the estimates based on the intrinsic potential method (IP) in Table 6-6.

Table 6-6. **Estimates of % historically available habitat (intrinsic potential, IP) blocked by mainstem hydro/flood control facilities, estimate of historic production lost, and estimate of current potential spawning habitat conditions. Numbers in parentheses for McKenzie and MF Willamette are IP proportions corrected for proportion of historic production. Bolded values are those used in analyses.**

	Intrinsic Potential (IP) Method		TRT Viability Report (2003)	WP BiOp (NMFS 2008a)	R2 Resource Consultants (2008, Table 6)
Population	% of Total IP above mainstem hydro/flood control facility	% of Total IP available above mainstem hydro/flood control facility with reservoir correction	% inaccessible habitat	% historic production lost from dams	Current Potential % Spawning Habitat above Dams
Chinook					
North Santiam *above Big Cliff*	43%	39%	42%[1]	**71%[2]**	72%
South Santiam *above Foster*	14%[8]	11%[8]	40%[1]	**85%[3]**	66%
McKenzie	19%[4]	16%	25%	**25%[5]**	Not assessed
above Leaburg	51%				
above Blue River	7%	5% (8%)			
above Cougar	9%	8% (12%)			
above Trail Bridge (including Smith Res)	4%	3% (5%)			
MF Willamette	71%	64%[7]	56%	**95%[6]**	94%
Falls Creek	17%	15% (22%)			
above Dexter (including Hills Creek)	56%	49% (73%)			
above Dexter (not including Hills Creek)	33%	29%			
Steelhead					
North Santiam *above Big Cliff*	**48%**	44%	46%[1]	No estimate	39%
South Santiam *above Foster*	**18%[8]**	15%	17%	No estimate	63%

[1] citing ODFW (2005) report
[2] citing Mattson (1948)
[3] direct from Mattson (1948)
[4] does not include Leaburg; includes Blue River, Cougar, and Trail Bridge Dams
[5] WP BiOp (NMFS 2008a) cites ODFW (2005) as 16% of historic habitat is blocked by dams, whereas Maher (2005) estimated a 25% loss.
[6] includes Fall Creek Dam as inaccessible
[7] above Falls Creek and Dexter total
[8] assumes Foster Dam is not an IP barrier

Subcategory: Juvenile Passage

For the Scenario Analysis we did not include an estimate of current mortality impact from lack of downstream passage. Rather, we assumed that lack of spawner access above large flood control/hydropower projects precluded production of naturally produced juveniles, and that total above-barrier mortality was included in the spawner access category. Under a threat reduction scenario where spawner access was restored and habitat above a dam was fully seeded, we factored in a range of juvenile passage survival estimates.

Subcategory: Spawner Habitat Conditions

This threat subcategory principally addressed pre-spawning mortality of Chinook salmon. In subbasins with flood control/hydropower facilities, a combination of factors may be contributing to this mortality. One likely factor is due to stress associated with large numbers of hatchery fish that comprise a large portion of the run. Their presence in high numbers might lead to crowding in limited holding areas or contribute to disease transmission. In addition, the effect of dam operations that produce cooler spring/summer water temperatures below dams may delay upstream migrations and contribute to this mortality. In subbasins without flood control/hydro facilities and without larger numbers of hatchery fish (Molalla and Calapooia populations), it was assumed pre-spawning impacts were principally a result of high summer water temperatures (resulting from lack of riparian shading and other land use effects) combined with a lack of deep holding pools, and harassment/poaching issues. Because of this, the pre-spawning threat for the Molalla and Calapooia basins were included in the freshwater land management category below.

As an estimate of this threat under current conditions, we used pre-spawn mortality estimates collected by ODFW over the last several years. There is a high amount of uncertainty associated with the pre-spawn mortality data (see details in Schroeder et al. 2007), but provisionally we have estimated current conditions in Table 6-7.

Table 6-7. Estimates of pre-spawning mortality of UWR Chinook salmon, used to model the current impact of this mortality source in subbasins with flood control/hydro facilities and large hatchery programs. It is assumed a principle cause of this mortality is flood control/hydro related effects on water quality and fish crowding below the facilities. Other potential contributors to pre-spawning mortality include crowding by large numbers of hatchery-origin fish, disease, parasites, toxic bioaccumulation, and loss of health due to being caught and released and attacked by pinnipeds.

Chinook Population	% Pre-spawn Mortality below dams
North Santiam	60%
South Santiam	30%
McKenzie	10%
Middle Fork Willamette	80%

Subcategory: Juvenile Habitat Conditions

Estimates for flood control/hydropower related habitat impacts (and in the following subcategory under Land Management: Freshwater Habitat) were not available for any of the populations, so we used a provisional back-calculation method to assign an impact for this subcategory. (See the *Total Cumulative Mortality and Assigning Current Impact Rates to Freshwater Habitat* subheading).

Land Management

Subcategory: Freshwater Habitat

We assumed that much of the impact due to the freshwater habitat threat was not related to flood control/hydro effects on habitat quality, but rather other land management practices that impact both adult and juvenile life stages in natal tributaries, and principally rearing habitat in the Willamette River mainstem and some Westside tributaries of the Willamette. Both juvenile and adult life stages are impacted by this freshwater habitat threat (see LFT assessment Chapter 5). There was no clear approach to assign impact estimates to this subcategory so we relied on a provisional back-calculation method to assign an impact for this subcategory (See the *Total Cumulative Mortality and Assigning Current Impact Rates to Freshwater Habitat* subheading).

Subcategory: Estuary Habitat

Based on information presented in Estuary Recovery Module (NMFS 2008b), the mortality rate for coho and steelhead passing through the Columbia River estuary was assumed to be 40% for yearly outmigrants, (coho, steelhead, and spring Chinook) and 50% for subyearling migrants (fall Chinook and chum salmon). This estimate includes both natural and human related sources of mortality. Since the focus of recovery efforts is on impacts caused by humans, mortality that occurred under pristine conditions was separated from the additional mortality associated with human impacts. We adapted the approach of Magnuson and Hilborn (2003), wherein the estuarine habitat condition in Oregon and Washington were classified in terms of the percentage of the estuary not impacted by human activity. For fall Chinook (an ocean type or sub-yearling species that spends less than a full year rearing in freshwater), Magnuson and Hilborn (2003) found a relationship between estuary survival rate and proportion of the estuary that was still in a natural state. This relationship predicted that an estuary with no natural habitat left would have a fall Chinook survival rate of only 30% relative to fall Chinook migrating through an estuary with no human impacts. This equates to 70% of the fall Chinook mortality resulting from human impacts in degraded estuaries.

The same study looked at coho (a stream type or yearling species) and found no relationship between the amount of an estuary in natural condition and survival rate. In interpreting these results for application to the Columbia estuary it was assumed that: 1) estuary habitat for the Columbia is more degraded than most estuaries examined by Magnuson and Hilborn (2003) and therefore could be viewed as having essentially no remaining natural areas; and 2) the impact of poor estuary habitat on coho probably exists, but perhaps below the level statistically detectable in the Magnuson and Hilborn (2003) study. Based on these assumptions we concluded that 70% of the mortality estimated for sub-yearling species for the Columbia was likely human related. For steelhead, and yearling Chinook we simply split the difference between the 70% impact rate and 0% to come up with a provisional estimate of 35% of the total mortality to be apportioned to human related impacts.

The human related mortality due to estuary habitat was estimated by:

1) $TEM = M_{total} * F_{human}$

Where TEM = total estuary mortality due to human related factors, M_{total} = total natural and human mortality rate, by species, as reported in the Estuary Module and F_{human} = fraction of total mortality that was human related as described above. Solving for Equation 1 results in an estuarine mortality rate due to human related impacts of 0.35 * 0.40 = 0.14 for steelhead and spring Chinook.

However, it was necessary to make an additional adjustment to these values because the total estuary mortality impacts reported in Estuary Module (i.e., 40% for yearlings and 50% for sub-yearlings) included the effects of predation on juveniles. Based on other studies as sources for the total impact of each predator class (Ward et al. 1995, Friesen and Ward 1999, Roby et al.

1998, LCFRB 2004, USACE 2005 and 2007b, USFWS 2005, Collis et al. 2007), we adjusted these rates downward to partition out the fraction of the impact that is of human origin. To do this we used the same fractions as for the habitat calculation (i.e., 0.35 for yearlings). Finally, these adjusted predation impacts were removed from the human related estuary habitat impacts using a multiplicative formula rather than a simpler, but incorrect mathematical approach of subtracting the predation impact. The net results of this removal are the final estimates for human related impacts for estuary habitat for steelhead and spring Chinook of 0.1.

Other Species

The principal impact on UWR Chinook and steelhead from other species is predation. In the estuary the predation impacts were basically a combination of the adjusted predation impacts that were partitioned out from the estuary habitat impact described for the subcategory "Estuary Habitat" above. Sources of predation are principally from terns, cormorants, and pikeminnow and the mortality impacts caused by pinniped predation. For pinnipeds, we assumed all of the mortality that occurred at Willamette Falls was human related, whereas for pinniped predation downstream from Willamette Falls we assumed that 50% of the estimated impact rate was natural and 50% related to changes due to humans. We assumed the predation impact due to migrating past Willamette Falls was equal to the impact of migrating past Bonneville Dam, so we applied the same base predation rate estimate as we used for the Hood River Chinook population in the Lower Columbia River Recovery Plan (~.16). We also assumed that some populations above Willamette Falls had additional freshwater predation due to anthropogenic influences, based on those identified in the Limiting Factors and Threats process. Since we had no estimates for these freshwater predation impacts, we multiplied the base estuary rate by factors between 5-20% (depending on population) to derive a freshwater predation term that could be added to the total predation equation. We combined these various sources of mortality in a multiplicative rather than additive fashion. To accomplish this, mortality rates were converted to survival rates (1 – mortality rate). These survival rates were then all multiplied times each other and the result subtracted from 1 to yield the combined predation impact rate. Table 6-8 summarizes the current predation rates used in this Plan.

Table 6-8. Estimated predation rates on UWR Chinook and steelhead used in Scenario Analysis to index the impact of the "Other Species" subcategory.

	Predation Mortality Rate	
Population	Chinook	Steelhead
Populations below Willamette Falls		
Clackamas	0.12	
Populations above Willamette Falls		
Mollala[1]	0.16	0.16
North Santiam[2]	0.17	0.17
South Santiam[2]	0.17	0.17
Calapooia[1]	0.16	0.16
McKenzie[3]	0.18	
Middle Fork Willamette[1]	0.16	

[1] Molalla and Calapooia CHS and STW, and MF Willamette CHS-rates are the same the Hood CHS population (0.16).

[2] North and South Santiam CHS and STW-freshwater rate is 10% of estuarine base rate of 0.16, due to summer steelhead predation in the natal subbasins

[3] McKenzie CHS-freshwater rate is 20% of estuarine base rate of 0.16, due to summer steelhead and rainbow trout predation in the natal subbasin

Harvest

Harvest rates are based on those described and used in Chapter 4 for CATAS. Impact rates for UWR Chinook are thought to average ~25%, and for steelhead, 16[63]%. These rates reflect both freshwater and marine harvest impacts.

Hatchery

Hatchery impacts were divided into those that influenced juvenile competition (estuary and freshwater natal streams), and those resulting from genetic concerns due to interbreeding.

Subcategory: Juvenile Competition

Because we had no direct estimate of this impact we assumed it was some proportion of the estuary habitat impact. We have provisionally assigned a value of 5% impact, which is half of the estuary habitat impact. This rate was applied to all populations.

Subcategory: Adults

The productivity of naturally reproducing populations, expressed as the number of offspring produced per spawner, has been found to be less in those populations where the long-term average incidence of hatchery spawners is high. This relationship, initially described by Chilcote (2003) for steelhead and Nickelson (2003) for coho, has recently been supported by Chilcote et al. (2011) for a wider range of populations, including Chinook. The universal feature of this relationship is an inverse relationship between the mean proportion of hatchery fish in natural spawning populations and overall population productivity. Note that the mechanisms behind this relationship merit further investigation, including fitness of various offspring, genotypic and phenotypic responses, hatchery stock origin, hatchery domestication level, amplification of the relationship through time, variance due to spatial or temporal separation of hatchery and wild spawners, and other responses and factors.

Although most of the loss in productivity in UWR Chinook and steelhead populations has been due to habitat degradation, the presence of large numbers of hatchery fish on natural spawning grounds is an additional productivity impact. In general, with a higher proportion of *potential* spawners being hatchery fish, there is greater chance that wild:hathery and hatchery:hatchery pairings can occur, with subsequent reduction in progeny survival (e.g., less productivity). Poor productivity can lower a population's ability to rebound from periods of adverse environmental conditions and its ability to persist over the long term. Therefore, extinction risk is generally higher in those populations where hatchery fish represent an additional productivity impact. Conversely, reducing the proportion of hatchery fish on natural spawning grounds should reduce this source of productivity loss, and by extension, lessen the extinction risk. However, projecting how much of a conservation benefit would occur with a given reduction in the proportion of hatchery spawners is a complicated problem. Our evaluation of this question suggests that the relationship is sensitive to both the density of spawners relative to habitat carrying capacity and to base level of hatchery spawners. Essentially the effect on extinction risk is both density (spawners) and frequency (hatchery fish) dependent.

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[63] With implementation of the steelhead FMEP, estimates in recent years are <10%. The 16% estimate was used in CATAS simulations, reflecting a longer period in the data record.

NMFS and ODFW considered multiple comments on the treatment of hatcheries in the Proposed Plan and also reviewed the most recent scientific reports and articles. NMFS and ODFW agree that there is ample evidence in the scientific literature to suggest the impacts of hatchery programs should be considered a major threat to recovery. One recent article written by NMFS and ODFW scientists explains:

> "We found a negative relationship between the reproductive performance in natural, anadromous populations of steelhead trout (*Oncorhynchus mykiss*), coho salmon (*O. kisutch*), and Chinook salmon (*O. tshawytscha*), and the proportion of hatchery fish in the spawning population…. In most cases, measures that minimize the interactions between wild and hatchery fish will be the best long-term conservation strategy for wild populations (Chilcote et al 2011)."

The estimates of adult hatchery impact rates for each population were based on the pHOS estimates used in Chapter 4, which were based on available data from coded wire tag (CWT) and spawner surveys.

Some Threat Reduction Caveats and Sequencing Threat Reductions

Review of the magnitude of the mortality rates under current conditions (Table 6-4 above) indicated that improvements in the Flood Control/Hydro sub category threats and Land Use FW Habitat sub category threat and hatchery threat reductions would provide the largest benefits in closing conservation gaps. However, these rates do not reflect their *relative* magnitude under current conditions or their *relative* contribution under recovery scenarios (scenario tables below). Several attempts were made to extract relative importance estimates from the TCM equation, to help show which threats reductions would have the greatest benefits. As a first step in evaluating relative importance for threat reduction options, the Planning Team helped define maximum feasible reductions in the other subcategories, where actions and mortality reductions had already been defined. With these reductions in place, we then evaluated additional threat reductions in flood control/hydro, freshwater habitat impacts, and hatchery impacts to examine how much each of them contributed to meet both abundance viability goals for the ESU/DPS (population delisting scenarios), and maximum mortality reduction thought to be feasible for broad sense recovery goals for a population.

The gains in survival characterized in the desired status scenarios served as a scoping tool for determining how and where efforts and resources could best be allocated to achieve desired status. Actions that address those limiting factors with the broader threat categories that require the most improvement should have a higher priority than actions that address a limiting factor where it is understood that only a modest improvement is needed. Within a threat category, actions in areas that are believed to result in a significant improvement in survival (conversely a reduction in mortality) should be prioritized before those actions in areas that are believed to result in a marginal improvement. A couple of caveats when reviewing the scenario tables below: 1) the approach greatly simplifies the population dynamics that underlie the inter-relation among the threats and limiting factors (for example, decreases in the hatchery threat, mostly represented by reductions in pHOS, are not independent of decreases in flood control threats); and 2) the threat reduction percentages do not reflect the actual difficulty (in terms of cost and technical and social feasibility) in making survival gains. For example, although the scenarios indicate large mortality reductions are needed in the hatchery threat category, the there is disagreement among scientists about how much pHOS reduction actions will benefit natural production until flood control and land use threats are reduced significantly.

Flood Control/Hydropower Management

Subcategories: Spawner Access and Juvenile Passage

Threat reduction targets for mortality associated with Flood Control/Hydro will most likely be implemented through actions identified in the WP BiOp (NMFS 2008a). The WP BiOp did not set targets for improvement in adult or juvenile fish passage, but did outline some measures ("reasonable prudent alternatives; RPA's) that addressed passage, flows, and habitat improvements. We used the Scenario Analysis to explore a range of mortality reductions from WP BiOp actions that would contribute to the desired delisting status. Embedded in the adult passage improvements were reductions in hatchery pHOS above dams, where we assumed pHOS could be maintained at ≤ 5%.

As a first step to examining the magnitude of impact reductions from lack of access and passage, we assumed that reaches inundated by reservoirs were not recoverable for spawning, and that an estimate of the proportion of historic intrinsic potential presently in reservoirs represented a lower range limit for feasible impact rate reduction. This adjustment basically reduces somewhat the carrying capacity benefits of providing access above dams, and therefore the % of recoverable production above the dams (see column 5 in Table 6-10). For example, ~11% of the intrinsic historic production in the Middle Fork Willamette is now in reservoirs, and therefore about 84% of total historic intrinsic potential would be available for production with adult access actions above Lookout Pt., Falls Creek, and Hills Creek dams. Even if enough adults can be transported above the dams to seed the remaining habitat successfully and the resulting juvenile productivity can be restored to historic levels,, juvenile mortality through the flood control/hydropower system would remain a key limiting factor. To scope this issue, Table 6-9 shows three levels of passage survival that result in flood control impact reductions. These values were used in scenario runs that integrated the other threat reductions. Members of the Planning team were asked to consider a "best case" goal for passage survival through the USACE large tributary dams and reservoirs, resulting from passage actions. Because there was lack of clear input and agreement on this issue, the ODFW chose 75% dam and reservoir survival as a higher end value to use in scenarios. It was noted by some team members that downstream survival improvement could vary greatly from dam to dam, and that fish passage facilities and reservoir operations could potentially be designed to achieve much higher survival rates.[64]

Table 6-9. The range of remaining impact rates after adult access has been restored and different levels of juvenile Chinook passage survival.

Population	Proportion historic production lost from dam blockage(=current impact rate for lack of spawner access in Table 6-7)	% Above Barrier Proportion IP in reservoirs	% Total production lost due to reservoir	% Remaining recoverable production above dams	Rates of Juvenile passage survival and resulting remaining impact from Flood Control/hydro passage limiting factors[1]		
					.75	.50	.25
N. Santiam	.71	10%	7%	64%	23%	39%	55%
S. Santiam	.85	20%	17%	68%	34%	51%	68%
McKenzie	.25	17%	4%	21%	9%	15%	20%
MF Will	.95	12%	11%	84%	32%	53%	74%

[1] after the % remaining recoverable production above dams is factored in (column 5)

[64] It should be noted that using a rate of 75% survival in the TCM equation shows that improving passage to this level has significant benefits to affected populations, thus justifying the high priority give to passage actions in this Plan.

Subcategory: Spawner Habitat Conditions

In the Scenario Analysis we modeled this threat separate from the spawner access threat described previously, in acknowledgment that pre-spawn mortality would continue to occur above the dams (mostly due to handling). Members of the Planning Team indicated that the adult trap improvements called for in the WP BiOp (NMFS 2008a) will likely reduce prespawn mortality of adults trapped and hauled above the dams by < 10%. Adult fish remaining below the dams will not likely benefit by the trap improvements, and would likely continue to experience high prespawn mortality. It is not clear for some populations what causes the majority of pre-spawn mortality below dams, and this Recovery Plan calls for research to examine potential causes. In the case of the Middle Fork Willamette Chinook population, where the vast majority of natural origin adults would be outplanted above the large flood control facilities, this below-dam mortality will presumably have a minor effect on overall population improvement. But in the North and South Santiam populations, where ~30% of the historical production may have come from, there is a clear need to reduce prespawn mortality below dams to improve population status.

Subcategory: Juvenile Habitat Conditions

See discussion below under Land Management *Subcategory: Freshwater Habitat*

Land Management

Subcategory: Freshwater Habitat

As discussed above, we separated the fresh water habitat LFTs into two subcategories: 1) mortality associated with juvenile habitat conditions due to hydro/flood control (JHM), and 2) mortality associated with other freshwater habitat conditions (non hydro, FWHM). There is underlying uncertainty regarding the extent to which freshwater habitat improvements can increase survival for specific life stages (see McHugh et al. 2004), and whether these increases could contribute to a large enough proportion in total life cycle survival to produce positive growth rates (Budy and Schaller 2007). Ideally one would first identify a mechanistic link between a specific life stage (example: fry survival) with specific habitat attributes, then attempt to derive a numerical fish response (change in survival rate) to modeled improvements in habitat that reduce limiting factors. At the population level there is an assumption that specific habitat improvements will lead to a cumulative watershed condition where salmonid survival is quantitatively enhanced (Bartz et al. 2005). However, these types of analyses require detailed information on existing habitat conditions for specific populations, and life-stage specific survival rates. In addition, UWR juvenile Chinook salmon have a range of early life history behaviors that are linked to flows and temperature, resulting in variable residence and migration time in natal streams and Willamette mainstem habitats. Predicting the population response (increase in adult spawners) from improvements in mainstem habitat is complex, in part because mainstem habitat conditions are not the result of discrete actions but are influenced by the cumulative effects of conditions upstream. While improvements in upstream areas will presumably have a positive effect on mainstem conditions, their magnitude is unknown.

In the absence of specific quantifiable habitat:fish relationships, our initial approach to examine restoration potential was to evaluate available EDT data for Chinook salmon and steelhead. Our goal with EDT data was to help establish upper bounds of the maximum feasible survival improvements. For the Clackamas and McKenzie Chinook, we used EDT data to help estimate improvements in fish survival based in some cases on restoration endpoints (goals) for which the EDT data were modeled. From EDT data we assumed that increases in the adult and smolt equilibrium abundance from current habitat conditions to projected habitat improvements was the net percent survival improvement. We used the EDT average value of the adult and smolt survival improvements to back calculate the mortality reduction these improvements represented. In general we have assumed that an approximate 30-35% decrease in the mortality rate from current conditions in the case of the McKenzie and Clackamas populations is the upper limit of what can feasibly be achieved for Chinook and steelhead. Lacking EDT data for other subbasins, we assumed this mortality decrease was also the maximum feasible improvement for those subbasins.

Subcategory: Estuary Habitat

The Estuary Module assumed that feasible estuarine habitat improvements would result in a maximum increase of 20% in the number of outmigrants leaving the Columbia River Estuary. While the Module authors note the difficulty predicting the exact quantitative benefits of estuary actions, for planning purposes we apply this improvement value for all populations. The current estuary threat estimate of 10% is the same for all UWR populations, and when the Module improvements are applied, we expect the maximum reduction of anthropogenic enhanced mortality to decrease from 10% to 8%.

Other Species

The predation reduction goal used in our recovery scenarios is based mostly on mortality reductions expected from the Caspian Tern Management Plan (USFWS 2005) and the Pikeminnow Reward Program (Beamesderfer et al. 1996). We assume some predation reduction for UWR populations will also occur with pinniped control as outlined in the NMFS final Environmental Assessment of this impact (NMFS 2008d)[65]. In the Willamette River mainstem and subbasins this Recovery Plan calls for liberalizing bag limits on warm water exotic fish, but the reduction in predation from this action is likely to be modest. For UWR Chinook and steelhead, we project, based on the Estuary Module, that the total of the actions identified in the applicable estuary plans equates to an approximate 59-62% reduction in the current mortality due to predation that is human influenced. As with estuary habitat, there is general agreement that these reductions in mortality associated with predation are likely the maximum that can be accomplished to alleviate this impact. In addition, the relatively minor impact that predation represents among all the threats means that decreasing predation mortality further will have relatively little effect on the status of UWR populations.

Harvest Management

As noted in Chapters 4 and 5, there are several fisheries that impact UWR Chinook and steelhead. After review of the primary and secondary LFTs by the Expert Panel, Planning Team, Stakeholder Group, and the general public, fishery harvest rates managed under the approved FMEPs since the listing result in adequate protection of wild populations and will not impede the recovery of populations once the primary and secondary LFTs are addressed. Fishery harvest exploitation rates have been reduced by more than 75% compared to pre-listing exploitation rates. The analyses conducted in the approved FMEPs demonstrate that the new fishing strategies adopted will not impede the recovery of all steelhead and Chinook populations in the Willamette. The fact that the wild populations have not improved in viability status after the substantial fishery harvest reductions have occurred suggests fishery impacts are not the primary or secondary bottlenecks affecting these populations. Other recovery actions in the management of land use, dams, and hatcheries are now needed to improve population viability. Improvements will not be gained from further fishery restrictions. As these fisheries have considerable social and economic value which would be lost for a relatively small reduction in overall mortality, this Plan does not identify

[65] http://www.nwr.noaa.gov/Marine-Mammals/Seals-and-Sea-Lions/upload/Sec-120-Final-EA.pdf

actions to reduce the impact to wild Chinook and steelhead from fisheries, therefore no impact reduction is identified under the scenarios presented here.

Hatchery Management

Subcategory: Juvenile Competition

At this time there is relatively little information regarding the effects of ecological interactions between hatchery and natural-origin juvenile salmon and steelhead. Due to the emerging science on the subject, the potential benefits of reduced juvenile competition in the estuary or in natal subbasins are as yet unknown. Habitat improvements in both of these areas have the potential to lessen the negative effects of competitive interactions to some unknown degree. Modification of hatchery rearing practices that can reduce competition may also contribute to reducing this threat. However, given this uncertainty and the relatively minor impact that juvenile competition is assumed to represent relative to the threats, decreasing competition mortality further may have relatively little effect on the status of UWR populations. Therefore no impact reduction is identified under the scenarios presented here.

Subcategory: Adults

Reducing pHOS to zero is technically feasible for selected species and populations in the short term by reducing or eliminating hatchery production. However, given that hatchery fish support almost all fisheries within the UWR ESU, eliminating hatchery production would reduce or eliminate fisheries in some areas with resulting social and economic impacts. In order to gain management flexibility for considering alternative ways to reduce pHOS, the State of Oregon, U.S. Army Corps of Engineers, and NMFS could review the hatchery mitigation agreements (described in Appendix E) and evaluate them in the context of ESA listings and recent scientific information.. When reintroduction above the dams results in self-sustaining, naturally-produced sub-populations in these locations, the requirement to produce hatchery fish as mitigation for dam construction and operation will be re-assessed. The primary source of pHOS is from the harvest hatchery programs (mitigation programs) in the ESU. Actions that reduce this source of pHOS are coupled with actions that will improve passage, survival, and production of wild fish above flood control/hydropower barriers. Under the assumption that improved sorting facilities below dams (as called for in the WP BiOp, NMFS 2008a) can support an above-barrier guideline of ≤ 5% pHOS above flood control barriers for reintroduction purposes of natural origin fish, pHOS rates below the barriers could remain fairly high and still achieve a *total* subbasin pHOS consistent with VSP criteria. Ultimately, NMFS and ODFW think that the proposed hatchery pHOS at different extinction risk level goals (i.e., 30% for moderate risk, and 10% for low or very low risk, respectively, for within-ESU hatchery fish) are feasible for most populations, and when combined with other threat reductions outlined in the threat reduction scenarios, will contribute to fulfill delisting and broad sense recovery goals. Because most of the populations are proposed to be deliberately managed with split subbasin goals (mitigation production emphasis below mainstem barriers, wild fish management focus above mainstem barriers), average subbasin pHOS goals may eventually be achieved by having low pHOS above barriers, with greater levels in mitigation zones, but NMFS and ODFW should continue to study the adverse effects of high pHOS below the dams on natural productivity of each population. Table 6-10 illustrates how reduced pHOS levels below large barriers (mitigation zones) would contribute to total population pHOS to desired status goals, under a condition of restored access and production of natural origin fish above barriers.

Table 6-10. Projected pHOS levels needed to meet desired status (based on WLC-TRT viability guidelines) for UWR Chinook and winter steelhead populations.

Population	Max total subbasin pHOS to meet desired status goal	Max pHOS below dam to meet desired status[1]
Chinook		
Clackamas	10%	Na
Molalla	Not defined	Na
North Santiam	10%	21%
South Santiam	30%	80%
Calapooia	Not defined	Na
McKenzie	10%	95%[2]
MF Willamette	10%	95%
Steelhead[3]		
Molalla	5%	Na
North Santiam	5%	21%
South Santiam	5%	21%
Calapooia	15%	Na

[1] assumes pHOS above barrier is ≤ 5% and production is equal above and below barrier, therefore proportional to spawning area
[2] below Leaburg, assuming that area below there would be 5% of total production
[3] for steelhead, most hatchery strays are an out-of-DPS stock of summer steelhead, and for viable populations of winter steelhead, pHOS for out-of-DPS fish should be ≤5%.

6.2.2 Threat Reduction Scenarios for Individual Populations

The following tables show threat reduction scenarios for each UWR Chinook and steelhead populations which, if implemented successfully, would lead to a desired status for that population[66]. Included in some of the tables are threat reduction scenarios that would yield 1) a more modest level of recovery, and 2) a more ambitious level of recovery beyond desired status. The scenarios in the tables below are defined as follows:

- Maintain Current Status (into the future): One of the recovery principles outlined by the WLC-TRT was that no population should decline from its current risk status. Since we applied a 20% conservation buffer on the Abundance criterion for future risks, some threats will need to be reduced to some level just to maintain current risk status. This scenario represents the minimum threat reduction necessary to achieve only the 20% increase in abundance to meet unknown future threats and maintain the current risk class. For three of the UWR steelhead populations, the current status is also the Desired Status (following).
- Desired Status (to Delist ESU/DPS): This is the threat reduction scenario that leads to a population-level desired status for that population, as determined within the chosen ESU/DPS-level desired status scenario in Table 6-1, to help meet the ESU/DPS recovery goal of delisting the ESU/DPS. In most cases these scenarios were crafted to improve the extinction risk level of a population to achieve its desired status as indicated in Table 6-1. This scenario represents the threat reduction framework that will guide implementation of actions in this Plan.
- ESU/DPS Viability Buffer: One of the ESU/DPS-level viability principles outlined by the WLC-TRT was that not all population-level recovery efforts will be successful, therefore, where feasible,

[66] Threat reduction scenarios for Broad Sense goals are in Chapter 10, where broad sense recovery criteria are discussed.

recovery goals should include improving some populations beyond the minimum level to meet ESU/DPS viability criteria. Therefore, we have included for two Chinook populations and one steelhead population not targeted for a desired status level to viable (Chinook: Molalla, Calapooia; steelhead: Calapooia) a threat reduction scenario that would improve their extinction risk levels to a low risk level (viable).

Scenario Tables

The threat reduction scenario serve as a comparative exercise in outlining different threat reduction options necessary to achieve a given extinction risk level. The tables are complex and are derived from several chapters. Therefore terms and table organization are provided as follows:

1. Broad Threat Management Categories & Subcategory columns: As summarized in Tables 6-2 and 6-3 above, the broad threats identified in Chapter 5 were reorganized into subcategories to provide better resolution of impacts for those threats. Those ten subcategories are the column headers in row 3 of the following tables, nested within the broader threat categories as column headers in row 2.
2. The population-specific key and secondary limiting factor (LFT) codes from Chapter 5 were associated with the most appropriate threat subcategory, and are binned in rows 5 and 6 under the respective subcategory threat. A few LF codes are associated with more than one threat subcategory. For example, LF code 8a "Physical habitat quality…" is influenced by both Flood Control and Land Management practices. In addition, LF Codes 5a, 5b, 7h, and 10f are essentially due to Columbia basin Hydro operations, but their effects on UWR Chinook and steelhead occur in the estuary as habitat degradation.
3. The impacts (mortality rates of threats) associated with current status (row 8) developed in this chapter are from Table 6-5 and are headed in column 7 by the acronym terms in the TCM equation associated with Table 6-5. As described in the section discussing how tributary threat rates were developed, the cumulative mortality of threat impacts in the Scenario Analysis is multiplicative (i.e., TCM = 1-((1-SAM)x(1-JHM)x(1-SHM)x(1-FWHM)x(1-EHM)x(1-OSM)x(1-HM)x(1-JCM)x(1-HFM))[67]. The 3 sub-column headings in row 7 under Total Reduced Life Cycle Impact (row 6) track reductions in mortality and improvements in adult abundance, resulting from threat reductions in the scenario rows.
4. The VSP Extinction Risk Class indicates current risk status of the VSP parameters (see Chapter 4) under current conditions, and improvements to those risk classes under the different scenarios. A&P= abundance and productivity, DV=diversity, SS=spatial structure).
    a. The A&P (abundance and productivity) VSP parameter value for each scenario was derived from the A/P conservation gaps in Chapter 4, plus a 20% increase to offset future development and climate change uncertainty.
    b. The D (diversity) VSP parameter for each scenario is based on the diversity guidelines described in Chapter 4 for this parameter.
    c. For the SS (spatial structure) VSP parameter there was no quantitative target for a risk level, but it was assumed risk status for SS would be improved if the scenario included increases in A&P that came with improvements in fish access and freshwater habitat.

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[67] For the Scenario Analysis there is not estimate of current mortality impact from lack of downstream passage. It was assumed that lack of spawner access above large flood control/hydropower projects precluded production of naturally produced juveniles, and that total above-barrier mortality was included in the spawner access category. Therefore the Juvenile Passage Mortality term (JPM) was combined with SAM in the TCM equation.

   d. The derivation of the overall extinction risk class from the component parameters is described in Chapter 4, though it is heavily influenced by the A&P component (which tends to also influence D and SS as well).

5. In the scenario rows, each successive scenario employs the threat reductions from the previous row, and adds more threat subcategories (increasing threat integration) and/or more percent decrease in a threat impact rate (increasing threat reduction intensity). Therefore the scenarios are a progressive down-row reduction in threats, reflecting improvements in VSP extinction risk classes.

6. Finally, the text that describes the details of each scenario indicates levels of mortality reduction of a threat from the current estimated impact rates. For the hatchery threat, the term "to VSP pHOS standard" refers to the threshold pHOS values that are aligned with different levels of risk for the Diversity criterion. For Chinook salmon pHOS involves a within-ESU hatchery population, and viable natural populations should maintain a pHOS ≤10%, and populations at moderate risk should maintain a pHOS ≤30%. For steelhead, pHOS is mostly an out-of-DPS hatchery population, and viable natural populations should maintain a pHOS ≤5%.

Several attempts were made to depict the relative importance of each threat category. The figures that follow each population's scenario table provide a visual summary of the relative reductions in mortality impact for each threat category, under current conditions and under desired status. In most cases , estuary and "other species" threats have modest impacts relative to other impacts, and that most reductions in mortality impacts (and contribution to total life cycle survival) will come from a combination of mortality reductions due to threats of flood control/hydropower, freshwater habitat, and hatcheries.

Table 6-11. Threat reduction and VSP scenarios for Clackamas spring Chinook. See the text in Section 6.2.2 for a detailed description of table organization and contents.

Clackamas Spring Chinook																	
	Flood Control / Hydropower (subbasin)				FW Land Use Management	Estuary LFT's	Other Species	Harvest Management	Hatchery Management								
Limiting Factor Importance	Spawner Access	Juvenile Passage	Spawner Habitat Conditions	Juvenile Habitat Conditions	Adult and Juvenile Conditions	Land Use & Flood Control/Hydro	Competition / Predation	Adults	Juv Competition / Predation	Adults							
Key	1a				8a	5ab, 7h, 10f				3a							
Secondary			9k	7i, 8a	8a, 9ahi	8a, 9ahij	6e	11ag	4a								
	Mortality Rates of Threats										Total Reduced Life Cycle Impact			VSP Extinction Risk Class			
	SAM	JPM	SHM	JHM	FWHM	EHM	OSM	HM	JCM	HFM	Cumulative Mortality	% Mortality Reduction	Modeled Abundance	A&P	DV	SS	Overall Risk
Current Status	0.27				0.83	0.10	0.12	0.25		0.33	95%	---	1,369	M	M	L	M
Scenarios																	
Maintain into Future: Moderate Risk *Estuary Module Actions* -max reduction in EHM & OSM threats *Land Management Actions* -small reduction in FWHM ~2%	0.27				0.81	0.08	0.07	0.25		0.33	94%	1.0%	1,641	M	M	L	M
Desired Status: Very Low Risk *Flood Control/Hydro Actions* -small reduction in SAM and JPM *Hatchery Actions* -medium reduction in HFM to VSP pHOS standard	0.24				0.81	0.08	0.07	0.25		0.10	92%	3.6%	2,314	VL	L	L	VL

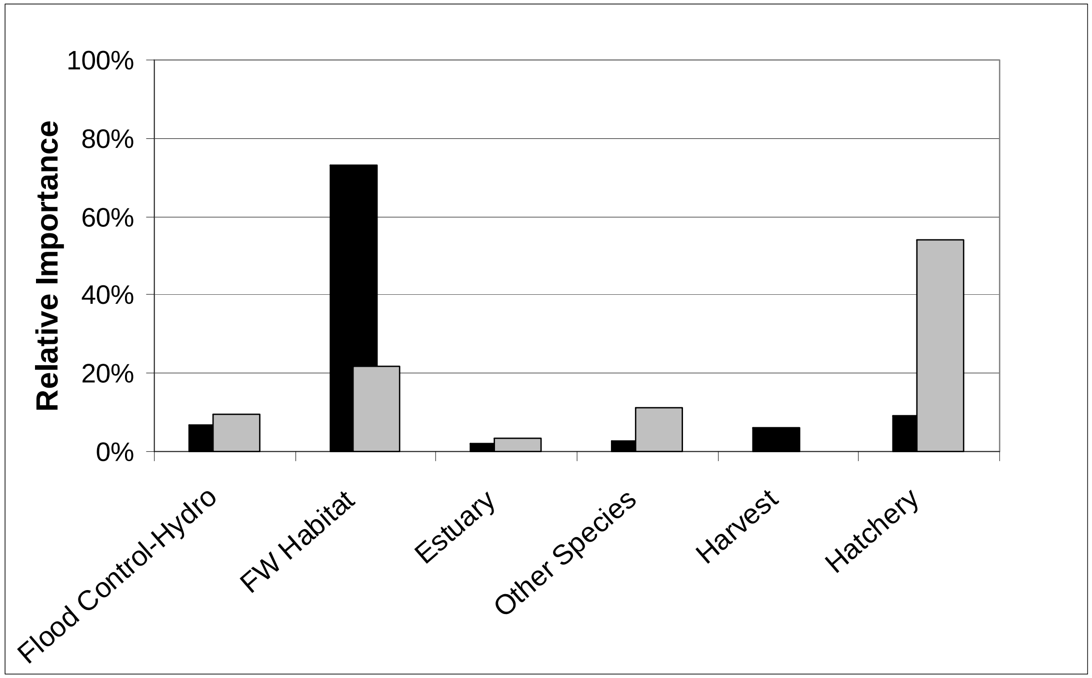

Figure 6-1. For Clackamas spring Chinook, bar chart depicts the percent relative contribution of mortality for each threat category to the cumulative mortality under current baseline conditions (black bars), and the percent relative importance of each threat category to cumulative mortality under the desired status scenario (gray bars). Data are based on associated scenario table.

Table 6-11 above depicts a desired status scenario to improve the Clackamas spring Chinook population from a moderate risk of extinction (current status) to a very low risk of extinction. It accomplishes this with: 1) maximum feasible mortality reductions in Estuary and Other Species threats to improve A/P; 2) small/moderate % mortality reductions in FW Habitat and Flood Control / Hydro threats to improve A/P; and 3) moderate reduction in Hatchery threats to improve A/P and to meet a Diversity pHOS threshold for a viable population (≤ 10% pHOS). Under current conditions, FW Habitat mortality has the greatest relative importance to cumulative mortality, and even a small/moderate % reduction in this threat is projected to have a large contribution to reducing cumulative mortality (Figure 6-1[68]). However, as conditions improve towards desired status, there is a rebalancing of relative importance across threat categories.

[68] Relative importance under current conditions was determined by calculating how much the % cumulative mortality reduction changed when a threat category mortality value was held constant, while reducing other threat category mortality values to their desired status targets.

Table 6-12. Threat reduction and VSP scenarios for Molalla spring Chinook. See the text in Section 6.2.2 for a detailed description of table organization and contents.

Molalla Spring Chinook																
	Flood Control / Hydropower (subbasin)				FW Land Use Management	Estuary LFT's	Other Species	Harvest Management	Hatchery Management							
Limiting Factor Importance	Spawner Access	Juvenile Passage	Spawner Habitat Conditions	Juvenile Habitat Conditions	Adult and Juvenile Conditions	Land Use & Flood Control/Hydro	Competition / Predation	Adults	Juv Competition / Predation	Adults						
Key					8ab, 9ach	5ab, 7h, 8a,10f				3a						
Secondary					7a, 9i, 10b	9ahij	6e		4a							
	Mortality Rates of Threats										Total Reduced Life Cycle Impact			VSP Extinction Risk Class		
	SAM	JPM	SHM	JHM	FWHM	EHM	OSM	HM	JCM	HFM	Cumulative Mortality	% Mortality Reduction	Modeled Abundance	A&P	DV	SS	Overall Risk
Current Status	0.00	0.00	0.00	0.00	1.00	0.10	0.16	0.25	0.05	0.95	100%	---	0	VH	H	H	VH
Scenarios																
Maintain into Future: VH Risk *Estuary Module Actions* -max reduction in EHM & OSM threats *Land Management Actions* -large reduction in FWHM ~20%	0.00	0.00	0.00	0.00	0.80	0.08	0.08	0.25	0.05	0.95	99%	0.6%	83	VH	H	H	VH
Desired Status: High Risk *Hatchery Actions* -medium reduction in HFM ~40%	0.00	0.00	0.00	0.00	0.80	0.08	0.08	0.25	0.05	0.57	95%	5.1%	699	H	H-M	L	H
ESU Viability Buffer: Low Risk *Hatchery Actions* -large reduction in HFM to VSP pHOS standard	0.00	0.00	0.00	0.00	0.80	0.08	0.08	0.25	0.05	0.10	89%	10.7%	1,471	L	L	L	L

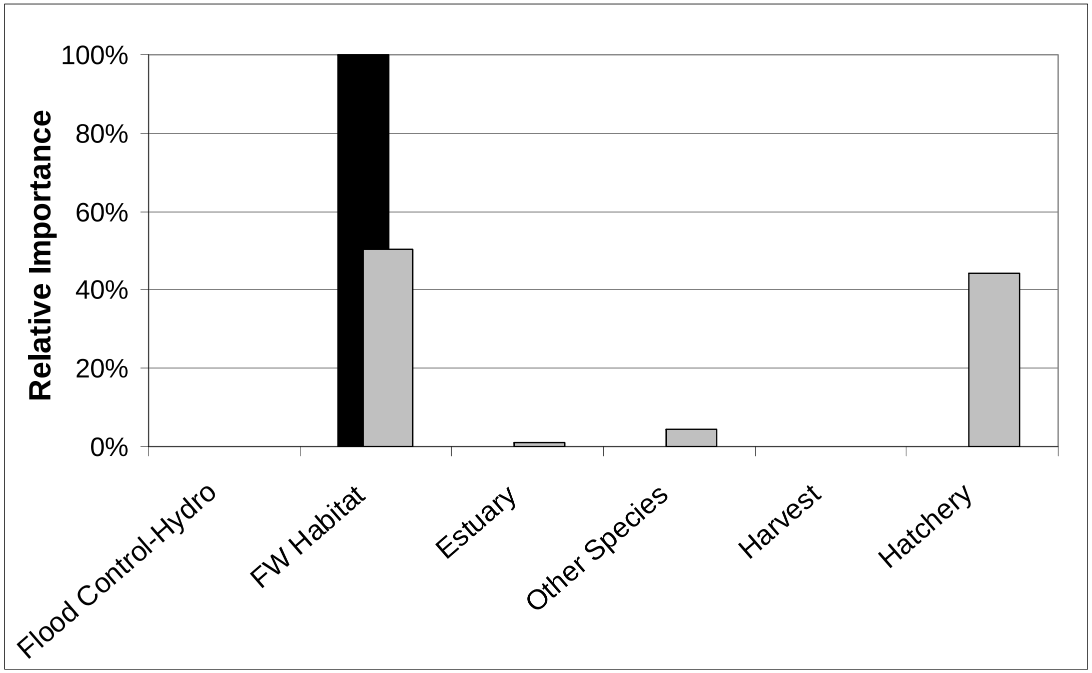

Figure 6-2. For Molalla spring Chinook, bar chart depicts the percent relative contribution of mortality for each threat category to the cumulative mortality under current baseline conditions (black bars), and the percent relative importance of each threat category to cumulative mortality under the desired status scenario (gray bars). Data are based on associated scenario table.

Table 6-12 above depicts a desired status scenario to improve the Molalla spring Chinook population from a very high risk of extinction (current status) to a high risk of extinction. It accomplishes this with: 1) maximum feasible mortality reductions in Estuary and Other Species threats to improve A/P; 2) a large reduction in FW Habitat threats to improve A/P and SS; and 3) moderate/large reduction in Hatchery threats to improve A/P and to some extent, Diversity. Under current conditions, FW Habitat mortality has the greatest relative importance to cumulative mortality, and a large % reduction in this mortality source is projected to have a large contribution to cumulative mortality reduction (Figure 6-2). As conditions improve towards desired status, there is a rebalancing of relative importance across threat categories.

Table 6-13. Threat reduction and VSP scenarios for North Santiam spring Chinook. See the text in Section 6.2.2 for a detailed description of table organization and contents.

North Santiam Spring Chinook																	
	Broad Threat Management Categories & Sub-Categories																
	Flood Control / Hydropower (subbasin)				**FW Land Use Management**	**Estuary LFT's**	**Other Species**	**Harvest Management**	**Hatchery Management**								
Limiting Factor Importance	**Spawner Access**	**Juvenile Passage**	**Spawner Habitat Conditions**	**Juvenile Habitat Conditions**	**Adult and Juvenile Conditions**	**Land Use & Flood Control/Hydro**	**Competition / Predation**	**Adults**	**Juv Competition / Predation**	**Adults**							
Key	2b, 2f	1d		9b,10d	8a,9ahi	5ab, 7h, 8a,10f				3a							
Secondary	2k			7bc	8a	9ahij	6ce		4a								
	Mortality Rates of Threats										**Total Reduced Life Cycle Impact**			**VSP Extinction Risk Class**			
	SAM	**JPM**	**SHM**	**JHM**	**FWHM**	**EHM**	**OSM**	**HM**	**JCM**	**HFM**	**Cumulative Mortality**	**% Mortality Reduction**	**Modeled Abundance**	**A&P**	**DV**	**SS**	**Overall Risk**
Current Status	0.71	0.00	0.60	0.97	0.97	0.10	0.17	0.25	0.05	0.90	100%	---	0	VH	H	H	VH
Scenarios																	
Maintain into Future: VH Risk *Estuary Module Actions* -max reduction in EHM & OSM threats *Flood Control/Hydro Actions* -medium reduction in SAM and JPM (improve A/P & SS via passage actions -large reduction in JHM (improve WQ, flows) *Land Management Actions* -large reduction in FWHM ~25% *Hatchery Actions* -small reduction in HFM	0.39	---	0.60	0.29	0.70	0.08	0.08	0.25	0.05	0.88	100%	0.4%	205	VH	H	H	VH

Desired Status: Low Risk *Flood Control/Hydro Actions* -maximum reduction in SAM and JPM (maximize habitat capacity for A/P and SS) -maximum reduction in SHM (resolve pre-spawn mortality impacts) *Land Management* -maximum reduction in FWHM *Hatchery Actions* -large reduction in HFM to VSP pHOS standard	0.23	---	0.12	0.29	0.63	0.08	0.08	0.25	0.05	0.10	90%	9.7%	5,428	L	L	L	L

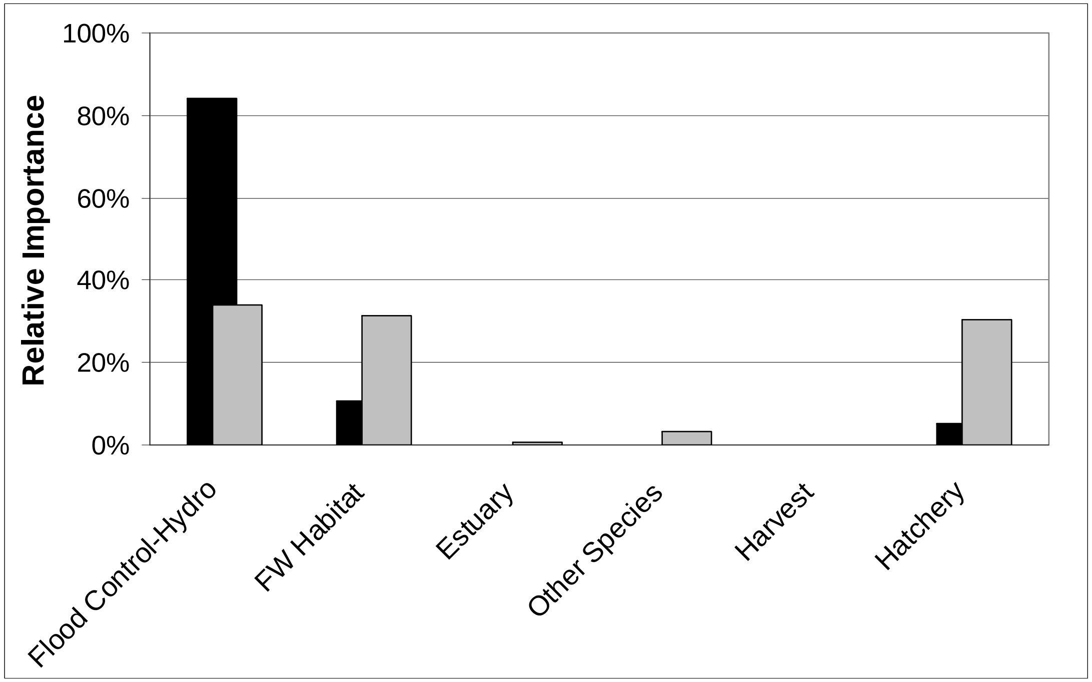

Figure 6-3. For North Santiam spring Chinook, bar chart depicts the percent relative contribution of mortality for each threat category to the cumulative mortality under current baseline conditions (black bars), and the percent relative importance of each threat category to cumulative mortality under the desired status scenario (gray bars). Data are based on associated scenario table.

Table 6-13 above depicts a desired status scenario to improve the North Santiam spring Chinook population from a very high risk of extinction (current status) to a low risk of extinction. It accomplishes this with: 1) maximum feasible mortality reductions in Estuary and Other Species threats to improve A/P; 2) maximum mortality reductions in FW Habitat and Flood Control / Hydro threats to improve A/P and SS; and 3) large reduction in Hatchery threats to improve A/P and to meet a Diversity pHOS threshold for a viable population (≤ 10% pHOS). Under current conditions, aggregated Flood Control/Hydro mortality has the greatest relative importance to cumulative mortality, and a large % reduction in this mortality source is projected to have a large contribution to cumulative mortality reduction (Figure 6-3). Note that currently estuary mortality and other species have very little current impact, relative to other life-cycle bottlenecks. As conditions improve towards desired status, there is a rebalancing of relative importance across threat categories.

Table 6-14. Threat reduction and VSP scenarios for South Santiam spring Chinook. See the text in Section 6.2.2 for a detailed description of table organization and contents.

South Santiam Spring Chinook																	
	Flood Control / Hydropower (subbasin)				FW Land Use Management	Estuary LFT's	Other Species	Harvest Management	Hatchery Management								
Limiting Factor Importance	Spawner Access	Juvenile Passage	Spawner Habitat Conditions	Juvenile Habitat Conditions	Adult and Juvenile Conditions	Land Use & Flood Control/Hydro	Competition / Predation	Adults	Juv Competition / Predation	Adults							
Key	2c, 2g	1e		9e,10d	8a,9ahi	5ab, 7h, 8a,10f				3a							
Secondary	2l			7d	8a	9ahij	6ce		4ab								
	Mortality Rates of Threats										**Total Reduced Life Cycle Impact**			**VSP Extinction Risk Class**			
	SAM	**JPM**	**SHM**	**JHM**	**FWHM**	**EHM**	**OSM**	**HM**	**JCM**	**HFM**	**Cumulative Mortality**	**% Mortality Reduction**	**Modeled Abundance**	**A&P**	**DV**	**SS**	**Overall Risk**
Current Status	0.85	0.00	0.30	0.95	0.95	0.10	0.17	0.25	0.05	0.90	100%	---	1	VH	M	M	VH
Scenarios																	
Maintain into Future: VH Risk *Estuary Module Actions* -max reduction in EHM & OSM threats *Flood Control/Hydro Actions* -medium reduction in SAM and JPM (improve A/P & SS via access/passage actions) -large reduction in JHM (improve WQ, flows) *Land Management Actions* -large reduction in FWHM ~20% *Hatchery Actions* -small reduction in HFM	0.51	---	0.30	0.29	0.75	0.08	0.08	0.25	0.05	0.86	99%	0.5%	201	VH	H	H	VH
Desired Status: Moderate Risk *Flood Control/Hydro Actions* -maximum reduction in SAM and JPM (maximize habitat capacity for A/P and SS) -maximum reduction in SHM (resolve pre-spawn mortality impacts) *Land Management* -max. reduction in FWHM *Hatchery Actions* -large reduction in HFM to VSP pHOS standard	0.34	---	0.04	0.19	0.62	0.08	0.08	0.25	0.05	0.30	92%	8.3%	3,116	M	M	L	M

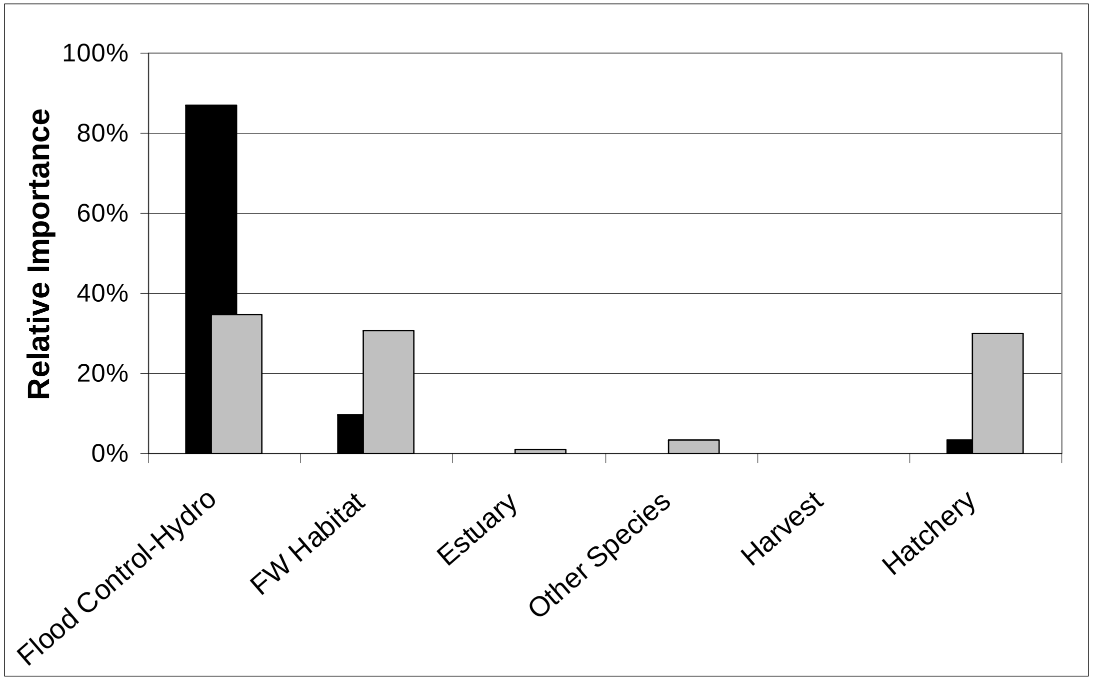

Figure 6-4. For South Santiam spring Chinook, bar chart depicts the percent relative contribution of mortality for each threat category to the cumulative mortality under current baseline conditions (black bars), and the percent relative importance of each threat category to cumulative mortality under the desired status scenario (gray bars). Data are based on associated scenario table.

Table 6-14 above depicts a desired status scenario to improve the South Santiam spring Chinook population from a very high risk of extinction (current status) to a moderate risk of extinction. It accomplishes this with: 1) maximum feasible mortality reductions in Estuary and Other Species threats to improve A/P; 2) maximum mortality reductions in FW Habitat and Flood Control / Hydro threats to improve A/P and SS; and 3) large reduction in Hatchery threats to improve A/P and to meet a Diversity pHOS threshold for a population at moderate risk (≤ 30% pHOS). Under current conditions, aggregated Flood Control/Hydro mortality has the greatest influence on current status, and a large % reduction in this mortality source is projected to have a large contribution to cumulative mortality reduction (Figure 6-4). Note that currently estuary mortality and other species have very little current impact, relative to other life-cycle bottlenecks. However, as conditions improve towards desired status, the relative importance of other mortality sources increases..

Table 6-15. Threat reduction and VSP scenarios for Calapooia spring Chinook. See the text in Section 6.2.2 for a detailed description of table organization and contents.

Calapooia Spring Chinook																
	Flood Control / Hydropower (subbasin)				FW Land Use Management	Estuary LFT's	Other Species	Harvest Management	Hatchery Management							
Limiting Factor Importance	Spawner Access	Juvenile Passage	Spawner Habitat Conditions	Juvenile Habitat Conditions	Adult and Juvenile Conditions	Land Use & Flood Control/Hydro	Competition / Predation	Adults	Juv Competition / Predation	Adults						
Key					2h,9a 9c 9hi 8ab	5ab, 7h, 8a,10f				3a						
Secondary					7a,10b	9ahij	6e		4a							
	Mortality Rates of Threats										**Total Reduced Life Cycle Impact**			**VSP Extinction Risk Class**		
	SAM	**JPM**	**SHM**	**JHM**	**FWHM**	**EHM**	**OSM**	**HM**	**JCM**	**HFM**	**Cumulative Mortality**	**% Mortality Reduction**	**Modeled Abundance**	**A&P**	**DV**	**SS**	**Overall Risk**
Current Status	0.00	0.00	0.00	0.00	1.00	0.10	0.16	0.25	0.05	0.95	100%	---	0	VH	H	VH	VH
Scenarios																
Maintain into Future: VH Risk *Estuary Module Actions* -max reduction in EHM & OSM threats *Land Management Actions* -large reduction in FWHM ~25%	0.00	0.00	0.00	0.00	0.74	0.08	0.08	0.25	0.05	0.95	99%	0.8%	74	VH	H	H	VH
Desired Status: High risk *Hatchery Actions* -medium reduction in HFM ~40%	0.00	0.00	0.00	0.00	0.74	0.08	0.08	0.25	0.05	0.60	94%	6.3%	598	H	H-M	L	H
ESU Viability Buffer: Low risk *Hatchery Actions* -large reduction in HFM to VSP pHOS standard	0.00	0.00	0.00	0.00	0.74	0.08	0.08	0.25	0.05	0.10	86%	14.2%	1,348	L+	L	L	L+

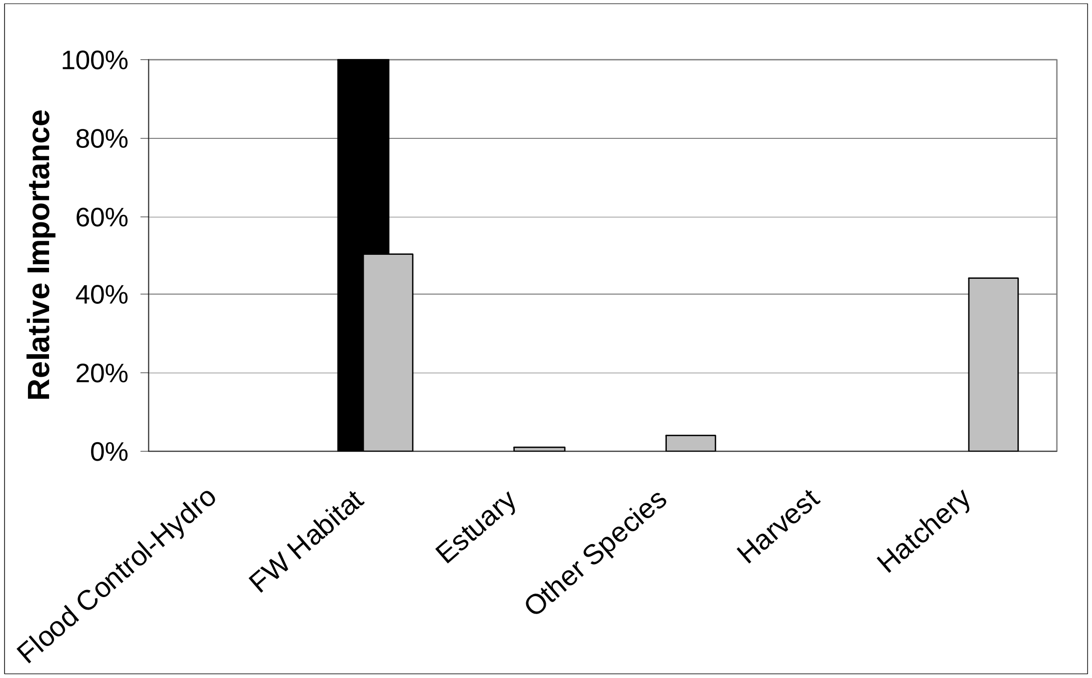

Figure 6-5. For Calapooia spring Chinook, bar chart depicts the percent relative contribution of mortality for each threat category to the cumulative mortality under current baseline conditions (black bars), and the percent relative importance of each threat category to cumulative mortality under the desired status scenario (gray bars). Data are based on associated scenario table.

Table 6-15 above depicts a desired status scenario to improve the Calapooia spring Chinook population from a very high risk of extinction (current status) to a high risk of extinction. It accomplishes this with: 1) maximum mortality reductions in Estuary and Other Species threats to improve A/P; 2) large reduction in FW Habitat threats to improve A/P and SS; and 3) moderate/large reduction in Hatchery threats to improve A/P and to some extent, Diversity. Under current conditions, FW Habitat mortality has the greatest relative importance to cumulative mortality, and a large % reduction in this mortality source is projected to have a large contribution to cumulative mortality reduction (Figure 6-5). As conditions improve towards desired status, there is a rebalancing of relative importance across threat categories.

Table 6-16. Threat reduction and VSP scenarios for McKenzie spring Chinook. See the text in Section 6.2.2 for a detailed description of table organization and contents.

McKenzie Spring Chinook																	
	Flood Control / Hydropower (subbasin)				**FW Land Use Management**	**Estuary LFT's**	**Other Species**	**Harvest Management**	**Hatchery Management**								
Limiting Factor Importance	**Spawner Access**	**Juvenile Passage**	**Spawner Habitat Conditions**	**Juvenile Habitat Conditions**	**Adult and Juvenile Conditions**	**Land Use & Flood Control/Hydro**	**Competition / Predation**	**Adults**	**Juv Competition / Predation**	**Adults**							
Key	2d			10d	8a, 9hi	5ab, 7h, 8a,10f				3a							
Secondary		1b		7e, 9g	9a	9ahij	6cde		4a								
	Mortality Rates of Threats										**Total Reduced Life Cycle Impact**			**VSP Extinction Risk Class**			
	SAM	**JPM**	**SHM**	**JHM**	**FWHM**	**EHM**	**OSM**	**HM**	**JCM**	**HFM**	**Cumulative Mortality**	**% Mortality Reduction**	**Modeled Abundance**	**A&P**	**DV**	**SS**	**Overall Risk**
Current Status	0.25	0.00	0.10	0.56	0.56	0.10	0.18	0.25	0.05	0.35	96%	---	4,889	VL	M	M	L
Scenarios																	
Maintain into Future: Low Risk *Estuary Module Actions* -max reduction in EHM & OSM threats *Flood Control/Hydro Actions* -small reduction in SAM and JPM (improve A/P & SS via access/passage actions) -small reduction in JHM (improve WQ, flows) *Land Management Actions* *-small reduction in FWHM* *Hatchery Actions* -small reduction in HFM	0.15	---	0.10	0.51	0.51	0.08	0.09	0.25	0.05	0.30	92%	3.4%	8,414	VL	M	M	L
Desired Status: Very Low Risk *Flood Control/Hydro Actions* -small reduction in SAM and JPM (maximize habitat capacity for A/P and SS) *Land Management Actions* *-small reduction in FWHM* *Hatchery Actions* -modest reduction in HFM to VSP pHOS standard	0.15	---	0.10	0.51	0.51	0.08	0.09	0.25	0.05	0.10	90%	5.7%	10,916	VL+	L	L	VL+

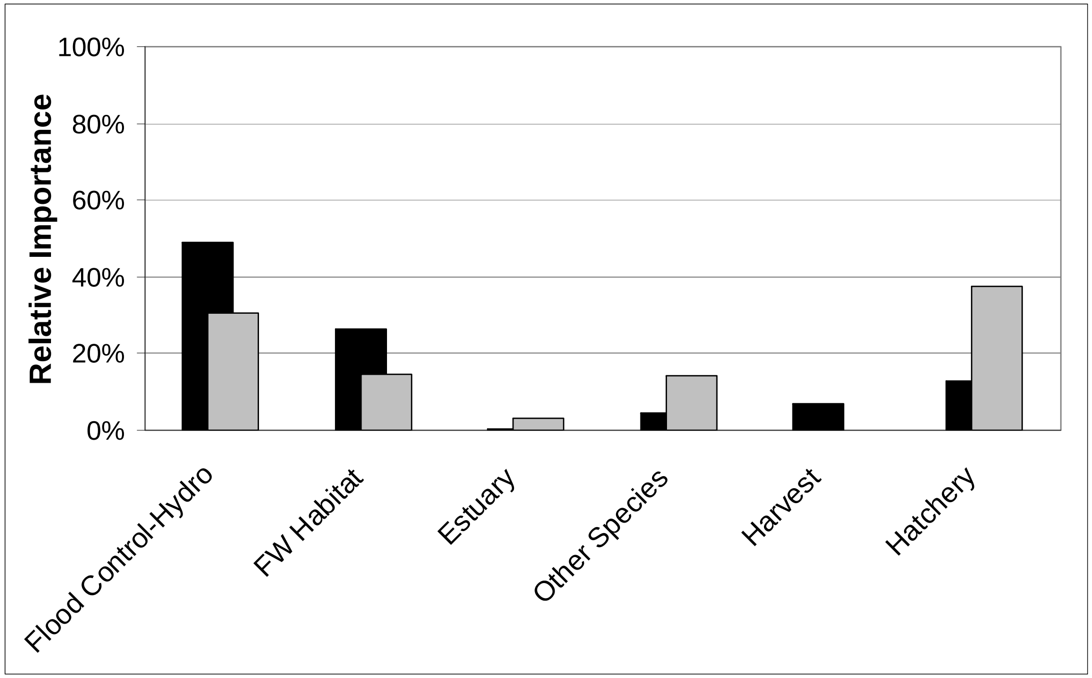

Figure 6-6. For McKenzie spring Chinook, bar chart depicts the percent relative contribution of mortality for each threat category to the cumulative mortality under current baseline conditions (black bars), and the percent relative importance of each threat category to cumulative mortality under the desired status scenario (gray bars). Data are based on associated scenario table.

Table 6-16 above depicts a desired status scenario to improve the McKenzie spring Chinook population from a low risk of extinction (current status) to a very low risk of extinction. It accomplishes this with: 1) maximum mortality reductions in Estuary and Other Species threats to improve A/P; 2) moderate reductions in Flood Control / Hydro threats to improve A/P and SS; 3) small reduction in FW habitat threats to improve A/P; and 4) moderate reduction in Hatchery threats to meet a Diversity pHOS threshold for a viable population (≤ 10% pHOS) and to slightly improve A/P. Under current conditions, aggregated Flood Control/Hydro mortality has greatest relative importance to cumulative mortality, followed by FW Habitat, and it is projected that a moderate % reduction in Flood Control/Hydro mortality source and a small to moderate % reduction in FW Habitat mortality will have a large contribution to cumulative mortality reduction (Figure 6-6). As conditions improve towards desired status, there is a rebalancing of relative importance across threat categories.

Table 6-17. Threat reduction and VSP scenarios for Middle Fork Willamette spring Chinook. See the text in Section 6.2.2 for a detailed description of table organization and contents.

Middle Fork Willamette Spring Chinook																	
	Flood Control / Hydropower (subbasin)				FW Land Use Management	Estuary LFT's	Other Species	Harvest Management	Hatchery Management								
Limiting Factor Importance	Spawner Access	Juvenile Passage	Spawner Habitat Conditions	Juvenile Habitat Conditions	Adult and Juvenile Conditions	Land Use & Flood Control/Hydro	Competition / Predation	Adults	Juv Competition / Predation	Adults							
Key	2e	1f	2m	7f, 9f, 10d	8a, 9hi	5ab, 7h, 8a,10f				3a							
Secondary				7g	9a	9ahij	6e		4a								
	Mortality Rates of Threats										**Total Reduced Life Cycle Impact**			**VSP Extinction Risk Class**			
	SAM	**JPM**	**SHM**	**JHM**	**FWHM**	**EHM**	**OSM**	**HM**	**JCM**	**HFM**	**Cumulative Mortality**	**% Mortality Reduction**	**Modeled Abundance**	**A&P**	**DV**	**SS**	**Overall Risk**
Current Status	0.95	0.00	0.80	0.87	0.87	0.10	0.16	0.25	0.05	0.95	100%	---	0	VH	H	H	VH
Scenarios																	
Maintain into Future: VH Risk *Estuary Module Actions* -max reduction in EHM & OSM threats *Flood Control/Hydro Actions* -medium reduction in SAM and JPM (improve A/P & SS via access/passage actions) -medium reduction in SHM -large reduction in JHM (improve WQ, flows) *Land Management Actions* -medium reduction in FWHM ~20% *Hatchery Actions* -small reduction in HFM	0.53	---	0.64	0.42	0.69	0.08	0.08	0.25	0.05	0.81	100%	0.4%	203	VH	H	H	VH
Desired Status: Low Risk *Flood Control/Hydro Actions* -maximum reduction in SAM and JPM (maximize habitat capacity for A/P and SS) -maximum reduction in SHM (resolve pre-spawn mortality impacts)	0.32	---	0.14	0.28	0.56	0.08	0.08	0.25	0.05	0.10	90%	12.8%	5,820	L	L	L	L

-maximum reduction in JHM (improve WQ, flows)
Land Management -max. reduction in FWHM
Hatchery Actions
-large reduction in HFM to VSP pHOS standard

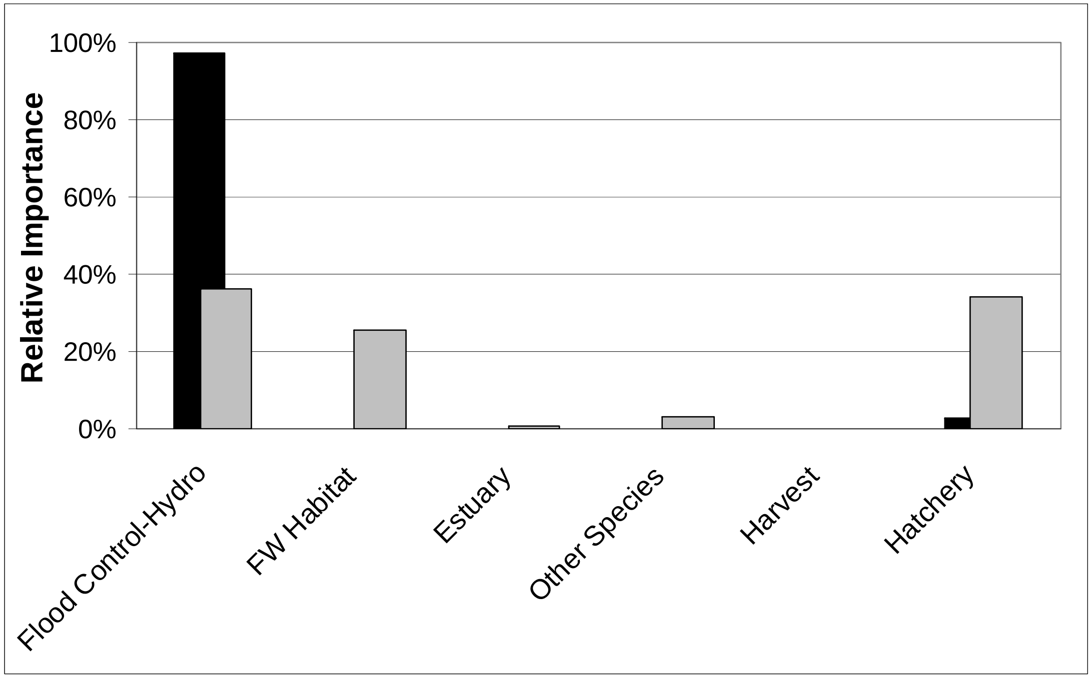

Figure 6-7. For Middle Fork Willamette spring Chinook, bar chart depicts the percent relative contribution of mortality for each threat category to the cumulative mortality under current baseline conditions (black bars), and the percent relative importance of each threat category to cumulative mortality under the desired status scenario (gray bars). Data are based on associated scenario table.

Table 6-17 above depicts a desired status scenario to improve the Middle Fork Willamette spring Chinook population from a very high risk of extinction (current status) to a low risk of extinction. It accomplishes this with: 1) maximum mortality reductions in Estuary and Other Species threats to improve A/P; 2) maximum mortality reductions in FW Habitat and Flood Control / Hydro threats to improve A/P and SS; and 3) large reduction in Hatchery threats to improve A/P and to meet a Diversity pHOS threshold for a viable population (≤ 10% pHOS). Under current conditions, aggregated Flood Control/Hydro mortality has greatest relative importance to cumulative mortality, and that a large % reduction in this mortality source is projected to have a large contribution to cumulative mortality reduction (Figure 6-7). As conditions improve towards desired status, there is a rebalancing of relative importance across threat categories.

Table 6-18. Threat reduction and VSP scenarios for Molalla winter steelhead. See the text in Section 6.2.2 for a detailed description of table organization and contents.

Molalla Winter Steelhead																	
	Flood Control / Hydropower (subbasin)				FW Land Use Management	Estuary LFT's	Other Species	Harvest Management	Hatchery Management								
Limiting Factor Importance	Spawner Access	Juvenile Passage	Spawner Habitat Conditions	Juvenile Habitat Conditions	Adult and Juvenile Conditions	Land Use & Flood Control/Hydro	Competition / Predation	Adults	Juv Competition / Predation	Adults							
Key					8a	5ab, 7h, 10f											
Secondary					2a,7a,9a, 9hi,10b	8a,9ahij	6e		4a								
	Mortality Rates of Threats										**Total Reduced Life Cycle Impact**			**VSP Extinction Risk Class**			
	SAM	**JPM**	**SHM**	**JHM**	**FWHM**	**EHM**	**OSM**	**HM**	**JCM**	**HFM**	**Cumulative Mortality**	**% Mortality Reduction**	**Modeled Abundance**	**A&P**	**DV**	**SS**	**Overall Risk**
Current Status	0.00	---	0.00	0.00	0.94	0.10	0.16	0.16	0.05	0.19	97%	---	2,456	VL	M	M	L
Scenarios																	
Maintain into Future: Low Risk *Estuary Module Actions* -max reduction in EHM & OSM threats	0.00	---	0.00	0.00	0.94	0.08	0.08	0.16	0.05	0.19	96%	0.4%	2,744	VL	M	L	L
Desired Status: Very Low Risk *Hatchery Actions* -small reduction in HFM to VSP pHOS standard	0.00	---	0.00	0.00	0.94	0.08	0.08	0.16	0.05	0.05	96%	1.0%	3,226	VL	L	L	VL

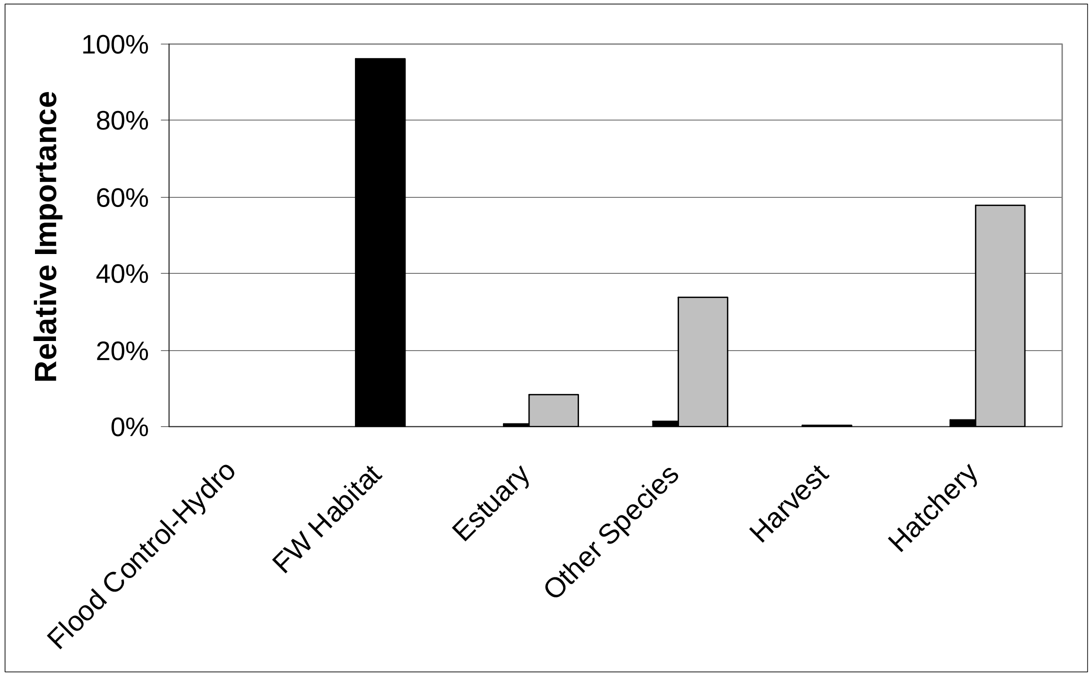

Figure 6-8. For Molalla winter steelhead, bar chart depicts the percent relative contribution of mortality for each threat category to the cumulative mortality under current baseline conditions (black bars), and the percent relative importance of each threat category to cumulative mortality under the desired status scenario (gray bars). Data are based on associated scenario table.

Table 6-18 above depicts a desired status scenario to improve the Molalla winter steelhead population from a low risk of extinction (current status) to a very low risk of extinction. It accomplishes this with: 1) maximum mortality reductions in Estuary and Other Species threats to improve A/P; 2) small reduction in Hatchery threats to improve A/P and to meet a Diversity pHOS threshold for a viable population (≤ 5% pHOS of an out-of ESU stock). Although not depicted, SS and A/P will also be improved by large reductions in FW Habitat threats that will be implemented for meeting desired status of Molalla spring Chinook. Under current conditions, FW Habitat mortality has greatest relative importance to cumulative mortality (Figure 6-8), but it is projected that mortality reductions in other categories will likely be sufficient to meet desired status goals. However, steelhead will also benefit from the FW Habitat improvements to meet Molalla spring Chinook goals, moving this population beyond the very low risk threshold. As conditions improve towards desired status, there is a rebalancing of relative importance across threat categories.

Table 6-19. Threat reduction and VSP scenarios for North Santiam winter steelhead. See the text in Section 6.2.2 for a detailed description of table organization and contents.

North Santiam Winter Steelhead																	
	Flood Control / Hydropower (subbasin)				FW Land Use Management	Estuary LFT's	Other Species	Harvest Management	Hatchery Management								
Limiting Factor Importance	Spawner Access	Juvenile Passage	Spawner Habitat Conditions	Juvenile Habitat Conditions	Adult and Juvenile Conditions	Land Use & Flood Control/Hydro	Competition / Predation	Adults	Juv Competition / Predation	Adults							
Key	2b	1d		10acd	8a	5ab, 7h, 8a,10f			4cd	3a							
Secondary		2i*	7c	7b,9d	2a,7a, 9ahi, 10b	9ahij	6e		4a								
	Mortality Rates of Threats										**Total Reduced Life Cycle Impact**			**VSP Extinction Risk Class**			
	SAM	**JPM**	**SHM**	**JHM**	**FWHM**	**EHM**	**OSM**	**HM**	**JCM**	**HFM**	**Cumulative Mortality**	**% Mortality Reduction**	**Modeled Abundance**	**A&P**	**DV**	**SS**	**Overall Risk**
Current Status	0.48	---	0.00	0.57	0.57	0.10	0.17	0.16	0.05	0.14	95%	---	3,668	VL	M	H	L
Scenarios																	
Maintain into Future: Low Risk *Estuary Module Actions* -max reduction in EHM & OSM threats *Hatchery Actions* -medium reduction in HFM to VSP pHOS standard	0.48	---	0.00	0.57	0.57	0.08	0.08	0.16	0.05	0.05	94%	1.3%	4,594	L	L	M	L
Desired Status: Very Low Risk *Flood Control/Hydro Actions* -small reduction in SAM and JPM -small reduction in JHM *Land Management Actions* -medium reduction in FWHM ~20%	0.37	---	0.00	0.48	0.48	0.08	0.08	0.16	0.05	0.05	89%	6.6%	8,362	VL	L	L	VL

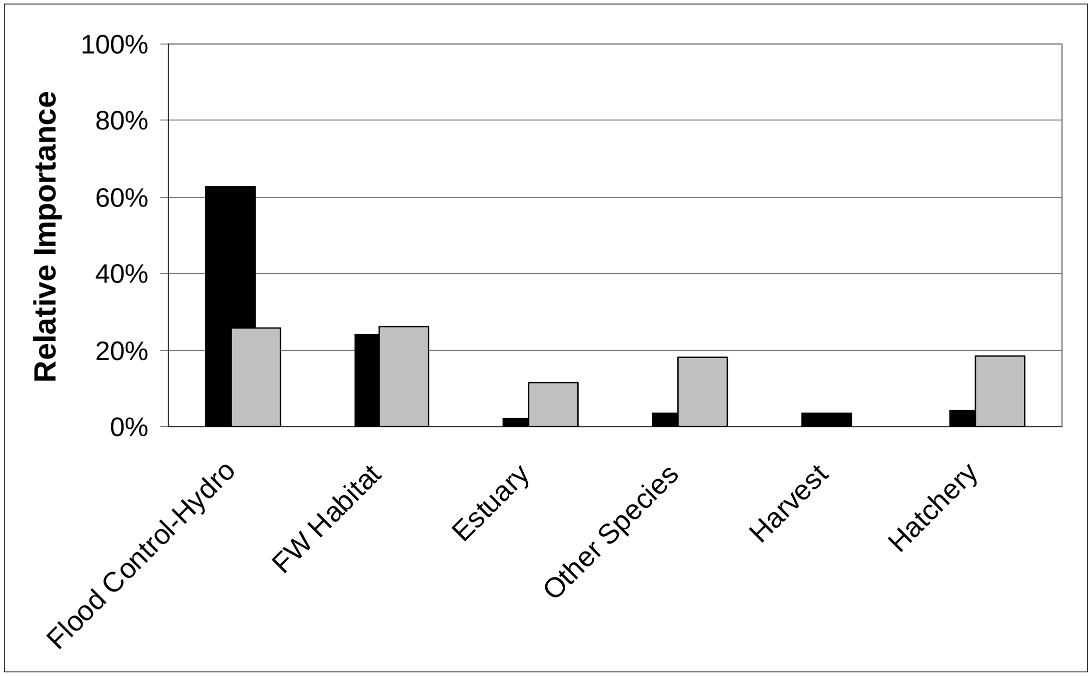

Figure 6-9. For North Santiam winter steelhead, bar chart depicts the percent relative contribution of mortality for each threat category to the cumulative mortality under current baseline conditions (black bars), and the percent relative importance of each threat category to cumulative mortality under the desired status scenario (gray bars). Data are based on associated scenario table.

Table 6-19 above depicts a desired status scenario to improve the North Santiam winter steelhead population from a low risk of extinction (current status) to a very low risk of extinction. It accomplishes this with: 1) maximum mortality reductions in Estuary and Other Species threats to improve A/P; 2) mortality reductions in FW Habitat and Flood Control / Hydro threats to improve A/P and SS, which are coupled with large reductions in these threats for actions that will be implemented for meeting desired status of North Santiam spring Chinook; and 3) small reduction in Hatchery threats to improve A/P and to meet a Diversity pHOS threshold for a viable population (≤ 5% pHOS of an out-of ESU stock). Under current conditions, aggregated Flood Control/Hydro mortality has greatest relative importance to cumulative mortality, and it is projected that a small to moderate % reduction in this mortality source will have a large contribution to cumulative mortality reduction (Figure 6-9). As conditions improve towards desired status, there is a rebalancing of relative importance across threat categories.

Table 6-20. Threat reduction and VSP scenarios for South Santiam winter steelhead. See the text in Section 6.2.2 for a detailed description of table organization and contents.

South Santiam Winter Steelhead																	
	Flood Control / Hydropower (subbasin)				FW Land Use Management	Estuary LFT's	Other Species	Harvest Management	Hatchery Management								
Limiting Factor Importance	Spawner Access	Juvenile Passage	Spawner Habitat Conditions	Juvenile Habitat Conditions	Adult and Juvenile Conditions	Land Use & Flood Control/Hydro	Competition / Predation	Adults	Juv Competition / Predation	Adults							
Key	2c	1e		10cde	8a	5ab, 7h, 8a,10f			4cd	3a							
Secondary		2j*		7d,9e	2a,7a, 9ahi, 10b	9ahij	6be		4a								
	Mortality Rates of Threats										**Total Reduced Life Cycle Impact**			**VSP Extinction Risk Class**			
	SAM	**JPM**	**SHM**	**JHM**	**FWHM**	**EHM**	**OSM**	**HM**	**JCM**	**HFM**	**Cumulative Mortality**	**% Mortality Reduction**	**Modeled Abundance**	**A&P**	**DV**	**SS**	**Overall Risk**
Current Status	0.18	---	0.00	0.66	0.66	0.10	0.17	0.16	0.05	0.04	95%	---	2,715	VL	M	M	L
Scenarios																	
Desired Status: Very Low Risk *Estuary Module Actions* -max reduction in EHM & OSM threats *Flood Control/Hydro Actions* -small reduction in SAM and JPM *Land Management Actions* -medium reduction in FWHM	0.14	---	0.00	0.66	0.58	0.08	0.08	0.16	0.05	0.04	92%	2.5%	3,912	VL	L	L	VL

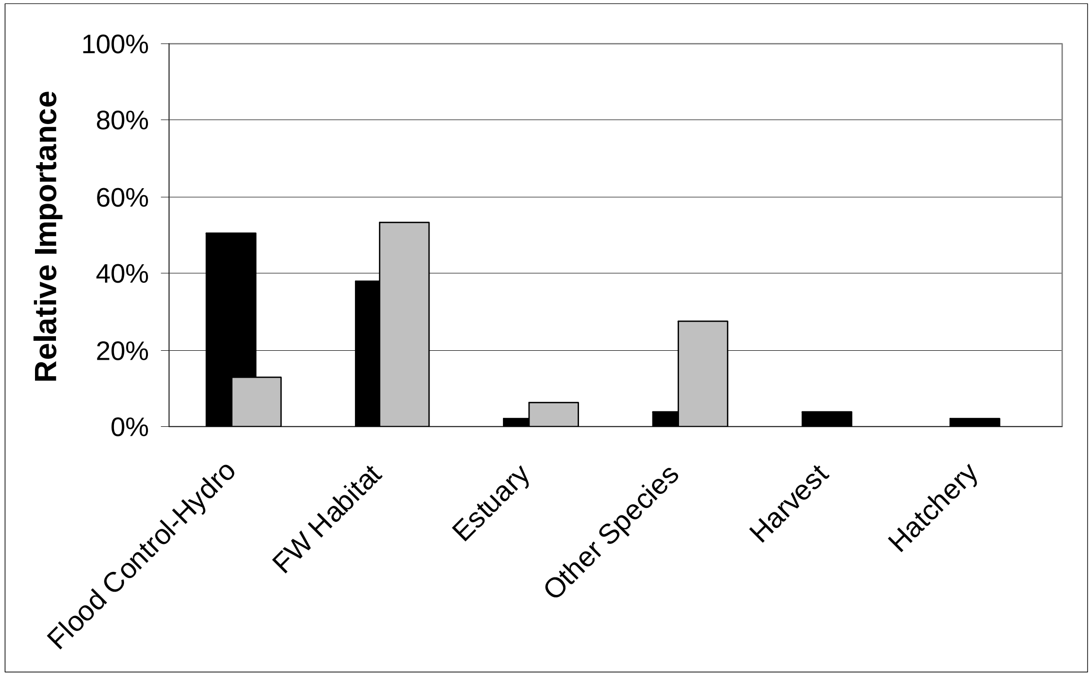

Figure 6-10. For South Santiam winter steelhead, bar chart depicts the percent relative contribution of mortality for each threat category to the cumulative mortality under current baseline conditions (black bars), and the percent relative importance of each threat category to cumulative mortality under the desired status scenario (gray bars). Data are based on associated scenario table.

Table 6-20 above depicts a desired status scenario to improve the South Santiam winter steelhead population from a low risk of extinction (current status) to a very low risk of extinction. It accomplishes this with: 1) maximum mortality reductions in Estuary and Other Species threats to improve A/P; 2) small mortality reductions in Flood Control/Hydro threats and moderate mortality reductions in FW Habitat threats to improve A/P and SS, which are coupled with large reductions in these threats for actions that will be implemented for meeting desired status of South Santiam spring Chinook. Under current conditions, aggregated Flood Control/Hydro mortality and FW Habitat mortality have the greatest relative importance to cumulative mortality, and it is projected that a small to moderate % reduction in these mortality sources will have a large contribution to cumulative mortality reduction (Figure 6-10). As conditions improve towards desired status, there is a rebalancing of relative importance across threat categories.

Table 6-21. Threat reduction and VSP scenarios for Calapooia winter steelhead. See the text in Section 6.2.2 for a detailed description of table organization and contents.

Calapooia Winter Steelhead																	
	Flood Control / Hydropower (subbasin)				FW Land Use Management	Estuary LFT's	Other Species	Harvest Management	Hatchery Management								
Limiting Factor Importance	Spawner Access	Juvenile Passage	Spawner Habitat Conditions	Juvenile Habitat Conditions	Adult and Juvenile Conditions	Land Use & Flood Control/Hydro	Competition / Predation	Adults	Juv Competition / Predation	Adults							
Key					8a	5ab, 7h, 10f											
Secondary					2ah,7a, 9ahi, 10b	8a,9ahij	6e		4a								
	Mortality Rates of Threats										Total Reduced Life Cycle Impact			VSP Extinction Risk Class			
	SAM	JPM	SHM	JHM	FWHM	EHM	OSM	HM	JCM	HFM	Cumulative Mortality	% Mortality Reduction	Modeled Abundance	A&P	DV	SS	Overall Risk
Current Status	0.00	---	0.00	0.00	0.96	0.10	0.16	0.16	0.05	0.00	98%	---	416	M	M	VH	M
Scenarios																	
Desired Status: Maintain at Moderate Risk *Estuary Module Actions* -max reduction in EHM & OSM threats *Land Management Actions* -small reduction in FWHM	0.00	---	0.00	0.00	0.96	0.08	0.08	0.16	0.05	0.00	97%	0.6%	522	M	M	M	M
ESU Viability Buffer: Low Risk *Land Management Actions* -small reduction in FWHM	0.00	---	0.00	0.00	0.94	0.08	0.08	0.16	0.05	0.00	96%	1.9%	751	L	L	L	L

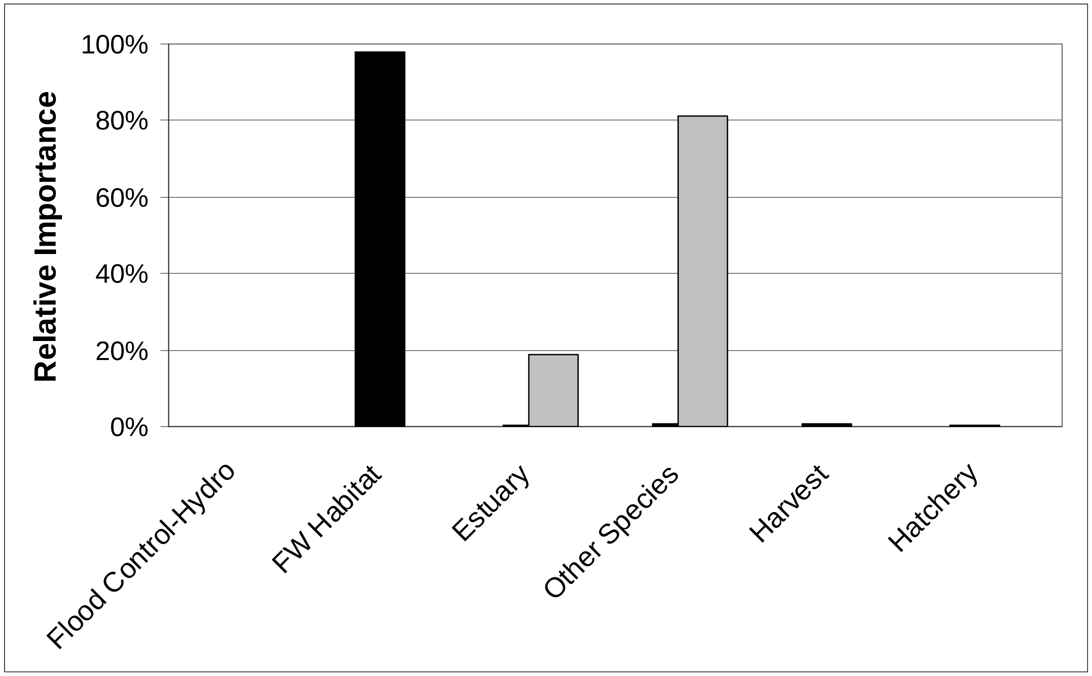

Figure 6-11. For Calapooia winter steelhead, bar chart depicts the percent relative contribution of mortality for each threat category to the cumulative mortality under current baseline conditions (black bars), and the percent relative importance of each threat category to cumulative mortality under the desired status scenario (gray bars). Data are based on associated scenario table.

Table 6-21 above depicts a desired status scenario to maintain the Calapooia winter steelhead population at a moderate risk of extinction. It accomplishes this with: 1) maximum mortality reductions in Estuary and Other Species threats to improve A/P; 2) small reduction in Hatchery threats to improve A/P and to meet a Diversity pHOS threshold for a viable population (≤ 5% pHOS of an out-of ESU stock). Although not depicted, SS and A/P will also be improved by large reductions in FW Habitat threats that will be implemented for meeting desired status of Calapooia spring Chinook. Under current conditions, FW Habitat mortality has the greatest relative importance to cumulative mortality (Figure 6-11), but it is projected that mortality reductions in other categories will likely be sufficient to meet desired status goals.

6.2.3 SLAM

The Species Life-cycle Analysis Modules (SLAM[69]) is a tool designed to model life-cycle dynamics and can be used to evaluate the effect of management actions on population abundance and viability. The SLAM tool was used to check results generated using the CATAS model and address its limitations. SLAM was used to model life-stage specific stochasticity, density dependence, delays in the effects of management changes, and cyclic patterns like inter-decadal ocean oscillations. However, since building each model (i.e. each scenario) is quite time-consuming, models in SLAM were only created for those scenarios that were most likely to be realized. Consequently, we created models in SLAM only for those scenarios that are intended to achieve targeted delisting goals.

SLAM uses repeated random sampling via a Monte Carlo simulation to generate multiple trajectories for a given scenario. Statistics on the population of trajectories, such as the mean or median trajectory with quantiles, the absolute distribution at a given time point, or the percent of trajectories that fall below a threshold value can then be used to describe the scenario. The number of individual animals is tracked through different life stages based on the survival rates from one stage to the next. Further details about development of the life cycle models and parameterization can be found in Appendix D.

In SLAM the probability of extinction is defined as the proportion of trajectories that fall below the Critical Risk Threshold (CRT) for a period of 4 consecutive years. The CRT (or quasi-extinction threshold -QET- in SLAM) is defined as the minimum population size required for a population to be self-sustaining. If a population falls below this threshold for an entire generation it is said to be functionally extinct. Since the offspring of stray hatchery fish contribute to the number of natural spawners in these models, the number of naturally-spawned hatchery origin fish that returned to spawn was added to the CRT. See Appendix D for detailed documentation on the data sources and SLAM model structure used respectively for Chinook and steelhead.

<u>Preliminary Comparison to CATAS</u>

The probability that the population abundance modeled in SLAM, using the threat reductions identified in the Scenario Analysis, would fall below the critical risk threshold (CRT) based on the parameter values for a specific risk scenario was compared to the CATAS model's probability of extinction (see Appendix D for SLAM metadata). In general there was good concordance between the projected extinction risk classes for the two model types. Exceptions were the Molalla and Calapooia spring Chinook model runs, where SLAM predicted a higher risk of extinction than the CATAS model, and in both of these cases the current abundance was below or near the CRT (Table 6-22). If the population abundance is already below the CRT it is easy to see how delays in realizing survival improvements could have a substantial impact on the proportion of trajectories where the population abundance falls below the CRT.
That the two vastly different modeling approaches (CATAS and SLAM) give similar probability of extinction results lends confidence that the threat reductions portrayed in the VSP scenarios summarized in Section 6.2 are projecting improvements in the future status of these populations within a reasonable range. However, it is also clear that when the current population abundance is low relative to the CRT it is important to use a model that can take into account delays in the implementation of recovery.

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[69] The SLAM and time-series generators created by Paul McElhany, Mirek Kos and Anne Mullan are available at http://www.nwfsc.noaa.gov/trt/slam/slam.cfm.

Table 6-22. A comparison of two PVA models. QET = quasi-extinction threshold from SLAM. When the abundance falls below the CRT or QET for 4 consecutive years the population is considered functionally extinct. Models were constructed under both CATAS and SLAM that brought the population to the same equilibrium abundance. The probability of extinction was then calculated for each model. This determined the risk category for the population.

	Current Status A&P Extinction Risk Class		Viability Scenario A&P Extinction Risk Class				
	Abundance	CATAS	CATAS Abundance	CATAS Risk Class	SLAM Abundance	SLAM Risk Class	QET
Chinook							
Clackamas	1,371	M	2,317	VL	3,500	VL	0.001
Molalla	0	VH	696	H	850	VH	0.600
North Santiam	0	VH	5,400	L	5,500	L	0.001
South Santiam	1	VH	3,100	M	4,500	VL	0.000
Calapooia	0	VH	590	H	380	VH	0.470
McKenzie	4,885	VL	8,376	VL	2,800	VL	0.002
MF Willamette	0	VH	5,820	L	2,800	L	0.011
Steelhead							
Molalla	2,443	VL	3,000	VL	1,900	VL	0.000
North Santiam	3,671	VL	8,358	VL	5,000	VL	0.000
South Santiam	2,701	VL	3,913	VL	3,000	VL	0.000
Calapooia	415	M	498	M	375	VL	0.000

SLAM was also used to explore multiple recovery scenarios for the Middle Fork Willamette Chinook population. This was done in part to test some initial assumptions of fish passage improvements through the multiple flood control facilities, and whether restoring production above Hills Creek dam would be needed for a recovery target of low extinction risk. Initial model runs indicated that the most likely projection was to achieve a moderate risk of extinction, under assumptions of passage at all large Middle Fork Willamette River dams. When assumptions of where production was allocated within different areas of the subbasin, different extinction projections were produced, ranging from high risk to low risk. To make SLAM a useful decision tool in this regard, there is a need to develop better capacity and production parameter estimates. It is assumed that RME associated with the WP BiOp (NMFS 2008a) will improve this data gap and that SLAM can then be applied to the decision making process as to how to best implement many Recovery Plan elements.

Chapter 7: Strategies and Actions

To successfully recover UWR Chinook and steelhead populations, strategies must be devised and actions implemented that are effective at: 1) reducing or eliminating the limiting factors and threats identified in Chapter 5 that currently impact viability, and 2) preventing factors that do not currently impact viability from doing so in the future. Because of the diverse life-history of UWR Chinook and steelhead populations and the broad array of limiting factors and threats that affect them, strategies and actions are needed that span their entire life-cycle and address all limiting factor and threat categories. The level to which these strategies and actions must be implemented is guided by the biological risk and threat reduction scenarios described in Chapter 6. This chapter describes the strategies and actions proposed to address the current impacts as well as those needed to prevent or minimize future impacts on UWR Chinook and steelhead populations. This chapter also describes the strategic approach used to develop and prioritize these strategies and actions. While fundamentally intended to produce biological results, strategies and actions included in this Plan also reflect economic, political, social, and cultural considerations. In particular, they are framed to regain the viability of the ESU and DPS as well as make progress toward Broad Sense Recovery Goals. These non-biological considerations are critical to the prospects for developing and implementing an effective and equitable Plan. It is expected that through time, additional actions will be incorporated as part of an adaptive management process. An approach for estimating the costs of implementing these strategies and actions are included in the Implementation chapter (Chapter 9).

7.1 Conceptual Framework

7.1.1 Key Components

The development of a comprehensive suite of actions to recover UWR Chinook and steelhead populations is based on the consideration of the following key components described in this chapter and elsewhere:

- *Threats* – human actions or natural occurrences that cause or contribute to limiting factors.
- *Limiting Factors* – threats can become limiting factors to viable salmonid populations when they interact or accumulate to the extent they degrade the physical, biological, or chemical conditions and associated ecological processes and interactions experienced by the fish.
- *Biological Risk Scenarios* – objectives for improvement in each population from the current status to a desired future status.
- *Threat Reduction Scenarios* – objectives for reducing each threat affecting any population to achieve a desired status.
- *Strategies* – general statements about how threat reduction scenarios will be achieved.
- *Actions* – specific activities that are used to accomplish strategic objectives.
- *Priority Areas* – physical locations (e.g., specific stream reaches) where an action will have the greatest beneficial effect and where the implementation of that action is most feasible.
- *Programs* – regulatory and non-regulatory mechanisms or projects that govern and/or implement actions.

The relationship between these components is shown in Figure 7-1. The development of the strategies and actions needed to recover UWR Chinook and steelhead populations are founded on the assessment of limiting factors and threats (LFTs), described in Chapter 5. The extent to which reductions in LFTs are needed for desired status objectives and how they are balanced across management regimes are projected as scenarios in Chapter 6. Many of the LFTs were specific to some life-stage or geographic area, and the UWR Planning Team helped identify priority actions for specific locations. To provide an ecological context and foundation for identifying actions, a number of overarching strategies were developed, which will be implemented by specific on-the-ground actions. Once strategies and actions were identified, existing programs or potential implementers were identified that will help implementing them.

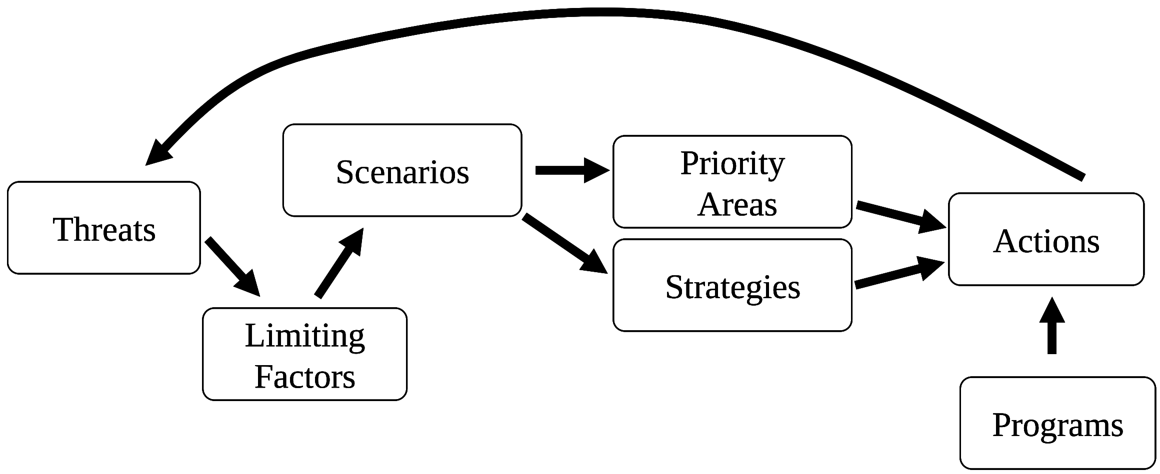

Figure 7-1. Relationship between key components of developing and implementing actions for recovering UWR Chinook and steelhead populations.

7.1.2 General Strategies

The recovery strategies developed for this Plan are based on the conservation biology goals proposed by Trombulak et al. (2004) for achieving biological diversity[70], ecological integrity[71], and ecological health[72]. Achieving these goals in the context of this Recovery Plan requires strategies that incorporate the following general principles (adapted from Groom et al. 2006):

- Act to alleviate the impacts of threats to the viability of UWR Chinook salmon and steelhead populations throughout their entire life cycle
- Set aside or protect the highest quality habitat (including Federal lands above the dams)
- Do not let habitat conditions degrade further and restore ecosystems that have been degraded
- Maintain or restore critical ecological and evolutionary processes
- Develop goals and objectives based on interaction of ecological properties of the system
- Manage fisheries and hatchery programs adaptively so their impacts on wild salmon and steelhead populations are compatible with recovery goals.
- Reduce impacts of predation that are specifically related to anthropogenic alterations to the ecosystem, and prevent the establishment of non-native species, and where necessary eliminate non-native species that have become established.
- Act as quickly as possible to achieve the goals of this Recovery Plan.

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[70] Biological diversity is a measure of the range of variety and variability within and among living organisms and the ecological complexes in which they occur.
[71] Ecological integrity is a measure of the composition, structure, and function of biological systems.
[72] Ecological health is a measure of a biological system's resiliency and ability to maintain itself over time.

Most of these guiding principles are self explanatory. The last principle (act as quickly as possible to achieve the goals of this Recovery Plan) is particularly applicable to subbasin habitat actions and interim flood control/ hydro actions. The need for implementing some subbasin habitat actions in the near term is especially critical given the time it may take for some of these actions to have their full benefit to fish recovery (e.g., shading of riparian vegetation, restoring other riparian and floodplain functions, improving water quality). These actions also need immediate implementation to help buffer against emerging threats that may increase extinction risk for some populations. Interim flood control water quality actions need to be implemented immediately and extensively to help reduce prespawn mortality and early juvenile mortality below WP dams. For four of the Chinook populations and two of the steelhead populations, the interim WP BiOp RPA actions (NMFS 2008a) will play a major role in reduce the current extinction risk, until more permanent BiOP measures can be implemented. The WP BiOp RPAs will play a major role in the success of the general strategies listed above and the more specific strategies listed below. In addition, achieving the Plan objectives will rely on effective alignment of implementing the land management actions with actions occurring under the Flood Control/Hydropower programs.

Based on these general principles, 14 recovery strategies were developed to help organize the development of recovery actions needed for UWR Chinook and steelhead populations. Successful implementation of these strategies will require intensive and coordinated efforts at regional, watershed, and local levels. The relationship between these strategies and the broad threat categories that are contributing to limiting facts affecting viability of UWR Chinook and steelhead populations are shown in Table 7-1. Many of the strategies in Table 7-1 and the on-the-ground actions in Table 7-2 will be implemented in a coordinated fashion, so that significant life-cycle bottlenecks (example: multiple LFTs affecting a critical life stage) are addressed first. For example, many Chinook populations have very high pre-spawning mortality, in some cases due to a combination of known and unknown factors. It will be critical to remove this critical life-cycle bottleneck as soon as possible, so that implementing a full suite of actions for other limiting factors will have the greatest possible biological response and not be thwarted by the presence of a bottleneck that produces high mortality for a life stage. These bottleneck strategies are embedded in the scenarios in Chapter 6 and actions to be implemented immediately are outlined in Chapter 9.

Habitat related strategies in Table 7-1 are more numerous than those for harvest and hatchery management. This does not imply a disproportionate emphasis on habitat management. Rather, there are many more limiting factors and threats in the habitat category than in the harvest and hatchery categories. For example, restoring degraded habitat in a watershed should entail overlapping strategies to address floodplain connectivity and function, riparian condition, passage impairment, inadequate streamflows, lack of habitat complexity, and degraded water quality. On the other hand, reducing the impact of fish harvest to levels that are needed for recovery simply involves a strategy to reduce fishery harvest rates.

Table 7-1. General strategies to recover UWR Chinook and steelhead populations, and their relevance to the broad threats that are impacting those populations.

	Strategy	Broad Threat Categories Addressed				
		Fish Harvest	Hatchery	Flood Control/Hydro	Land Management	Other Species
1	Protect and conserve natural ecological processes that support the viability of wild salmon and steelhead populations and their life history strategies throughout their life cycle.	√	√	√	√	√
2	Restore floodplain connectivity and function and maintain unimpaired floodplain connectivity and function.			√	√	
3	Restore riparian condition and LWD recruitment, and maintain unimpaired conditions			√	√	
4	Restore passage and connectivity to habitats blocked or impaired by artificial barriers, and maintain unimpaired passage and connectivity.		√	√	√	
5	Restore and maintain hydrologic regimes that support the ecological needs of wild salmon and steelhead populations.			√	√	
6	Restore channel structure and complexity, and maintain unimpaired structure and complexity.			√	√	
7	Restore impaired food web dynamics and function, and maintain unimpaired dynamics and function (both impacts of competition for food resources and altered ecosystem function).		√	√	√	√
8	Restore degraded water quality and maintain unimpaired water quality.			√	√	
9	Restore degraded upland processes to minimize unnatural rates of erosion and runoff, and maintain natural upland processes				√	
10	Reduce the impact of non-native plants and animals on wild salmon and steelhead populations and prevent the introduction of new non-native plants and animals		√		√	√
11	Reduce predation on wild salmon and steelhead that has been exacerbated by anthropogenic changes to the ecosystem.		√	√	√	√
12	Manage fisheries so that harvest impacts do not compromise the recovery of wild salmon and steelhead populations	√				
13	Manage hatchery origin fish in ways that support the recovery of wild salmon and steelhead populations.		√			
14	Reduce or eliminate other anthropogenic sources of mortality (e.g., beach stranding of juveniles due to ship wakes in the estuary) and prevent them from becoming a problem in areas where they currently do not occur.	√	√	√	√	√

7.1.3 Development of Actions

The actions summarized below were developed by the Planning Team with assistance from Stakeholder Team members. Most actions are on-the-ground actions that address a key or secondary limiting factor, as described in Chapter 5, and which will contribute to improving VSP attributes and addressing listing factors (as scoped in Chapter 6 scenarios). Other actions are associated with coordination, reporting, and RME needs. For most populations, some level of watershed assessment had been completed that allowed the Planning Team to identify reach- or stream-specific locations for implementation of specific habitat actions. For populations lacking watershed assessments, the Planning Team used its professional judgment to identify locations for implementing specific habitat actions. For most of the Flood Control/Hydro actions, this Plan used the WP BiOp RPAs (NMFS 2008a) as a base set of actions. For estuary actions, this Plan used the NMFS Estuary Module actions as a base set of actions. This Recovery Plan has the highest likelihood of being successful in the shortest amount of time if actions that address the key and secondary limiting factors can be implemented in those areas and for life stages where the greatest benefit will result. This approach will also ensure that the greatest gains in recovery can be made if implementation funds are limited.

Building on Past and Current Efforts

Many steps have already been taken or are currently underway that will improve the status of UWR Chinook and steelhead. In the Willamette River mainstem and population subbasins, State and Federal natural resource managers, local governments, watershed councils, soil and water conservation districts, non-profit organizations, land owners and others continue to improve stream conditions to support viable Chinook and steelhead populations. They are also improving land use practices on uplands and floodplains that are allowing natural ecosystem functions and processes to recover. Efforts underway in the Columbia River estuary will improve estuarine and plume habitats and reduce predation. In the mainstem Columbia River, hydrosystem managers and fish resource managers continue to refine hydropower system operations to address the needs for survival and recovery of Chinook and steelhead from the UWR and other Columbia River ESUs/DPSs. New and innovative actions are being required by the WP BiOp (NMFS 2008a). As described in Chapter 5, extensive harvest management changes in both the Willamette River mainstem and subbasins have already been implemented to reduce the impacts of fisheries.

Much of the existing conservation effort in the region has been guided by a number of regional management plans that have been developed over the last few decades. See Appendix F for a listing of these plans. Many of the actions identified for this Recovery Plan originate in these earlier plans. Successful implementation of this Recovery Plan relies on the combined effort of State and Federal agencies, local governments, watershed councils, soil and water conservation districts, non-profit organizations, local land owners and others committed to the recovery of UWR Chinook and steelhead populations. Most, if not all, of these entities have existing programs that have contributed in the past and in the future will be integral to the implementation of the actions identified in this recovery Plan. Some of these programs are capable of accomplishing their goals with the resources at hand, while others are in need of additional resources in order to fully implement necessary actions. See Appendix G for a listing and description of the key programs that will be involved in implementing many of the actions identified in this recovery Plan.

Enhanced Effort and Innovative Actions

Although past and current efforts continue to play an important role in maintaining the current status and setting the foundation for recovery of UWR salmon and steelhead populations, there is an obvious need for enhanced effort and some innovative approaches. The actions identified for this Plan represent a mixture of continuing actions that are currently working, enhancing the effort for actions that should work if more resources are available for their implementation, and new and innovative actions that are not currently being implemented.

Uncertainty- The Role of Research, Monitoring, and Evaluation

As with developing the biological and threat reduction scenarios, there is uncertainty with how much abundance and productivity will improve given the implementation for some of the strategies and actions. As a result, it is difficult to determine how comprehensive and intense these actions need to be implemented in order to contribute to the desired status for populations. The status and trend and effectiveness monitoring that are outlined in Chapter 8 (RME) will need to be implemented to determine the biological effectiveness of these actions, and integrated in the adaptive management part of this Plan. Uncertainty in survival improvements is not uniform across the suites of actions. For example, actions related to harvest reductions would have more certainty, where an enforceable reduction in harvest will result in a commensurate improvement in spawner abundance, through greater ocean and in-river survival and greater escapement. However, it is also assumed that further reductions in harvest will do little to improve the VSP parameters until key and secondary LFTs and related life-cycle bottlenecks are alleviated. The fish passage actions related to Flood Control/Hydro management also have clear VSP benefits for: 1) adult spawning success (increased productivity, greater spatial structure, less hatchery fish influence) through access to better habitat and less prespawn mortality in wild fish focus areas, and 2) subsequent juvenile survival (productivity). Although VSP improvements are clearly linked to actions that improve tributary and estuary habitat, their implementation is less certain, primarily because they rely heavily on the voluntary efforts of individuals. It may be that individual stream improvement efforts will not be scaled sufficiently to restore enough spatial continuity within a stream to restore riparian and hydrologic function. Coordinated watershed strategies with a multitude of entities will be needed to prioritize and locate actions in stream reaches, and to identify appropriate metrics that can be monitored to reduce uncertainty with action effectiveness.

Linking Actions to Recovery Goals

The population recovery scenarios in Chapter 6 projected survival improvement targets across major threat category to meet A/P VSP targets. We assume that VSP targets and other biological criteria will be met for each UWR Chinook and steelhead population (and thereby achieving a significant ESU recovery goal) by implementing actions in this chapter that reduce key and secondary LFTs. Ideally, it would be desirable to identify the contribution of major suites of actions towards closing the gap between current status and desired status of individual populations. This would allow a more quantitative assessment as to whether the suite of actions in the plan will, when considered in total, achieve the Plan goals. However, our current understanding of the biological response to many of the habitat and “other species” actions precludes such a sufficiency assessment. Instead, this Plan will rely heavily on monitoring the population VSP metrics (described in Chapter 8), in order to provide timely information on both overall progress being made toward achieving VSP targets (population desired status) and the contribution of major actions towards that progress. If monitoring indicates insufficient progress is being made, strategies and major actions will be: 1) recalibrated to increase the level of implementation for some actions, 2) redirected or re-weighted some actions, or 3) integrated into a new set of strategies and actions. As such, this Plan will be modified as part of the adaptive management process outlined in Chapter 9.

Immediate Action

A recurring theme that surfaced during discussions with both the UWR Planning and Stakeholder Teams was the need for immediate implementation of some actions that would “stop the bleeding” and prevent a further decline in the status of UWR Chinook and steelhead populations. Most UWR Chinook populations are currently at a high or very high risk of extinction, and most of these populations are targeted in Chapter 6 (Recovery Scenarios) for lower risk levels. It is critical that some actions that will have immediate effect be implemented now to reduce the probability of extinction. Other actions that will have accruing long term benefits should also be started soon, because these actions will have a larger bearing on progress towards desired status risk level goals. The actions identified in this Plan represent a combination of actions that will have a relatively immediate impact on reducing significant threats to UWR Chinook and steelhead populations (e.g., some hatchery broodstock actions, some interim flood control/hydro actions) as well as actions that will take a longer time before impact reductions are realized (e.g. some habitat actions, some long-term flood control/hydro actions). To meet recovery goals, it is important to implement as soon as possible short-term and long-term restoration actions, as well as protective actions, to stop the decline and begin reducing the risk of extinction on UWR Chinook and steelhead populations. This Plan utilizes a priority setting process based on the strategies (above) and other considerations that are further outlined in Chapter 9, to identify strategies and actions that are the most urgent to implement.

<u>Actions to Address Emerging Threats</u>

In addition to detailed descriptions of current threats and limiting factors, Chapter 5 provided an overview of what UWR Chinook and steelhead populations may confront with projected effects of climate change and human population growth. For this Recovery Plan to succeed, it is important that actions be implemented now that prevent or mitigate for these future impacts. It is anticipated that strategies and actions addressing these emerging threats are not fundamentally different than the actions already in this Plan to address existing LFTs. However, some limiting factors may extend to more life stages or to larger spatial areas, such that existing actions may have to be implemented over a greater area and with more intensity. In addition, some areas may become more important for protection and restoration. For example, UWR stream reaches that drain the Cascade ecoregion may have even greater significance within a recovery strategy if they provide coldwater refugia under climate change scenarios that project warmer summer water temperatures. This would further emphasize the need for fish passage improvements in most subbasins via WP BiOp actions, and possibly the need for protective and restoration measures on publically-owned lands (USFS, BLM) above fish passage barriers and in upper subbasins. Section 9.1.1 in Chapter 9 outlines the strategic guidance to implement actions in the plan, and includes a set of focal issues related to emerging threats, and identifies strategies and actions that address these issues. In the Table 7-2 action matrix, there are codes for actions that have relevance to human population growth and climate change.

7.2 Actions Needed for Recovery

7.2.1 Overarching Approach to Recovery Actions

Most of the actions listed in Table 7-2 are intended to address current and emerging LFTs to the UWR Chinook and steelhead populations. These "LFT" actions are intended to be implemented at levels and in a manner where they reduce significant life-cycle bottlenecks at the population level. Guidance on mortality reduction targets for these bottlenecks and LFTs are outlined in the recovery scenarios (Chapter 6). Effective implementation of some of these on-the-ground actions will require some initial or ongoing: 1) monitoring of current population performance and habitat conditions, 2) assessment of action feasibility, 3) assessment of best approach among potentially competing ways to implement an action, and 4) research on critical uncertainty about a mortality source and effective actions to reduce that mortality source. Many of these "RME" (research, monitoring and evaluation) actions will be further defined through the adaptive management process outlined in Chapter 9. The actions listed in the sections of Table 7-2 are intended to meet the following overarching objectives for each broad threat category.

<u>Flood Control/Hydropower Management</u>

The highest priority actions in this Plan include those to address the direct impacts of flood control/hydropower and dam/reservoir operations are targeted at restoring adult access to and spawning success within historic production areas, reducing adult pre-spawning mortality above and below barriers, reducing juvenile downstream migration mortality through reservoirs and structures, and improving habitat attributes by adjusting flows, water temperature regimes, sediment loads, and large wood recruitment to more natural levels. These actions are intended to increase survival of multiple life stages and create better habitat and food sources in the project subbasins and estuary for juvenile Chinook and steelhead. Most of the actions are identified and will be implemented through the WP BiOp (NMFS 2008a). Integral to the WP BiOp and a benefit to the ESUs are the Reasonable and Prudent Alternatives (RPAs) that delineate how facility maintenance, inspections, and emergency protocols are to be reported and implemented. In some instances RME and workgroups are proposed to better understand the level of change needed and how to make the desired changes to dam/reservoir operations. The WP BiOp also includes several RPAs that represent significant structural and operational changes to the Willamette Project, including downstream passage structures, a temperature control structure, and upgrades to several adult handling facilities. The action table below includes the most significant WP BiOp RPAs relative to how they reduce LFTs. In some cases this Plan has identified, either through provisional modeling or other analyses, where further Willamette Project actions will be needed to assist recovery of the UWR ESUs.

In addition to the subbasin effects of the Willamette Project on UWR ESU LFTs, there are cumulative effect of some Columbia River Hydro impacts that occur downstream of the Willamette basin in the Columbia River estuary. These impacts are being addressed to some extent within the FCRPS BiOp (NMFS 2008e) and the Estuary Module (NMFS 2008b). The table below includes these actions.

Land/Water Management - Subbasin and Willamette River Mainstem Habitat

Subbasin habitat actions are focused on protecting existing functional physical habitat, restoring degraded habitat reaches (adequate pools/glides/riffles, side channels, cover structures, spawning gravels) and improving water quality/quantity. One key component of this is the continued protection of spawning and rearing habitat in public (Federal) lands above the dams in the North Santiam, South Santiam, McKenzie and Middle Fork sub-basins. In addition, there are short-term and long-term strategies and actions that can be located and scaled sufficiently to create complex stream habitat features that can restore hydrologic connectivity with the adjacent riparian area and floodplain. In the short-term, subbasin habitat actions are proposed to help encourage the placement of large wood in streams to create reach complexity, and to protect key stream reaches that contain summer holding pools for Chinook adults. This latter action is augmented by actions that reduce harassment and poaching of adults in summer holding pools. These actions are intended to bridge the gap until long-term habitat actions begin restoring natural habitat forming processes. In the long-term, this Plan proposes creating or improving/maintaining riparian areas to provide a continual source of large wood and other functions (example: shade and filtering functions) that benefit water quality/quantity and complexity. Water quality improvement actions are proposed, many of which are to be implemented through TMDL implementation plans and other supporting programs. Actions are also proposed to identify sources of sediment entering streams and approaches to reduce or eliminate those sources. Actions are also identified to encourage water conservation and coordination of water withdrawals for permitted users. Subbasin habitat actions within smaller tributaries are more focused on steelhead, as Chinook do not often spawn in smaller tributaries. However, Chinook that spawn and rear in larger order streams downstream of steelhead will benefit indirectly from the actions identified and implemented in upstream steelhead habitat, as water quality improvements and habitat forming processes are transmitted downstream. Watershed assessments and Watershed Council action plans will be used to refine the locations for specific habitat actions.

The Willamette River mainstem supports both winter steelhead and spring Chinook at various life stages throughout the entire year. Juvenile Chinook and steelhead also enter the Westside tributaries to rear. The key and secondary limiting factors in the mainstem Willamette and Westside tributaries are related predominately to land use (see Chapter 5 for a full description).

Emerging Threats

There are several actions in Table 7-2 that are indexed for addressing climate change and human population growth. A needed information element (and RME action in this Plan) is to do a formal risk analysis at the population level, specific to climate change projections. This assessment will help prioritize existing actions and identify new strategies and actions.

Land/Water Management - Estuary Habitat

Estuary habitat actions seek to protect and restore habitat complexity (shallow waters, side channels, cover vegetation and structures, riparian areas, wetlands), habitat accessibility (tide gates, other structures) and water quality/quantity. Many of these actions came from the Estuary Module (NMFS 2008b) and apply to the mainstem Columbia River from its mouth to Bonneville Dam and the lower Willamette River below Willamette Falls. The actions identified seek to prevent and reduce invasive species; reduce impacts of development activities; reduce pollutants; and restore and protect off channel, side channel, and riparian habitats. UWR Chinook and steelhead will receive some benefits from these estuary actions, and the most relevant ones from the Estuary Module are included in the table below.

Other Species Management

Increased rates of predation are associated mostly with alterations of stream and estuarine habitats, past management practices to introduce exotic species, and the uncoordinated actions of individuals. Actions related to predation are included in the Table 7-2. Actions to address predation focus on reducing the impacts of birds and fish in the estuary, but RME is included to evaluate the impact above Willamette Falls. As noted in previous chapters, actions addressing predation and competition from hatchery programs are ascribed under hatchery management actions.

Harvest Management

Actions related to harvest seek to keep or reduce harvest to levels that do not inhibit recovery. This Plan relies on the goals and actions identified in the Willamette Chinook and steelhead FMEP’s and the Harvest BiOps (NMFS 2008c, NMFS 2008f) to assure harvest risks are managed appropriately (see Chapter 5).

Hatchery Management

Reducing interactions between wild and hatchery fish are the focus of actions related to hatchery management. These interactions are guided by the LFT assessment of hatchery impacts. On-going adult monitoring actions will continue to provide estimates of the level and location of naturally spawning hatchery fish, and an evaluation process will be in place to guide the most effective strategy for reducing hatchery fish on natural spawning grounds. Other actions will examine whether hatchery programs are creating negative ecological effects for wild juveniles via competition or predation. Where negative interactions are found, ODFW proposes to adjust hatchery releases, modify hatchery techniques, and/or remove returning adult hatchery fish.

As passage conditions for adult and juvenile fish begin to improve through actions associated with the WP BiOp, this Plan supports the development of wild fish management areas (similar to the Clackamas subbasin upstream of North Fork Dam) in the upper subbasins of the North and South Santiam’s, Mckenzie, and Middle Fork Willamette populations. Currently, hatchery fish are outplanted in these upper subbasins to meet several fish management needs, including supplementing production, and there is support among the fishery co-managers to continue these releases to also meet RME needs associated with the WP BiOp. Eventually, hatchery fish will be used to initiate a more formal re-introduction program, and as wild populations recover to some level, outplanting of hatchery fish will be discontinued. A provisional set of conditions for transitioning from an out-planting program using surplus mitigation hatchery broodstock to a re-introduction program are described in the hatchery management actions in the tables below and in Appendix E. Co-managers are soliciting input from regional experts on the best way to manage the hatchery broodstock now to minimize long-term risk to fish productivity and diversity.

Chinook Salmon Recovery for Extirpated Populations

As noted in Chapter 4 some UWR Chinook populations are considered nearly extinct or extirpated from their natal basins, and there is a need in some cases to deliberately reintroduce fish into those subbasins to start a production cycle. For example, few, if any naturally produced Chinook currently exist in the Molalla and Calapooia basins, and one strategy is to proceed with habitat improvements and allow these subbasins to be re-seeded naturally with Chinook salmon strays from other subbasins. However, in the case of the Molalla population, members of the Planning Team thought this approach would take too long and would not guarantee restoring populations in this subbasin. So, for the Molalla, a provisional proposal has been developed that couples habitat improvements with development of a conservation hatchery program from an identified hatchery stock that would eventually produce a localized broodstock. Details of this strategy are in Appendix E. For the Calapooia Chinook population, this Plan proposes to evaluate whether natural seeding will occur as a result of habitat improvements. If over time it is determined that reintroduction actions are necessary, the RME/Adaptive Management portion of this Plan will outline steps to accomplish reintroduction in the Calapooia.

7.2.2 Summary of Actions

Table 7-2 organizes the recovery actions of this Plan according to how they address the LFTs that were identified for the Chinook salmon and steelhead populations. Therefore the table uses the heading framework from the CH 6 scenarios tables to help indicate where and how an action should be implemented. Chapter 9 provides more detailed information on the actions, including the specifics of the LFTs and life stages being affected, priority locations, and estimated costs and implementation timeframes.

There are several tiers of actions:

Higher-level strategies/actions/processes to decrease general threats across the ESU/DPS, or to administer and support adaptive management and RME

Many of these actions are intended to build the information structure for adaptive management and RME, increase coordination of existing programs, and increase funding for analyses, reporting, and coordination. Many of these actions will also address the uncertainties associated with climate change, and some outline the larger planning and management efforts that will be needed to address the effects that human population growth will have on UWR Chinook and steelhead.

Strategies and actions focused mainly on decreasing LFTs in the estuary

This Plan assumes the estuary actions identified in the Estuary Module and additional estuary actions identified in the OrLCR Plan will be implemented and will benefit the UWR ESU and DPS. Therefore this Plan includes actions from that plan which were determined to reduce LFTs to UWR populations. Those actions are included in Table 7.2.

Strategies and generalized actions focused on decreasing LFTs in freshwater

These actions apply to all UWR populations, and are mostly organized around actions that have relevance to the freshwater ecosystem. Some of these are specific to decreasing LFTs, while others are programmatic within public agencies to protect existing habitat and water resources. Some of these actions represent the continuation of ongoing efforts, while others will require enhancements of existing efforts in order to achieve the recovery goals set out in this Plan.

Strategies and actions focused on decreasing LFTs in the mainstem Willamette River

These actions apply to LFTs identified in the mainstem Willamette River above Willamette Falls. They are a mixture of land protection actions, actions within existing programs for administering uses on urban and rural lands, water quality and flow actions, and on-the-ground actions to restore habitat complexity in the mainstem Willamette River so that it can support rearing and migration of juvenile salmonids. In addition, some of these actions will be applied across all the subbasins, and are not specific to a given subbasin. Since most UWR populations use portions of the mainstem Willamette River for rearing and migration, the habitat actions addressing Willamette River mainstem LFTs will benefit multiple populations. In addition, there are some habitat actions in lower reaches of West-side tributaries that could increase the amount of rearing habitat for multiple populations. However, given these reaches are not within the primary production areas for the designated independent populations, they are given lower priority for habitat improvement relative to improvements needed in the natal subbasins and the mainstem Willamette.

Actions focused on decreasing LFTs within specific subbasins and populations

This section of Table 7.2 shows all the LFTs affecting a population, but only shows the actions that will be focused within the natal subbasin for that population.

Table 7-2. A summary of LFTs for the UWR Chinook salmon ESU and steelhead DPS, and actions to address those LFTs at different levels of organization and spatial scales. Refer to Chapter 5 for legend of LFT codes. Many of the actions have already been identified in supporting plans and are identified in the "Actions" column here as follows: "FCRPS" actions are from the RPA's in the Federal Columbia River Power System BiOp (NMFS 2008e), "CRE" actions are from the Estuary Module (NMFS 2008b), and "WP BiOp RPA" actions are from Willamette Project Biological Opinion (NMFS 2008a). Table subheadings include definitions of other acronyms that are used to categorize actions and are applied to the "Action ID" suffix. An "x" in the LFT matrix indicates that action has a relationship to reducing that LFT, or is related to RME. Within the estuary actions, management domains to address LFTs were indicated as land use management (LUM), flood control/hydropower (FCH), fish harvest management (HVM) and hatchery management (HTM). In the "Future Threats" column, "pg" and "cc" refer to actions and strategies that have relevance to population growth and climate change respectively.

		Flood Control / Hydropower (subbasin)				FW Land Use Management	Estuary LFT's	Other Species	Harvest Management	Hatchery Management			
Action ID	**Action**	**Spawner Access**	**Juvenile Passage**	**Spawner Habitat Conditions**	**Juvenile Habitat Conditions**	**Adult and Juvenile Conditions**	**Land Use & Flood Control/Hydro**	**Competition / Predation**	**Adults**	**Juv Competition / Predation**	**Adults**	**Emerging Threats**	**RME**
ESU: Higher-level Strategies/Actions/Processes to decrease General Threats across ESU/DPS, or Administer & Support Adaptive Management/RME													
ADM: Adaptive Management / Implementation / RME / Information and Education / Plan Support and Administration													
PHQ: Actions that decrease Physical Habitat Quality Limiting Factors													
WQH: Actions that decrease Water Quality / Water Quantity / Hydrograph Limiting Factors													
CPP: Actions that decrease Competition, Predation, and Population Trait Limiting Factors													
1 - ESU-ADM	Develop three-year Implementation Schedules across and within populations for priority actions at a site-specific scale based on existing reach-specific habitat assessments, identified regulatory requirements, other threat reduction needs, research and monitoring needs, and adaptive management.	x				x	x		x		x	cc, pg	x
2 - ESU-ADM	NMFS support coordination of organizations and funders who help provide and implement incentive programs for landowners.	x				x			x		x	cc, pg	x
3 - ESU-ADM	Complete annual reporting for this plan and coordinate adaptive management actions as necessary and indicated by monitoring and reporting results.	x				x	x		x		x	cc, pg	x
4 - ESU-ADM	Regularly update inventories and maps of instream habitat					x	x						x

	conditions, water quality, wetlands, and riparian conditions (including restoration projects) to more accurately capture current habitat conditions.												
5 - ESU-ADM	Identify whether there are dependent and independent winter steelhead populations in West-side tributaries, and if appropriate, determine status goals for them.												x
6 - ESU-ADM	Assess adequacy of local regulatory programs to address listing threat factors within the federal ESA framework (e.g., 5-year status reviews, delisting decision, other).	x			x	x			x		x		x
7 - ESU-ADM	Implement credible, science-based programs, policies and rules that contribute collectively to protect fish and water resources.	x				x	x	x	x		x	cc, pg	x
8 - ESU-ADM	Provide adequate funding and staffing for existing programs to achieve their mandates.	x				x			x		x	cc, pg	x
9 - ESU-ADM	Enhance efforts to enforce existing land use regulations, laws, and ordinances.					x	x						
10 - ESU-ADM	Form a UWR-specific hatchery genetic technical group (HGTG; comprised of RIST and other experts) to conduct scientific review of current UWR hatchery programs and develop recommendations for achieving a conservation (reintroduction) hatchery program or suite of strategies that promotes and maintains a locally adapted population in the short term (until other LFT conditions are improved), and how to maintain VSP attributes and recovery goals while managing within a split basin management framework where there are hatchery mitigation goals in lower subbasins.										x		x
11 - ESU-ADM	(similar to FCRPS RPA 7) To address forecasting and climate change/variability, hold annual forecast performance reviews and report on effectiveness of experimental or developing/emerging technologies.	x				x	x		x		x	cc	x
12 - ESU-ADM	Conduct detailed climate change risk analysis for all populations and use this to help prioritize existing actions, or develop new ones. Incorporate these into the Implementation Schedule.	x				x	x	x	x		x	cc	x
13 - ESU-ADM	Adequately fund and implement RME needed to answer critical uncertainties related to the assumptions under which the recovery plan was developed.	x				x		x	x		x	cc, pg	x
14 - ESU-ADM	Participate in the development of emerging ecosystem markets and ensure they are shaped to be consistent with recovery goals and actions.					x	x					cc, pg	x
15 - ESU-ADM	Fund development and maintenance of web-based data management and reporting, including tracking needs and accomplishments by entity through a map-based depiction of prioritized actions and locations.	x				x	x		x		x	cc, pg	x
16 - ESU-ADM	ODFW and NMFS provide expanded staffing support as needed to develop and coordinate Recovery Plan Implementation schedules and actions with associated processes and programs (example: WP BiOP RME and other WP BiOP WATER teams).	x				x			x		x	cc, pg	x

17 - ESU-ADM	State of Oregon agencies clearly describe the large wood goals in subbasins and potential ways to achieve these goals.	x				x							
18 - ESU-ADM	Provide liability protection for landowners that participate in restoration projects.					x	x					cc, pg	x
19 - ESU-ADM	Explore land use strategies and regulations to reduce ownership fragmentation, including, but not limited to, acknowledging the importance of family owned forests and supporting actions that help sustain working family owned forests.					x	x					cc, pg	x
20 - ESU-ADM	Promote and provide technical support for volunteer efforts of private landowners and user groups to increase the amount of large wood in stream channels (e.g. site-specific riparian management plans, placement of large wood, reducing removal).					x	x						x
21 - ESU-ADM	Provide technical and financial assistance to landowners with property damage due to beavers, and provide incentives to landowners that want to manage their land to achieve the habitat benefits provided by beaver dams.					x							x
22 - ESU-ADM	Expand monitoring of populations to track status and trends of VSP metrics and improve understanding of the composition of natural spawners (what type/pHOS? how many? where from? timing?), other life history information, and habitat.	x				x			x		x	cc	x
23 - ESU-ADM	Determine funding sources and strategies to implement monitoring needed to track progress towards achieving recovery goals.	x				x	x		x		x	cc	x
24 - ESU-ADM	Provide education on the goals of recovery plans, what is needed to achieve these goals, and how citizens can contribute.					x							
25 - ESU-ADM	Continue to fund outreach efforts that have known success in educating and engaging landowners.					x							
26 - ESU-ADM	Fund OSU Extension Service to provide Riparian Function Workshops for all Oregon Plan participants to improve success rate of volunteer projects.					x						cc, pg	
27 - ESU-ADM	Provide education and outreach to contractors, developers, and resource owners.					x	x					cc, pg	
28 - ESU-ADM	Implement and expand upon I&E to use demonstration sites where landowners can view the results of various types of restoration efforts. Focus on demonstration sites where the landowner was active in the restoration activity.					x	x					cc, pg	
29 - ESU-ADM	Mark all hatchery fish to support harvest management goals and hatchery managements goals.								x		x		x
30 - ESU-ADM	Support tagging efforts and different tagging types and technologies from each hatchery release to meet RME and management goals.								x		x		x
31 - ESU-PHQ	Develop proactive framework to minimize future development impacts in key reaches and floodplains.	x				8a	x					cc, pg	x
32 - ESU-PHQ	Where habitat restoration targets exist and progress toward					8a						cc,	x

	them is tracked, but where targets are not being met in the first five years of implementation.											pg	
33 - ESU-PHQ	DSL will work within existing mandates to facilitate implementing habitat actions in this Plan.					8a	x					pg	
34 - ESU-PHQ	(similar to CRE-15) Reduce the introduction and spread of invasive plants by implementing education and monitoring projects that increase public awareness of exotic plant species and proper stewardship techniques.					8a		x					
35 - ESU-PHQ	Provide enhanced incentives for habitat restoration work.					8a	x						
36 - ESU-PHQ	Conduct sediment source analysis and then implement actions to reduce sediment from identified sources.	x				x	x						
37 - ESU-PHQ	Improve coordination and streamlining of habitat restoration efforts for a) impaired instream habitat complexity, b) floodplain processes and access to off-channel habitat by increasing lateral movement with improvements in revetments, dikes and floodwalls, and c) riparian conditions	x				x	x						
38 - ESU-WQH	(similar to CRE-20 but expanded to include FW areas) Reduce non-point sourcing and loading of nutrients and pesticides from land use activities in subbasin streams, the Willamette River mainstem, and estuary. Implement pesticide and fertilizer BMP's to reduce loading.					9h	9h					cc,pg	
39 - ESU-WQH	Support RME that evaluates cumulative and interactive effects of contaminants on different salmonid life stages.					9i	9i						x
40 - ESU-WQH	(CRE-23) Implement stormwater BMP's in cities, towns, and rural areas.					9i	9i						x
41 - ESU-WQH	Provide more technical resources and incentives to small (non-metropolitan) communities so they have the infrastructure to better manage runoff from impervious surfaces.					9i	9i					cc,pg	
42 - ESU-WQH	(similar to CRE-21) Identify and reduce terrestrially and marine-based industrial, commercial, and public sources of pollutants.					9i	9i						
43 - ESU-WQH	Develop, update, implement stormwater management plans for urban areas and roads.					9i	9i						
44 - ESU-WQH	Develop recommendations for land management scenarios that address hydrograph changes due to climate change, impervious surfaces, and other factors that result in altered water runoff.					x	x					cc,pg	x
45 - ESU-WQH	Develop options for water banking and implement.	x				x	x					cc,pg	

46 - ESU-CPP	Continue the release of hatchery fish as smolts to reduce competition and predation with wild fish in tributaries and estuaries.							x			x		
47 - ESU-CPP	Investigate the feasibility of coordinated release timing among hatcheries, to reduce the numbers of out-migrating hatchery fish in-river at any one time.							x			x		
48 - ESU-CPP	Eliminate/reduce/shift hatchery programs to decrease mainstem and estuary competition and predation and reduce straying of hatchery fish onto natural spawning grounds							x	x		x		
49 - ESU-CPP	Require hatchery programs/releases that are new, or increased more than 10% from 2009 levels to complete or modify an HGMP and receive ODFW Fish Division approval.							x			x		
EST: Strategies and Actions focused mainly on decreasing LFT's in the Estuary ALL: All populations													
50 - EST-ALL	(see Estuary Module actions that improve habitat and flows)						5a FCM x LUM						
51 - EST-ALL	(see Estuary Module actions that improve flows)						5b FCM x LUM						
52 - EST-ALL	Work with various stakeholders to restore and develop complex habitat for rearing juveniles in the lower Willamette River.						8a LUM					cc,pg	x
53 - EST-ALL	Protect remaining shallow water habitat in estuary, especially high quality habitat in the lower estuary.						8a LUM x FCH					cc	
54 - EST-ALL	Coordinate with the Portland Harbor Natural Resource Damage Assessment and Restoration process to implement restoration in the Lower Willamette River that will aid salmon and steelhead recovery.						8a LUM						
55 - EST-ALL	Identify and acquire conservation flexibility in key salmonid habitats in the estuary.						8a LUM					cc,pg	x
56 - EST-ALL	Expand upon current efforts to remove invasive plant species where they inhibit natural or deliberate re-establishment of native riparian plant species.						8a LUM						
57 - EST-ALL	Acquire conservation management flexibility for priority sites in the PDX Metro area.						8a LUM						
58 - EST-ALL	As feasible, re-establish connection between Columbia Slough and Columbia River to improve flushing and water quality.						8a LUM						
59 - EST-ALL	(CRE-10) Breach or lower dikes and levees to establish or improve access to off-channel habitats.						8a LUM x FCH						

60 - EST-ALL	(similar to CRE-11) Reduce the square footage of over-water structures in the estuary and lower mainstem Willamette River. Where possible, modify remaining overwater structures to provide beneficial habitat.						8a LUM						x
61 - EST-ALL	(CRE-6) Reduce the export of sand and gravels via dredge operations by using dredged materials beneficially.						8a LUM x FCH						x
62 - EST-ALL	(CRE-12) Reduce the effects of vessel wake stranding in the estuary.						8a LUM						x
63 - EST-ALL	(CRE-7) Reduce entrainment and habitat effects resulting from main and side-channel dredge activities and ship ballast intake in the estuary.						8a LUM						x
64 - EST-ALL	(CRE-8) Remove or modify pilings and pile dikes when removal or modification would benefit juvenile salmonids and improve ecosystem health.						8a LUM						x
65 - EST-ALL	(CRE-5) Study and mitigate the effects of entrapment of fine sediment in Columbia basin reservoirs, to improve nourishment of the littoral cell.						7h FCH						x
66 - EST-ALL	(CRE-3) Establish minimum instream flows for the lower Columbia River mainstem that would help prevent further degradation of the ecosystem.						10f FCH						
67 - EST-ALL	(CRE-4) Adjust the timing, magnitude and frequency of flows (especially spring freshets) entering the estuary and plume to better reflect the natural hydrologic cycle, improve access to habitats, and provide better transport of coarse sediments and nutrients in the estuary, plume, and littoral cell.						10f FCH						x
68 - EST-ALL	(FCRPS RPA's 10-13) Columbia River Treaty and non-Treaty storage management, agreements, and coordination.						10f FCH						
69 - EST-ALL	(FCRPS RPA 14) Manage flow during dry years to maintain and improve habitat conditions for ESA-listed species.						10f FCH						
70 - EST-ALL	(OrLCR Plan) Draft storage reservoirs to meet lower Columbia summer flow and velocity equivalent objectives on a seasonal and weekly basis.						10f FCH						
71 - EST-ALL	(OrLCR Plan) Operate reservoirs at rule curves and seek additional flow augmentation volumes from Snake River and Canadian reservoirs to better meet spring and summer flow and velocity objectives.						10f FCH						
72 - EST-ALL	(FCRPS RPA 4) Operate the FCRPS storage projects for flow management to aid anadromous fish.						10f FCH						
73 - EST-ALL	(FCRPS RPA 5) Operate the FCRPS run-of-river mainstem lower Columbia River and Snake River projects to minimize water travel time through the lower Columbia River to aid in juvenile fish passage.						10f FCH						
74 - EST-ALL	(FCRPS RPA 6) In-season water management via water management plans and by the Regional Forum.						10f FCH					cc,pg	
75 - EST-ALL	(CRE-22) Monitor the estuary for contaminants and restore or mitigate contaminated sites.						9i LUM						

76 - EST-ALL	Incorporate and coordinate Recovery Plan actions in lower Willamette River with habitat mitigation actions to be funded with the Port of Portland Superfund Clean-Up.						9j FCM x LUM						x
77 - EST-ALL	(CRE-2) Operate Columbia basin hydrosystem to reduce the effects of reservoir surface heating, or conduct mitigation measures.						x LUM						
78 - EST-ALL	(FCRPS RPA's 8-9) Manage the FCRPS for operations and fish emergencies.						x LUM x FCH x HVM x HTM	6b				cc	x
79 - EST-ALL	(CRE-19) Prevent new introductions of aquatic invertebrates and reduce the effects of existing infestations.											cc,pg	
80 - EST-ALL	To decrease juvenile salmonid competition in the estuary and straying by adults, investigate other hatchery release strategies, reductions, or program shifts to lower river terminal areas for commercial and/or sport harvest, including those from out-of-ESU and especially if there are surplus hatchery fish which are not harvested.							x	x	4a			x
81 - EST-ALL	(similar to CRE-18) Reduce competition with non-native fish in the estuary.							4				cc	
82 - EST-ALL	(similar to CRE-13) Manage pikeminnow and non-native piscivorous fishes to reduce predation on juvenile salmonids.						x LUM x FCH x HVM x HTM	6b				cc	x
83 - EST-ALL	(CRE-16) Implement projects to redistribute part of the Caspian tern colony currently nesting on East Sand Island.						x LUM x FCH x HTM	6e			x		
84 - EST-ALL	(CRE-17) Implement projects to reduce double-crested cormorant habitats and encourage dispersal to other locations.						x LUM x FCH x HTM	6e			x		x
85 - EST-CM	Shift mainstem commercial spring Chinook harvest to terminal areas during low return years (de facto "sliding scale").								11a		x		
86 - EST-CM	Monitor harvest levels in all fishery areas for all species (direct and indirect mortality).								11a		x		x
FW: Strategies and Generalized Actions focused on decreasing LFT's in Freshwater; OC: Ocean													

ALL: All populations													
87 - FW-ALL	Improve the maintenance of fish screens and fish passage structures.	x	x		x	x					x		
88 - FW-ALL	(similar to CRE-1 but for FW areas above Willamette Falls) Protect and restore riparian areas on private lands throughout the rearing zones for Chinook and steelhead that are not covered by of riparian actions in TMDL implementation plans.					8a						cc, pg	
89 - FW-ALL	(similar to CRE-9 but for FW areas above Willamette Falls) Protect remaining high-quality off-channel habitat from degradation and restore degraded areas with high intrinsic potential for high quality habitat.					8a						cc, pg	
90 - FW-ALL	Where population-level habitat monitoring indicates statistically-significant temporal degradation of key habitat features, encourage new/revised regulatory measures for key habitat feature(s) that eliminate further degradation, protect existing high quality areas, and allow long-term/"passive" restoration in other areas.			x	x	8a						cc,pg	x
91 - FW-ALL	Restore substrate recruitment to the mainstem Willamette River from tributary areas using a combination of peak flows and substrate supplementation.			x	x	8a							
92 - FW-ALL	Maintain and restore the best available spawning, rearing, and migration habitats, and acquire reaches or management flexibility where ecological processes (function) and salmonid historical habitat are impaired or lost.			x	x	8a							
93 - FW-ALL	Remediate adverse effects of rural roads and trails on aquatic physical habitat quality and water quality. Develop funding methods for retiring USFS/USBLM roads and private roads.					8a							
94 - FW-ALL	When reviewing new permits or activities, apply road and bridge fluvial performance standards that allow free passage of fish, sediment, and flows.					8a							
95 - FW-ALL	Work with landowners on alternatives to installing riprap along the banks of rivers and streams.			x		8a							
96 - FW-ALL	Protect and conserve rare and unique functioning habitats that may exert different selective pressures on segments of the population, thereby increasing genetic and life history diversity.					8a		x				cc	

97 - FW-ALL	Support WS Councils to conduct watershed education and outreach activities for landowners and in schools.					8a							
98 - FW-ALL	Develop methodology to assess and identify, and then protect, stream reaches and population strongholds which will be resilient/resistant to climate change impacts.					x						cc,pg	
99 - FW-ALL	ID and restore priority non-functioning wetlands.					8a						cc,pg	
100 - FW-ALL	Restore natural riparian communities and their function.					8a						cc,pg	
101 - FW-ALL	Support local governments to meet future water allocation and treatment needs, and stormwater management to minimize human population growth impacts on listed Chinook and steelhead.					10b						cc,pg	
102 - FW-ALL	(In coordination with supporting actions for LFT 9a) Increase protection and implementation of appropriate instream flows for UWR salmonids by a) removing barriers to coordinating with relevant management agencies on water withdrawals, b) encouraging BMP's to conserve water and reduce pollution loads, and c) not issuing anymore water rights within subbasins.	x				10b						cc,pg	
103 - FW-ALL	Work with ODEQ TMDL program (DMA Implementation Plans) to improve temperature and other water quality standards, to prioritize implementation on high priority CHS and STW areas. Also incorporate other reporting to ID other priority reaches for LFT's 9h and 9i (toxins and nutrients)	x				9a, 9c 9h, 9i							x
104 - FW-ALL	Implement RME of headwater springs to investigate the concern that they may be drying up due to land management practices.					9a						cc	x
105 - FW-ALL	Inventory and protect seeps, springs, and other coldwater sources.					9a						cc	x
106 - FW-ALL	Limit future in-river and groundwater withdrawals so that they do not impede achievement of recovery goals.					x						cc,pg	
107 - OC-ALL	Implement the new Pacific Salmon Treaty (reduce ocean fisheries on Chinook).								x		x		
108 - OC-ALL	Support mark-selective ocean fisheries when a new PST is negotiated in 10 years.								x		x		

MST: Strategies and Actions focused on decreasing LFT's in the Mainstem Willamette River
MST/SUB: Flow actions focused in subbasins to decrease LFT's in the Mainstem Willamette River for multiple populations
ALL: All populations
AMO: Actions for populations upstream of the Molalla River (NS, SSA, CA, MK, MF)

109 - MST-ALL	Maintain safe passage of juvenile and adult Chinook and steelhead at Willamette Falls.	2n											
110 - MST-ALL	Look for opportunities to remove unnecessary revetments or increasing setbacks in the Mainstem Willamette and in subbasins. Minimize new ones in the future.				X	8a						pg	
111 - MST-ALL	Release flows from WP dams and other storage dams to meet flow targets in mainstem Willamette River for rearing and migration.			10c		x							
112 - MST-AMO	Restore structure and function to strategic natural riparian reaches in the mainstem Willamette River				8a							cc,pg	
113 - MST-AMO	Increase overall channel complexity, floodplain connectivity, and flood storage to the mainstem Willamette River to increase and improve salmonid rearing and migration habitat.				x	8a						pg	
114 - MST-AMO	Protect existing highest quality salmonid rearing and migration habitats through conservation measures, acquisition, and/or regulation.					8a						cc,pg	
115 - MST-AMO	Consistently apply BMP's and existing regulations to protect and conserve natural ecological processes, with a focus on those that affect UWR CHS and STW and the LFT's identified in this Recovery Plan.					8a							
116 - MST-AMO	Protect and restore aquatic habitat function at confluence areas of Willamette River tributaries.				x	8a							
117 - MST-AMO	Use road and bridge fluvial performance standards that allow free passage of fish, sediment, and flows in the Mainstem Willamette River and subbasins.					8a							
118 - MST-ALL	Implement and evaluate the effectiveness of the "Agricultural Water Quality Management Area Rules" (SB 1010 plans) for the mainstem Willamette River and subbasins.					9h							
119 - MST-AMO	(see other actions involving TMDL's) Support implementation plans associated with TMDL compliance and focus salmonid habitat restoration efforts in those reaches where other LFT's are being improved and productivity can be restored					9h							

120 - MST/SUB-AMO	Evaluate the potential for releasing habitat-forming flows from WP Project storage dams to complement habitat restoration activities in the mainstem Willamette River.				10d	x							
121 - SUB -ALL	ODFW District staff lead the coordination and updating of ODFW's Fish Passage Program database to document status of remaining high priority barriers or passage problem areas.	x	x			2a							x
122 - SUB -ALL	Pursue development of a cooperative agreement or habitat conservation plan with land owners to further protect fish habitat in the future.					8a							
123 - SUB -ALL	Protect and restore headwater rivers and streams (salmon and non-salmon bearing) to protect the sources of cool, clean water and normative hydrologic conditions.					8a						cc	
124 - SUB -ALL	Evaluate allocation policies and legal and illegal water withdrawals, and look for opportunities to keep more water instream.				x	9a						cc,pg	
125 - SUB -ALL	Support the funding and implementation of Water Quality Management Plans (TMDL Implementation Plans) of Designated Management Agencies (DMA's) to meet their objective of restoring riparian vegetation as part of a larger strategy to restore and protect streams.					9a							x
Clackamas Spring Chinook													
Importance of LFT at Life Stage and Geographic Area	**Key**		1a			8a	5ab, 7h, 10f				3a	---	---
	Secondary			9k	7i, 8a	8a, 9ahi	8a, 9ahij	6e	11ag	4a		---	---
Status and Mortality Rate Assumption for Scenarios	Current Status: *Moderate*	0.27				0.83	0.10	0.12	0.25		0.33	---	---
	Desired Status: *Very Low*	0.24	0.00	0.00	0.00	0.81	0.08	0.07	0.25	0.00	0.10	---	---
126 - SUB -CM	Provide / improve fish passage in Clackamas subbasin tributaries.		1a										
127 - SUB -CM	Implement all measures in the Clackamas River Hydroelectric Project (FERC Project No. 2195) Fish Passage and Protection Plan, including measures for downstream fish passage (3% or less mortality at River Mill and North Fork dams), Oak Grove Mitigation and improvements to North Fork fish ladder/trap.		1a										
128 - SUB -CM	Breach, lower, remove, or relocate dikes and levees to establish or improve access to off-channel habitats; vegetate dikes and levees.					8a							
129 - SUB -CM	Review land use plans in context of salmon recovery needs (i.e., forest lands of higher value to salmon recovery than					8a							

	urbanized lands).												
130 - SUB -CM	Finish Clackamas Fish Habitat Analysis.					8a							
131 - SUB -CM	Protect remaining high-quality off-channel habitat from degradation.					8a							
132 - SUB -CM	Restore or create off-channel habitat and/or access to off-channel habitat: side channels.					8a							
133 - SUB -CM	Restore or create off-channel habitat and/or access to off-channel habitat: alcoves, wetlands, and floodplains. - Restoration includes revegetation.					8a							
134 - SUB -CM	Improve or regrade/revegetate streambanks.					8a							
135 - SUB -CM	Protect intact and functioning riparian areas through riparian easements and acquisition					8a							
136 - SUB -CM	Restore (plant and/or fence) and protect (conservation easements, acquisition) riparian areas that are degraded.					8a							
137 - SUB -CM	Annually place 8,000 yd3 of spawning sized gravel below River Mill Dam as per FERC settlement agreement.			x	7i	x							
138 - SUB -CM	Utilize the Clackamas Hydroelectric Project Mitigation and Enhancement Fund to provide for habitat mitigation and enhancements in the Clackamas Basin.			8a	8a	x							
139 - SUB -CM	Restore instream habitat complexity, including large wood placement (mitigate for loss of spring Chinook habitat complexity due to Clackamas hydropower dams).			8a	8a	x							
140 - SUB -CM	Restore instream habitat complexity, including large wood placement.					8a							
141 - SUB -CM	Daylight stream.					8a							
142 - SUB -CM	Create confluence habitat with cool water, restore channel and reconnect upper creek.					8a							
143 - SUB -CM	Reconnect tributary to Willamette River and create high quality habitat at tributary junction.					8a							
144 - SUB -CM	(similar to LFT 7f [MF] and 7e [MK]) Within authority of current FERC license, increase retention and sourcing of gravels and other materials below PGE facilities with a combination of habitat improvements, targeted flows, and augmentation.			x	7i	x							
145 - SUB -CM	Establish minimum ecosystem-based instream flows.					9a							
146 - SUB -CM	Reduce impact that roads have on impaired hydrograph.					8a							
147 - SUB -CM	Implement all water quality and hydrograph measures in the Clackamas River Hydroelectric Project (FERC Project No. 2195) Fish Passage and Protection Plan.			9k	9k	x							
148 - SUB -CM	Maintain existing wild fish sanctuary.	x	x	x					x		3a		
149 - SUB -CM	Operationally open the hatchery trap for a longer period.	x							x		3a		
150 - SUB -CM	(Purchase a freezer trailer to aid the logistical disposition to carcass placement, tribes, and food banks if program is maintained).					x					x		

Molalla Spring Chinook and Steelhead													
CHS: Importance of LFT at Life Stage and Geographic Area	**Key**					8ab, 9ach	5ab, 7h, 8a,10f				3a	---	---
	Secondary					7a, 9i, 10b	9ahij	6e		4a		---	---
CHS: Status and Mortality Rate Assumption for Scenarios	Current Status: *Very High*	0.00	0.00	0.00	0.00	1.00	0.10	0.16	0.25	0.05	0.95	---	---
	Desired Status: *High*	0.00	0.00	0.00	0.00	0.80	0.08	0.08	0.25	0.05	0.57	---	---
STW: Importance of LFT at Life Stage and Geographic Area	**Key**					8a	5ab, 7h, 10f				3a	---	---
	Secondary					2a,7a,9a, 9hi,10b	8a,9ahij	6e		4a		---	---
STW: Status and Mortality Rate Assumption for Scenarios	Current Status: *Low*	0.00	---	0.00	0.00	0.94	0.10	0.16	0.16	0.05	0.19	---	---
	Desired Status: Very Low	0.00	---	0.00	0.00	0.94	0.08	0.08	0.16	0.05	0.05	---	---
151 - SUB -MO	Improve known high priority STW passage impediments in the Molalla subbasin	x	x			2a							x
152 - SUB -MO	Identify priority reaches in Molalla subbasin where habitat restoration projects can be implemented and monitored.					8a, 9a							x
153 - SUB -MO	Reconnect floodplains to channels.					8a							
154 - SUB -MO	Reduce harassment of adult spring Chinook while they are holding during the summer.					8b							
155 - SUB -MO	Improve summer water quality of headwater areas for oversummering Chinook by implementing sufficient riparian buffers .					9c						cc	
156 - SUB -MO	Reform the existing harvest augmentation hatchery CHS program (non-local stock) into separate augmentation and conservation programs. (See Molalla Reintroduction proposal, Appendix E)					x			x		3a		x
North Santiam Spring Chinook and Steelhead													
CHS: Importance of LFT at Life Stage and Geographic Area	**Key**	2b, 2f	1d		9b,10d	8a, 9ahi	5ab, 7h, 8a,10f				3a	---	---
	Secondary	2k			7bc	8a	9ahij	6e		4a, 6c		---	---
CHS: Status and Mortality	Current Status: *Very High*	0.71	0.00	0.60	0.97	0.97	0.10	0.17	0.25	0.05	0.00	---	---

Rate Assumption for Scenarios	*Desired Status: Low*	0.23	---	0.12	0.29	0.63	0.08	0.08	0.25	0.05	0.00	---	---
STW: Importance of LFT at Life Stage and Geographic Area	**Key**	2b	1d		10acd	8a	5ab, 7h, 8a,10f			4cd	3a	---	---
	Secondary		2i*	7c	7b, 9d	2a, 7a, 9ahi, 10b	9ahij	6e		4a		---	---
STW: Status and Mortality Rate Assumption for Scenarios	Current Status: *Low*	0.48	---	0.00	0.57	0.57	0.10	0.17	0.16	0.05	0.14	---	---
	Desired Status: *Very Low*	0.37	---	0.00	0.48	0.48	0.08	0.08	0.16	0.05	0.05	---	---
157 - SUB -NS	Implement WP-RPA's 4.12.3 and 4.13 to provide safe and effective downstream passage through Detroit reservoir and Detroit and Big Cliff dams for juveniles and kelts.		1d										x
158 - SUB -NS	Work with and assist landowners with grants, funding, and design to screen the known water diversions.		x			2a							
159 - SUB -NS	As needed, evaluate effectiveness of success of upstream passage of adults at the Salem Ditch / Mill Creek headgate structure.	x				2a							x
160 - SUB -NS	Evaluate juvenile fish passage efficiency at the Mill Creek millrace diversion dam and modify the existing fishway if necessary.		x			2a							x
161 - SUB -NS	(see relation to LFT 2k) Reduce pre-spawn mortality by reducing injury and stress related to fish handling at and above USACE facilities.	2b		x					x		x		x
162 - SUB -NS	Until downstream passage facilities are completed and have demonstrated safe and timely passage, supplement natural production in the subbasin by implementing the interim trap-and-haul measures described in the 2008 WP BiOp to outplant adult fish into historical habitat above the Big Cliff/Detroit flood control/hydropower complex.	2b		x					x		x		x
163 - SUB -NS	Reduce fish loss and migration delays of juvenile and adult fish at Santiam Water Control District irrigation canal/hydro projects.	x	x			2f							
164 - SUB -NS	(related to LFT 9a coordination action) Ensure adequate streamflows exist for upstream migration of salmon during summer low flow periods at Geren/Stayton Island, and evaluate if there are other stream flow-related passage barriers in the subbas in summer.	x				2f							x
165 - SUB -NS	Improve fishway function and efficiency at Lower Bennett dams for both juvenile and adult fish.	x	x			2f					x		x

166 - SUB -NS	(see related LFT 1d actions for NS juveniles)		2i*								x		x
167 - SUB -NS	(see LFT 2b for handling actions) Resolve uncertainty of any remaining pre-spawn mortality not associated with injury and stress associated with Minto Collection facility.	2k		2k		x			x		x		x
168 - SUB -NS	(see actions associated with LFT 7c) Restore substrate recruitment and reduce streambed coarsening below dam projects.			x	7b	x							
169 - SUB -NS	(same as for LFT 7f [MF] and 7e [MK]) Increase retention and sourcing of gravels and other materials below USACE facilities with a combination of habitat improvements, targeted flows, and augmentation.			x	7c	x							
170 - SUB -NS	Identify priority reaches in North Santiam subbasin where habitat restoration projects can be implemented and monitored.					8a							x
171 - SUB -NS	In priority moderate-gradient stream reaches in the NS subbasin, increase habitat complexity to provide juvenile fish refugia during high flows, and to augment other channel forming processes and habitat/water quality actions in this Plan.					8a							
172 - SUB -NS	Restore natural function of the North Santiam River near Stayton Ponds	x				8a							
173 - SUB -NS	(WP BiOp Water Quality RPA's) Release flows from Detroit/Big Cliff dams to meet flow targets in the North Santiam River that protect spawning, incubation, rearing and migration of salmonids.				10a	x							x
174 - SUB -NS	Modify dam operations for multiple diversions at Geren/Stayton Island, e.g. Upper and Lower Bennett, SWCD pill dam.		x			10b							
175 - SUB -NS	(WP RPA 5.2) Construct, operate, and evaluate a temperature control structure at Detroit Dam to release water that more closely resembles normative water temperatures, reduces TDG exceedences, and meets TMDL temperature targets downstream of NS dams and operating dams to maximize benefits to Chinook and steelhead				9b	x							x
176 - SUB -NS	(see WP RPA 5.2 to address LFT 9b; temperature control facility action)				9d	x							x

177 - SUB -NS	Manage current CHS Harvest Mitigation Hatchery Program (HMP) facilities and broodstock to meet mitigation goals, but do so in a manner that the genetic and demographic impacts of program do not pose unacceptable risk to extant NOR fish populations or compromise long term productivity of a reintroduction stock that would preclude success of conservation reintroduction/supplementation program above Detroit Dam.	x		x					x		3a		x
178 - SUB - SAN	For Steelhead, conduct RME to identify most effective means to reduce inter-basin pHOS, so that over the long term average total basin pHOS < 5% (for the out-of-ESU stock).	x						x	x		3a		x
179 - SUB - SAN	Ensure hatchery summer steelhead smolts migrate quickly to the ocean by evaluating a suite of acclimation and release strategies.							x	x	4c			x
180 - SUB - SAN	Convene a BiOp WATER working group to further examine the competition risk of STS on NOR STW fry and winter parr.							x		4c			x
181 - SUB - SAN	Allow retention of fin-clipped trout in areas open to fishing to reduce residual STS smolts.								x	4d			
182 - SUB - SAN	Reduce natural spawning of non-native summer steelhead.							x	x	6c			x
South Santiam Spring Chinook and Steelhead													
CHS: Importance of LFT at Life Stage and Geographic Area	**Key**	2c, 2g	1e		9e,10d	8a, 9ahi	5ab, 7h, 8a,10f				3a	---	---
	Secondary	2l			7d	8a	9ahij	6e		4ab, 6c		---	---
CHS: Status and Mortality Rate Assumption for Scenarios	Current Status: *Very High*	0.85	0.00	0.30	0.95	0.95	0.10	0.17	0.25	0.05	0.90	---	---
	Desired Status: Moderate	0.34	---	0.04	0.19	0.62	0.08	0.08	0.25	0.05	0.30	---	---
STW: Importance of LFT at Life Stage and Geographic Area	**Key**	2c	1e		10cde	8a	5ab, 7h, 8a,10f			4cd	3a	---	---
	Secondary		2j*		7d, 9e	2a, 7a, 9ahi, 10b	9ahij	6be		4a		---	---
STW: Status and Mortality Rate Assumption for Scenarios	Current Status: *Low*	0.18	---	0.00	0.66	0.66	0.10	0.17	0.16	0.05	0.04	---	---
	Desired Status: Very *Low*	0.07	---	0.00	0.43	0.43	0.08	0.08	0.16	0.05	0.04	---	---
183 - SUB - SSA	Improve downstream passage through Foster reservoir and dam for juveniles and kelts.		1e								x		

184 - SUB - SSA	Evaluate further whether safe and effective downstream passage through Green Peter reservoir and dam is a viable alternative and highly beneficial in supporting improvements in VSP criteria for desired status risk level (CHS-Moderate, STW-Very Low).		1e										
185 - SUB - SSA	Provide technical and funding assistance to the SSA Watershed Council in restoring consistent fish passage into Ames Creek.	x	x			2a							
186 - SUB - SSA	Evaluate whether juvenile fish can pass the breached Jordan Dam on Thomas Creek.	x	x			2a							
187 - SUB - SSA	As needed, finalize evaluation of velocity testing and adjustment of baffles at the Lebanon diversion, to assure screen is still working within intent of NMFS design criteria.	x	x			2a							
188 - SUB - SSA	Determine whether the diversion screen on Lacomb Creek meets current juvenile fish standards.	x	x			2a							
189 - SUB - SSA	(see relation to LFT 2l) Reduce pre-spawn mortality by reducing injury and stress related to fish handling at and above USACE facilities.	2c				x			x		x		x
190 - SUB - SSA	Within the WP BiOp COP process, evaluate further whether access to and production above Green Peter Dam is a viable alternative and highly beneficial in supporting improvements in VSP criteria for desired status risk level (CHS-Moderate, STW-Very Low).	2c									x		x
191 - SUB - SSA	Until downstream passage facilities are completed and have demonstrated safe and timely passage, supplement natural production in the subbasin by implementing the interim trap-and-haul measures described in the 2008 WP BiOp to outplant adult fish into historical habitat above Foster Dam.	2c							x		x		x
192 - SUB - SSA	Clarify if passage criteria are being met, or if further RME is needed for the new fishways at Lebanon Dam.	2g				x							x
193 - SUB - SSA	(see related LFT 1e actions for SSA juveniles)		2j*								x		
194 - SUB - SSA	(see LFT 2c for handling actions) Resolve uncertainty of any remaining pre-spawn mortality not associated with injury and stress associated with Foster Dam Collection facility.	x		2l		x			x		x		x
195 - SUB - SSA	(WP RPA 2.7) Implement environmental pulse flows and combine with WP RPA actions below to restore substrate recruitment and reduce streambed coarsening below dam projects.				7d	x							x
196 - SUB - SSA	Identify priority reaches in South Santiam subbasin where habitat restoration projects can be implemented and monitored.				x	8a							
197 - SUB - SSA	In priority moderate-gradient stream reaches in the South Santiam subbasin, increase habitat complexity to provide juvenile fish refugia during high flows, and to augment other				x	8a							

	channel forming processes and habitat/water quality actions in this Plan.												
198 - SUB - SSA	Work with landowner adjacent to Waterloo Park to reestablish a long abandoned side channel for rearing and spawning.					8a							
199 - SUB - SSA	(WP BiOp WQ RPA's) Release flows from Foster/Green Peter dams to meet flow targets in the South Santiam River that protect spawning, incubation, rearing and migration of salmonids.	x		x	10e								
200 - SUB - SSB	(no specific actions for LFT 7a; see relevant riparian actions under LFT code 8a)					7a							x
201 - SUB - SSA	(WP RPA's 5.1, 5.1.2, and potentially 5.1.3) Evaluate feasibility and effectiveness of interim operational temperature control at Foster and Green Peter dams.			x	9e	x							x
202 - SUB - SSA	Manage current CHS Harvest Mitigation Hatchery Program (HMP) facilities and broodstock to meet mitigation goals, but do so in a manner that the genetic and demographic impacts of program do not pose unacceptable risk to extant NOR fish populations or compromise long term productivity of a reintroduction stock that would preclude success of conservation reintroduction/supplementation program above Foster Dam.	x							x		3a		x
Calapooia Spring Chinook and Steelhead													
CHS: Importance of LFT at Life Stage and Geographic Area	**Key**					2h, 9ac, 9hi, 8ab	5ab, 7h, 8a,10f				3a	---	---
	Secondary					7a,10b	9ahij	6e		4a		---	---
CHS: Status and Mortality Rate Assumption for Scenarios	Current Status: *Very High*	0.00	0.00	0.00	0.00	1.00	0.10	0.16	0.25	0.05	0.95	---	---
	Desired Status: *High*	0.00	0.00	0.00	0.00	0.74	0.08	0.08	0.25	0.05	0.60	---	---
STW: Importance of LFT at Life Stage and Geographic Area	**Key**					8a	5ab, 7h, 10f					---	---
	Secondary					2ah, 7a, 9ahi, 10b	8a,9ahij	6e		4a		---	---
STW: Status and Mortality Rate Assumption for Scenarios	Current Status: *Moderate*	0.00	---	0.00	0.00	0.96	0.10	0.16	0.16	0.05	0.00	---	---
	Desired Status: *Moderate*	0.00	---	0.00	0.00	0.96	0.08	0.08	0.16	0.05	0.00	---	---
203 - SUB -CA	Continue to work with agencies and private parties for a solution on the passage of adult CHS over Sodom and Shear dams that are associated with the Thompson's Mill State Park site.	x				2h							

204 - SUB -CA	In priority moderate-gradient stream reaches in the Calapooia subbasin, increase habitat complexity to provide juvenile fish refugia during high flows, and to augment other channel forming processes and habitat/water quality actions in this Plan.					8a							
205 - SUB -CA	Identify for protection and restoration, reaches in upper Calapooia River where deep pools can be maintained or created, for target summer water temperature < 70°F.					8a							
206 - SUB -CA	Eliminate parking areas along main line roads, and decrease harassment near those pools where investments in spring Chinook holding pools have been made to minimize disturbance to the fish.					8a							
207 - SUB -CA	Identify priority reaches in Calapooia subbasin where habitat restoration projects can be implemented and monitored.					8a							
208 - SUB -CA	Work in a priority up or downstream direction, eliminating even small breaks in shading to increase and expand cool water zones and fish bearing habitat.					8a							
209 - SUB -CA	Use fencing, weed control, and planting of native conifers at appropriate sites.					8a							
210 - SUB -CA	Improve summer water quality of headwater areas for oversummering Chinook by implementing sufficient riparian buffers.					9c						cc	
211 - SUB -CA	Modify hatchery CHS program practices in other subbasins of the ESU to minimize pHOS in the Calapooia subbasin.					x		x	x		3a		
McKenzie Spring Chinook													
Importance of LFT at Life Stage and Geographic Area	**Key**	2d			10d	8a, 9hi	5ab, 7h, 8a, 10f				3a	---	---
	Secondary		1b		7e, 9g	9a	9ahij	6e		4a, 6cd		---	---
Status and Mortality Rate Assumption for Scenarios	Current Status: *Low*	0.25	0.00	0.10	0.56	0.56	0.10	0.18	0.25	0.05	0.35	---	---
	Desired Status: *Very Low*	0.15	---	0.10	0.53	0.53	0.08	0.09	0.25	0.05	0.10	---	---
212 - SUB -MK	Restore adult access of natural origin fish to historic habitat blocked by large dams.	2d									x		x
213 - SUB -MK	(see related Leaburg action for LFT 3a to improve facility sorting) Provide safe and effective upstream passage of adult salmon migration at the Leaburg Dam left and right bank fish ladders.	2d							x		x		x
214 - SUB -MK	Provide safe and effective upstream passage of adult salmon at Walterville tailrace.	2d											x
215 - SUB -MK	Provide safe and effective downstream passage through Cougar reservoir and dam.		1b								x		x
216 - SUB -MK	Continue to operate and maintain the Walterville fish screen to provide safe and effective fish passage.		1b										
217 - SUB -MK	Provide safe and effective downstream passage through Trail Bridge reservoir and dam.		1b										x

218 - SUB -MK	Ensure new fish screen functions appropriately for Chinook salmon at the Leaburg Diversion		1b										x
219 - SUB -MK	(same as for LFT 7c [NS] and 7f [MF]) Increase retention and sourcing of gravels and other materials below USACE facilities with a combination of habitat improvements, targeted flows, and augmentation.				7e	x							
220 - SUB -MK	Continue to support implementation of Goal 1 restoration actions described in "The McKenzie Watershed Conservation Strategy" (2002), stated as to protect and restore key fish and wildlife habitats.					8a							x
221 - SUB -MK	Identify priority sites in the lower McKenzie River subbasin where habitat protection is needed and restoration is desirable, design restoration projects, implement work, and monitor.					8a							x
222 - SUB -MK	Protect and enhance the McKenzie/Willamette Confluence Area and lower river.					8a						pg	x
223 - SUB -MK	Continue to implement the McKenzie WS Council's "Action Plan for Recreation and Human Habitat".					8a						pg	
224 - SUB -MK	Implement the "Lane County Riparian Development Ordinance."					8a						pg	
225 - SUB -MK	Coordinate projects of the McKenzie River Trust to implement priority habitat restoration projects.					8a							
226 - SUB -MK	Coordinate projects with the "Friends of the Mohawk" to implement priority habitat restoration projects.					8a							
227 - SUB -MK	Operate Trail Bridge Dam to minimize adverse effects of ramping on fish stranding, redd desiccation, and loss of habitat in the McKenzie River downstream of Trail Bridge.				10d								x
228 - SUB -MK	Operate McKenzie subbasin WP flood control/hydropower projects to mimic natural temperature regime, while at the same time complementing the downstream passage benefits of spilling, and minimizing exceedence of TDG (total dissolve gas) below projects, and managing ramping rates to minimize stranding of early Chinook life stages.				9g								x
229 - SUB -MK	Until the Cougar downstream passage facility is completed and has demonstrated safe and timely passage, continue to supplement natural production in the subbasin by implementing the interim trap-and- haul measures described in the 2008 BiOp to outplant adult fish into historical habitat above the USACE Cougar flood control/hydropower complex.	x							x		3a		x
230 - SUB -MK	Manage current CHS Harvest Mitigation Hatchery Program (HMP) facilities and broodstock to meet mitigation goals, but do so in a manner that the genetic and demographic impacts of program do not pose unacceptable risks to the remaining wild fish population or impede long term recovery goals of the McKenzie CHS population.	x							x		3a		x

231 - SUB -MK	Reduce number of hatchery STS released.							x	x	6c			
232 - SUB -MK	Evaluate the potential for reduction of predation on juvenile Chinook by reducing or discontinuing releases of hatchery trout in the McKenzie River upstream of Leaburg Dam.							x	x	6d			
233 - SUB -MK	Release hatchery trout in areas and during periods when Chinook are not as susceptible to predation.							x	x	6d			
234 - SUB -MK	Evaluate predation by hatchery trout and conduct a net benefit analysis on the effects of hatchery trout releases on bull trout population size in Trail Bridge Reservoir.									6d			x
Middle Fork Willamette Spring Chinook													
Importance of LFT at Life Stage and Geographic Area	**Key**	2e	1f	2m	7f, 9f, 10d	8a, 9hi	5ab, 7h, 8a, 10f				3a	---	---
	Secondary				7g	9a	9ahij	6e		4a		---	---
Status and Mortality Rate Assumption for Scenarios	Current Status: *Very High*	0.95	0.00	0.80	0.87	0.87	0.10	0.16	0.25	0.05	0.95	---	---
	Desired Status: *Low*	0.32	---	0.14	0.09	0.56	0.08	0.08	0.25	0.05	0.10	---	---
235 - SUB -MF	Within the 2008 BiOp COP process and BRT activities, evaluate further whether eventual reintroduction and production above Hills Creek Dam is a viable alternative to other remedies for improving VSP criteria to meet desired status risk level (Chinook-Low).	2e									x		x
236 - SUB -MF	Provide safe and effective downstream passage through the Dexter/Lookout Point flood Control/hydropower complex to benefit all size classes of juvenile migrants produced above Lookout Pt. Dam.		1f								x		x
237 - SUB -MF	Provide safe and effective downstream passage through Fall Creek reservoir and dam.		1f								x		x
238 - SUB -MF	Provide safe and effective downstream passage through Hills Creek reservoir and dam.		1f								x		x
239 - SUB -MF	(see relation to LFT 2m) Reduce pre-spawn mortality by reducing injury and stress related to fish handling at and above USACE facilities.	2e				x			x		x		x
240 - SUB -MF	Until downstream passage facilities are completed and have demonstrated safe and timely passage, supplement natural production in the subbasin by implementing the interim trap-and-haul measures described in the 2008 WP BiOp to outplant adult fish into historical habitat above Fall Creek, Dexter/Lookout Pt, and Hills Creek Dams	2e							x		x		x
241 - SUB -MF	(see LFT 2e for handling actions) Resolve uncertainty of	x		2m		x					x		x

	any remaining pre-spawn mortality not associated with injury and stress associated with Middle Fork Willamette Collection facilities.												
242 - SUB -MF	(same as for LFT 7c [NS] and 7e [MK]) Increase retention and sourcing of gravels and other materials below USACE facilities with a combination of habitat improvements, targeted flows, and augmentation.			x	7f	x							
243 - SUB -MF	(see actions associated with LFT 7f) Restore substrate recruitment and reduce streambed coarsening below dam projects.			7g		x							
244 - SUB -MF	If it does not exist, develop proactive framework to minimize future urbanization impacts in Lower Middle Fork Willamette Basin					8a						pg	
245 - SUB -MF	Evaluate the restoration opportunities identified in the Lower MF Willamette Watershed Assessment (2002) for riparian and aquatic habitat, with emphasis on CHS.					8a							x
246 - SUB -MF	Implement the "high priority actions" that benefit CHS identified under each of the six Goals in MF Willamette Watershed Council's Action Plan.					8a							
247 - SUB -MF	Identify priority sites in the Lower Middle Fork Willamette subbasin where habitat protection is needed and restoration is desirable, design restoration projects, implement work, and monitor.				x	8a							x
248 - SUB -MF	Operate WP flows in MF subbasin to mimic the natural temperature regime in the fall				9f								x
249 - SUB -MF	Manage current CHS Harvest Mitigation Hatchery Program (HMP) facilities and broodstock to meet mitigation goals, but do so in a manner that the genetic and demographic impacts of program do not pose unacceptable risk to extant NOR fish populations or compromise long term productivity of a reintroduction stock that would preclude success of conservation reintroduction/supplementation program above MF Willamette dams.	x							x		3a		x

Chapter 8: Research, Monitoring, and Evaluation to Measure Progress Towards Recovery

Research, monitoring, and evaluation (RME) are needed to assess the status of listed species and their habitat, track progress toward achieving recovery goals, and provide information needed to refine recovery strategies and actions through the process of adaptive management. This chapter outlines the RME needs of this Recovery Plan as they pertain to biological VSP criteria (i.e., abundance, productivity, diversity, and spatial structure) and listing criteria (i.e., habitat degradation, fish harvest, hatcheries, disease and predation, inadequate regulatory mechanisms, or other natural or manmade factors) affecting the continued existence of UWR Chinook salmon and winter steelhead populations.

Because RME needs related to the Columbia River estuary are pertinent to all recovery domains in the Columbia River basin, RME plans for the estuary are being developed elsewhere. Within the Willamette River subbasins, a large RME effort is now underway by Federal action agencies in support of the WP BiOp (NMFS 2008a). Many of the elements in the WP BiOp RME plan have clear linkages with the overall RME needs of this Recovery Plan, and Chapter 9 describes some of the RME and implementation relationships between the WP BiOp and Recovery Plan. Chapter 9 (Implementation) of this Plan describes how the proposed RME will be incorporated into an adaptive management Plan.

Much of the following RME guidance for the UWR Chinook and steelhead Recovery Plan comes from *"Adaptive Management for ESA-Listed Salmon and Steelhead Recovery: Decision Framework and Monitoring Guidance"*[73] (NMFS 2007a). Based on this guidance, RME in this Plan is specifically designed to:

- Provide information to key questions that need to be addressed in de-listing decisions.
- Track progress toward achieving recovery goals.
- Provide managers and others implementing actions the Plan with information needed to adjust management actions (i.e., what does and doesn't work and why).
- Address questions of metrics and indicators, including frequency, distribution, and intensity of monitoring.
- Evaluate the adequacy of existing monitoring programs to meet the needs of this recovery Plan, identify needed adjustments in those programs, and outline additional monitoring not currently provided by existing programs.

8.1 Key Questions, Analytical Guidelines, Measurable Criteria, and RME Needs

In order to identify the RME needed to support this Recovery Plan it is necessary to consider: 1) the key questions that must be answered for de-listing decisions, 2) the analytical framework that will be used to answer these questions, and 3) the specific measurable criteria (or benchmarks) against which progress towards achieving recovery goals will be measured.

The NMFS listing status decision framework described in Chapter 3 provides the foundation for the information that is needed to inform de-listing decisions. Key questions can be divided into those pertaining to ESU/DPS viability (i.e., biological criteria) or the status of statutory listing factors (i.e., threats criteria). Questions on ESU/DPS viability are based on the four VSP parameters, and questions on

[73] http://www.nwr.noaa.gov/Salmon-Recovery-Planning/ESA-Recovery-Plans/upload/Adaptive_Mngmnt.pdf

the status of statutory listing factors are based on information of threats related to habitat condition, hydropower, fish harvest, disease and predation, regulatory programs, hatcheries, and natural events.

Guidance on the analytical framework for biological recovery criteria were provided by the Willamette/Lower Columbia Technical Review Team (McElhany et al. 2006[74]). If and when such guidance becomes available, the RME outlined in this Plan related to the threats criteria may need to be updated.

Measurable criteria related to biological recovery are based on the specific goals for each UWR Chinook salmon and winter steelhead population (see Chapter 6). Measurable criteria for the listing criteria are primarily based on the goals of specific actions described in Chapter 7 (Strategies and Actions) that are designed to address the listing factors. For assessing biological criteria, the benchmarks outlined in this chapter are intended to serve as interim measures of progress towards achieving recovery goals. The suite of RME identified as necessary to evaluate these measurable criteria will also ultimately provide the foundation for more comprehensive viability analyses such as those described in McElhany et al. (2007[75]) that follow the viability criteria framework established by the Willamette/Lower Columbia Technical Recovery Team (McElhany et al. 2006).

8.2 RME Categories

An RME Plan needs to provide information to answer three fundamentally different questions:

1. What is the condition or status of X over time?
2. What is the effect of Y on the condition or status of X?
3. What are the uncertain relationships or conditions that are critical to making good decisions?

The programs that generate data to address these three classes of questions are fundamentally different. While they can be related, integrated or interconnected, they cannot be substituted one for the other. As described by NMFS (2007a), there are six general types of monitoring that are relevant to Recovery Plan implementation and assessment.

Status monitoring is used to characterize existing conditions, establish a baseline for future comparisons, and capture temporal and spatial variability in the parameters of interest. *Trend monitoring* involves measurements taken at regular time or space intervals to assess the long-term trend in a particular parameter. Status and trend monitoring is equally pertinent to both the biological and listing factor criteria.

The general monitoring approach in this Plan to obtain information on status and trend of fish abundance, distribution, and habitat conditions will be to follow a GRTS[76] survey design structure, similar to what is currently implemented for Oregon Coastal Coho and for additional species in the ORLCR Recovery Plan. Individual components of this approach are outlined in this chapter, but an overview of this integrated monitoring approach is in Firman and Jacobs (undated[77]). Where possible, sampling of downstream migrating juveniles and/or returning adults will supplement the GRTS-based sampling to provide more precise estimates of survival and productivity.

[74] http://www.nwfsc.noaa.gov/trt/wlc_docs/Revised_WLC_Viability_Criteria_Draft_Apr_2006.pdf
[75] http://www.nwfsc.noaa.gov/trt/trt_documents/part_1_sep07.pdf
[76] Generalized Random Tessellation Stratified – see Stevens and Olsen, A.R. (2004).
[77] http://oregonstate.edu/dept/ODFW/spawn/pdf%20files/reports/emappaper.pdf

Implementation monitoring determines whether actions were carried out as planned. For example, if a restoration action is initiated to fence 20 miles of stream with the objective of reducing stream temperature and fine sediment input from run-off and bank erosion, implementation monitoring would consist of confirming the presence of the fence.

Compliance monitoring determines whether specified criteria are being met as a direct result of an implemented action. With the fencing example, the compliance monitoring indicator would be an assessment of the project's basic intent – preventing livestock from entering the riparian corridor – and thus an appropriate metric would be the presence or absence of livestock in the fenced-off area. Because implementation and compliance monitoring deal mainly with evaluating whether or not actions are being implemented, they are generally more applicable to monitoring related to the listing factors.

Effectiveness monitoring evaluates whether the management actions achieved their direct effect or objective. Success may be measured against "reference areas," "baseline conditions," or "desired future conditions." In the fencing example, effectiveness monitoring indicators would assessment the project's effect on improving riparian habitat, given that the project was properly implemented and in compliance with expected impact. Because effectiveness monitoring deals mainly with determining the effectiveness of actions designed to ameliorate the impacts of listing factors, it is generally not pertinent to monitoring related to the biological criteria.

Critical Uncertainty Research verifies the basic assumptions behind effectiveness monitoring and models, prioritization of limiting factors and threats, or any other topic for which assumptions have been made, which if untrue, would significantly alter the actions identified for implementation by the recovery Plan. Because critical uncertainties are associated both with biological criteria and listing factors, critical uncertainty research is needed in both contexts[78].

8.3 Biological Recovery

As described earlier, biological recovery is assessed in terms of four VSP parameters: 1) abundance; 2) productivity; 3) spatial structure; and 4) diversity. The following describes the decisions, key questions, analytical guidelines, measurable criteria, and specific RME needed by this Recovery Plan in order to assess the status of biological recovery of UWR Chinook and steelhead populations.

8.3.1 Decisions and Key Questions[79]

Decisions

1. The aggregate status and change in status over time of the populations and habitats within the ESU/DPS attains a level of risk, natural sustainability, or probability of persistence sufficient to consider the ESU/DPS viable.
2. The status and change in status of the population's viability parameters, in the aggregate, demonstrate a level of risk, or probability of persistence, sufficient to consider that the population has achieved the viability targets established for its classification (i.e., the level of risk considered acceptable for this population).

Key Questions

[78] In most cases the detailed approach and proposals for critical uncertainty will be prioritized, developed, and implemented as part of implementation, specifically during development of the three-year Implementation Schedules (see Chapter 9).
[79] Decisions and key questions come from a 2007 NMFS document entitled "*Adaptive Management for ESA-Listed Salmon and Steelhead Recovery: Decision Framework and Monitoring Guidance*".

Does the ESU have a high probability or a clear trending toward a high probability of persistence? Specifically do:

1. At least two populations in the ESU/DPS have at least a 95% probability or are clearly trending toward a high probability of persistence (i.e., low extinction risk)?
2. Other populations in the ESU/DPS have persistence probabilities consistent with or are clearly trending toward a high probability of ESU/DPS persistence (i.e., the average of all ESU/DPS population scores is 2.25 or higher, based on the TRT's scoring system)?

The population-specific extinction risk levels needed to achieve both ESU/DPS delisting and broad sense recovery are described fully in Chapters 6 and 10. As outlined in Chapter 4 (Current Status) the ability to evaluate these risk levels relies on collecting and analyzing information related to the four VSP parameters (abundance, productivity, spatial structure, and diversity). What follows is an outline of the analytical guidelines for each of these VSP parameters, along with the specific measurable criteria required as part of an ESA recovery Plan and under Oregon's Native Fish Conservation Policy.[80]

8.3.2 Analytical Guidelines, Measurable Criteria, and RME for Abundance and Productivity[81]

<u>Analytical Guidelines – Abundance and Productivity</u>

1. In general, viable populations should demonstrate a combination of population growth rate, productivity, and abundance that produces an acceptable probability of population persistence. Various approaches for evaluating population productivity and abundance combinations may be acceptable, but must meet reasonable standards of statistical rigor.
2. A population with a non-negative growth rate and an average abundance approximately equivalent to estimated historical average abundance should be considered to be in the highest persistence category. The estimate of historical abundance should be credible, the estimate of current abundance should be averaged over several generations, and the growth rate should be estimated with an adequate level of statistical confidence. This criterion takes precedence over criterion 1.

<u>Measurable Criteria – Abundance and Productivity</u>

Abundance and Productivity Metric

Annual estimates of the abundance of naturally-produced spawners in each UWR Chinook and steelhead population.

Abundance and Productivity Evaluation Thresholds (de-listing)

Pass – The observed spawner abundance is $\geq$ the abundance modeled for de-listing (shown in the threat reduction and VSP scenario tables for each population in Chapter 6) at least six times in any 12-year[82] period *and* the average observed spawner abundance is $\geq$ the average modeled abundance for delisting over that same time period.
Fail – The observed spawner abundance is $\geq$ the abundance modeled for de-listing less than six times in any 12-year period *or* the average observed spawner abundance is < the average modeled abundance for de-listing over that same time period.

Abundance and Productivity Evaluation Thresholds (broad sense recovery)

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[80] http://www.dfw.state.or.us/fish/nfcp/rogue_river/docs/nfcp.pdf
[81] Analytical guidelines are from Willamette/Lower Columbia Technical Review Team (WLCTRT 2006).
[82] 12 years was selected because it represents roughly three to four brood cycles for Chinook salmon and steelhead and should thus provide a reasonable snapshot in time of the trend in status of a population.

Pass – The observed spawner abundance is ≥ the abundance modeled for broad sense recovery at least six times in any 12-year[9] period *and* the average observed spawner abundance is ≥ the average modeled abundance for broad sense recovery over that same time period.
Fail – The observed spawner abundance is ≥ the abundance modeled for broad sense recovery less than six times in any 12-year period *or* the average observed spawner abundance is < the average modeled abundance for broad sense recovery over that same time period.

Analytical Procedures for Abundance and Productivity

As described in Chapter 4 (Population Conservation Gaps) we developed stock-recruitment curves for each UWR Chinook and steelhead population as a way of determining the abundance and productivity needed to achieve de-listing and broad sense recovery. Because the abundance and productivity derived from these recruitment curves represent the long term (i.e., 100 year) average, there is a need to develop annual benchmarks of abundance and productivity that will allow more timely assessments of progress towards recovery goals. Thus, in addition to the stock recruitment curves generated for each population, we need annual estimates of spawner abundance, harvest of wild fish, age at return, and an index of climate impact. Because natural fluctuations in climate conditions play such a significant role in the annual abundance of salmon and steelhead spawners, it is necessary to scale the average abundance targets to an annual index of climate.
The following generic example illustrates how this information will be used to derive annual benchmarks for abundance and productivity against which progress towards recovery can be assessed.

Step 1- Obtain recruitment parameters for population[83]

Alpha	Beta	Gamma	Clm Indx	Indx Lag
1.986	9343	1.999	CRF	-2

Step 2 – Determine the age composition of the returning fish

Return Year	Parental Brood Years age 2	age 3	age 4	age 5	age 6	age 7
2002	2000	1999	1998	1997	1996	1995

Step 3 – Obtain total number of spawners (hatchery + wild) for each brood year

Spawner Abundance by Parent Year					
2000	1999	1998	1997	1996	1995
843	363	858	895	361	1876

Step 4- Obtain climatic index for each brood year

1998	1997	1996	1995	1994	1993
0.524	0.587	0.462	0.164	0.200	-0.159

Step 5 – Calculate recruits for each brood year using the following equation based on recruitment curve

1) $$Ln(R_t) = Ln(\alpha) + Ln(S_t) - Ln(1 + (\alpha/\beta * S_t)) + (\gamma * C_{t+lag})$$

where S_t is the total number of fish that spawned (including both hatchery and wild fish) in year t, R_t is the number of naturally produced recruits that were produced by the fish that spawned in year t, C is the climatic index with a lag period equal to t+lag, where lag may assume any value in the search range form -3 to +3, and α, β, γ are parameters for the recruitment equation.

[83] CRF stands for Columbia River Flow

Estimated pre-harv Recruits w/o recovery actions, pre-harv					
2000	1999	1998	1997	1996	1995
4051	2166	3630	2070	993	1939

(note numbers above are calculated as the exp(Ln(Rt)) estiamted from Eq 1)

Step 6 – Calculate recruits after fishery (i.e. spawners) using the fishery impact rates used to determine the "modeled current" abundance described in chapter 6 (0.10 in this case).

Estimated pre-harv Recruits w/o recovery actions, pre-harv					
2000	1999	1998	1997	1996	1995
4051	2166	3630	2070	993	1939

(note numbers above are calculated as the exp(Ln(Rt)) estiamted from Eq 1)

Step 7 – Multiply each brood year recruits by recovery scalar[84] (described in chapter 4) to obtain the number of spawners needed to meet recovery goals given climate conditions for each brood year.

Estimated post-harv Recruits WITH recovery actions					
2000	1999	1998	1997	1996	1995
7074	3782	6338	3615	1734	3385

Step 8 – Use the age composition for this population to determine how many of each age fish returned using the brood year recruits estimated in Step 7.

Age at Spawning (Proportion of Total)						
2	3	4	5	6	7	
0.000	0.005	0.510	0.398	0.083	0.004	2002 Forecast
age 2 (00BY)	age 3 (99BY)	age 4 (98BY)	age 5 (97BY)	age 6 (96BY)	age 7 (95BY	TOTAL
0	20	3232	1439	143	14	4848

Step 9 – Take the forecast total for 2002 return and expand it by 20% as described in Chapter 6 to provide a buffer for the impacts of climate change.

4848 x 1.20 = 5818

Step 10 – The number derived in Step 9 is the forecast return of adult fish for 2002 if recovery goals have been met. These annual forecasts can be plotted along with the actual number of spawners observed to track progress towards recovery (see Figure 1 for a hypothetical example). In this example the population does not pass the abundance and productivity measurable criteria since observed spawner abundance equals or exceeds the forecasted abundance needed to achieve recovery goals only four out of the 12 years.

[84] The recovery scalar is the amount that the current survival rate needs to be improved to get the probability of CRT to the threshold for the risk category targeted for this population – in this instance the recovery scalar for this example population to achieve a low risk of extinction = 1.94

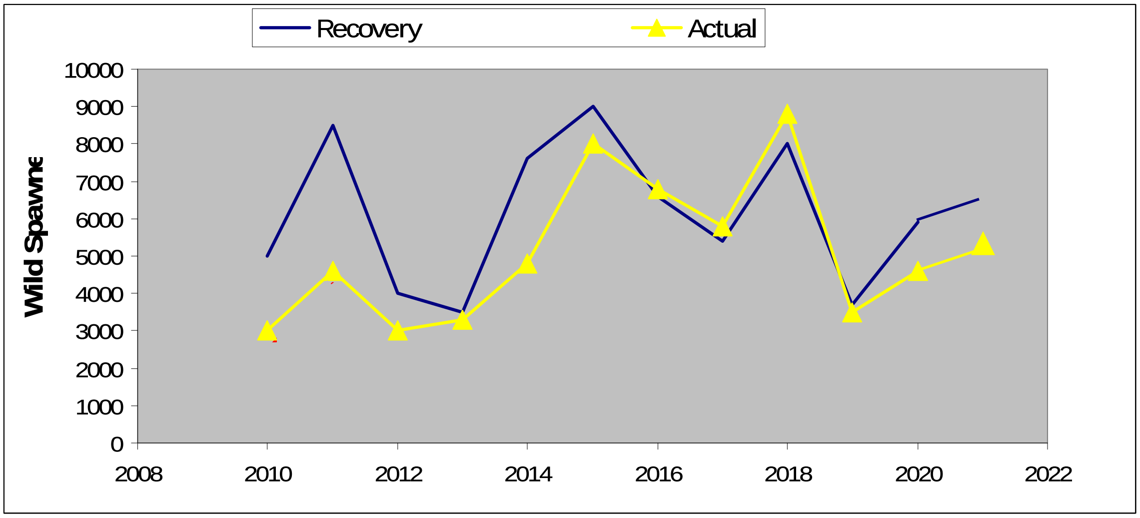

Figure 8-1. Hypothetical example comparing observed spawner abundance with recovery goals scaled to climate conditions.

RME Needed to Assess Abundance and Productivity

Status and Trend Monitoring

1. Annual estimates of the spawner abundance of natural and hatchery origin fish in each UWR Chinook and steelhead population.

   Relevance: Needed to calculate annual spawner and recruit estimates.

   Approach: Census surveys in subbasins where feasible. Where census-based surveys are not feasible, monitoring will include spatially balanced, random surveys based on the Generalized Randomized-Tessellation Stratified (GRTS) technique (Stevens and Olsen, 2004). Field protocols for winter steelhead will follow those outlined in ODFW (2007b[85]), and protocols for spring Chinook will follow those outlined in Schroeder et al. (2007[86]). The objective will be to provide annual estimates of spawner abundance with a 95% confidence interval of ±30%. Examination for hatchery fin clips of carcasses recovered during spawning surveys will delineate the proportion of hatchery fish. These samples will be supplemented where necessary and feasible with scale and/or otolith analyses, and capture of live fish when carcasses cannot be recovered (e.g., steelhead redd surveys). Spawner abundance monitoring will also rely on the future infrastructure and coordinated monitoring at the upgraded fish collection facilities at WP Project dams and other fish handling facilities.

2. Annual estimates of mortality due to harvest for each UWR Chinook and steelhead population.

   Relevance: A needed component of estimating total recruits for abundance and productivity analyses.

[85] http://oregonstate.edu/dept/ODFW/spawn/pdf%20files/reports/07StwManual.pdf
[86] https://nrimp.dfw.state.or.us/CRL/Reports/AnnPro/annual%2006-07_final_web%20v3.pdf

Approach: TBD[87]. The procedures adopted for the FMEP's for Chinook and steelhead will be the foundation for these estimates.

Critical Uncertainty Research

1. Better information on extent of potential spawning and rearing distribution of each UWR Chinook and steelhead population.

   Relevance: Accurate expansion of survey data to population estimates requires accurate information on population range.

   Approach: Map-based approach using existing IP layers and correcting as needed with expert opinion and field verification.

2. Development of efficient survey designs for assessing patchily-distributed populations based on understanding factors that influence annual variation in distribution (e.g., fish abundance and streamflow).

   Relevance: Traditional GRTS-based surveys can be misleading or costly to implement when populations exhibit patchy distributions. Understanding of factors that influence distribution will aid the design of more precise and efficient surveys.

   Approach: TBD

3. Cost effective survey designs and methods for assessing fish populations in streams where conditions (stream size, turbidity, cover) reduce the efficacy of traditional visual survey methods.

   Relevance: Many areas in the upper Willamette River subbasins are not amenable to traditional visual spawning survey protocols.

   Approach: TBD

4. Annual estimates of the marine and freshwater survival rates of natural origin spring Chinook and winter steelhead for selected areas in the upper Willamette River subbasins.

   Relevance: Needed to provide supplemental information on environmental factors influencing observed abundance and productivity.

   Approach: At least two intensively monitored watersheds (i.e., trapping of adults in and juveniles out) the ESU/DPS.

8.3.3 Analytical Guidelines, Measurable Criteria, and RME for Spatial Structure

Analytical Guidelines

1. The spatial structure of a population must support the population at the desired productivity, abundance, and diversity levels through short-term environmental perturbations, longer-term environmental oscillations, and natural patterns of disturbance regimes. The metrics and measurable criteria for evaluating the adequacy of a population's spatial structure should specifically address:
   a. Quantity: Spatial structure should be large enough to support growth and abundance, and diversity criteria.

[87] Early in the implementation phase of this Recovery Plan, workgroups will be convened to develop the approach for this and all other TBD RME elements.

b. Quality: Habitat underlying spatial structure should be within specified habitat quality limits for life-history activities (spawning, rearing, migration, or a combination) taking place within the patches.
c. Connectivity: Spatial structure should have permanent or appropriate seasonal connectivity to allow adequate migration between spawning, rearing, and migration patches.
d. Dynamics: The spatial structure should not deteriorate in its ability to support the population. The processes creating spatial structure are dynamic, so structure will be created and destroyed, but the rate of loss should not exceed the rate of creation over time.
e. Catastrophic Risk: The spatial structure should be geographically distributed in such a way as to minimize the probability of a significant portion of the structure being lost due to a single catastrophic event, either anthropogenic or natural.

Measurable Criteria – Spatial Structure

Spatial Structure Metric – Percent Occupied Habitat

The occupancy of spawning adults or juveniles at spatially balanced, random survey sites.

Percent Occupied Habitat Evaluation Thresholds

Pass – The percentage of sites not occupied by spawning adults or rearing juvenile spring Chinook or winter steelhead is ≤ the thresholds shown Table 8-1 at least six times during a twelve year period *and* the overall average percentage of sites not occupied during that same time period is ≤ than the thresholds shown Tables 8-1.

Fail – The percentage of sites not occupied by spawning adults or rearing juvenile spring Chinook or winter steelhead is > the thresholds shown Table 8-1 at least six times during a twelve year period *or* the overall average percentage of sites not occupied during that same time period is > the thresholds shown Tables 8-1.

Table 8-1. Occupancy thresholds for UWR Chinook and steelhead populations.

Population	Watershed Size	Delisting Risk Goal	Occupancy Threshold	
			Delisting	Broad Sense (Very Low Risk)
Spring Chinook				
Clackamas	medium	VL	10%	10%
Molalla	small	H	50%	5%
North Santiam	medium	L	20%	10%
South Santiam	medium	M	20%	10%
Calapooia	small	H	50%	5%
McKenzie	large	VL	15%	15%
Middle Fork Willamette	medium	L	20%	10%
Winter Steelhead				
Molalla	large	VL	15%	15%
North Santiam	large	VL	15%	15%
South Santiam	large	VL	15%	15%
Calapooia	small	M	25%	5%

Spatial Structure Metric – Geographic Distribution

Comparison of the spatial pattern of potential spawning distribution to that observed using SVB[88] spatial statistics.

Geographic Distribution Evaluation Thresholds (Adults and Juveniles)

> *Pass* – The observed distribution the SVB statistic of sites occupied by four or more adult spawning fish or one juvenile is not significantly different from a random distribution at least six times in any 12-year period.
>
> *Fail* – The observed distribution the SVB statistic of sites occupied by four or more adult spawning fish or one juvenile is not significantly different from a random distribution less than six times in any 12-year period.

Analytical Procedure for Spatial Structure

The manner in which juveniles and adults (spawners) are distributed within the freshwater portion of a population's home range is an important consideration in assessing the conservation status of a population (McElhany et al. 2000, Bisson et al. 1997). Healthy populations will experience periods when the distribution of spawners becomes spatially compressed (e.g., during poor marine survival periods) and periods when the spatial distribution of spawners expands (e.g., during good marine survival). It is important to keep in mind that distribution is also governed by some factors that are unrelated to population size, like weather patterns. During years with little rain and low stream flows, fish may not be able to access much of the habitat and distribution may be constricted even if the population size is large. The challenge is to select a criterion that will identify when a restriction in spawner distribution is greater than expected for a healthy population under given environmental conditions.

Because adult and juvenile salmon and steelhead often rely on different aspects of habitat during their stay in freshwater, it is important that the distribution of both adult and juveniles are monitored. ODFW and NMFS have established two measurable criteria for spatial structure. Both rely on spatially balanced, random surveys of the presence/absence of adult spawners and rearing juveniles that are conducted throughout their historic range. Adult spawner surveys will also provide information needed on abundance and productivity as described earlier. Surveys for spatial structure will not need to be conducted above barriers that do not allow the passage of wild fish; however, the survey design process will include such sites to enable a statistically rigorous analysis of occupancy across a species historic distribution[89].

The first measurable criterion is based on WLC-TRT guidance on the relationship between population persistence and the overall percentage of accessible habitat. Analysis of survey data for this criterion is relatively straight forward and simply involves calculating the percentage of sites that where spawners are absent.

The second criterion is designed to obtain information on the geographic distribution of spawning. For this criterion we will use the SVB statistic (Stevens 2006) to determine if the spatial distribution of occupied sites is comparable to the spatial distribution of sites where spawning may potentially occur. To calculate the SVB statistic, a polygon will be drawn around each point that encompasses the area closer to that point than to any other. If the polygons are similar in size and shape, then the distribution is more regular. If the polygons differ in size and shape then the distribution is more clustered. One criterion that is sensitive to both variation in area and shape is the variation of the distance from a point to the boundary

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[88] SVB stands for Sides, Vertices, and Boundaries
[89] Random survey sites above known barriers will be automatically assigned to the "absent" category.

of its polygon. If we define a Side as a division between two polygons, a Boundary as a segment of the domain boundary, and a Vertex as the intersection between two Sides or a Side and a Boundary, then the SVB can be approximated by the mean square deviation (MSD) of the distance from a sample point to Sides, Vertices, and Boundaries, relative to a nominal value (such as the MSD for a hexagon with area = [domain area / number of samples]).

To test that occupancy occurs at random over the population's range, a pattern of random presence/absence can by simulated by assigning each of the survey points either 0 (indicating absence) or 1 (indicating presence). By repeating the process multiple times, each time calculating the SVB statistic, a distribution of the SVB statistic can be constructed. The distribution will be specific to that particular population, because it will depend on the geometry of the stream network occupied by a population. The distribution will also depend on the occupancy rate.

Various hypotheses can be tested by choosing an occupancy rate, and then assigning absence following some hypothesized relationship. For example, to test the hypothesis of a shrinking domain, higher probability of absence could be assigned to stream sites near the domain boundary, or to stream segments deemed to have less suitable habitat. Standard randomization test procedures can then be used to establish significance level of the test. It is then possible to test various hypotheses about the actual distribution by comparing the observed value to the random distribution. A population would pass this criterion as long as the observed SVB statistic distribution did not significantly differ from the random distribution.

RME Needed to Assess Spatial Structure

Status and Trend Monitoring

1. Annual estimates of the distribution and density of natural origin spawning adult and rearing juvenile spring Chinook and winter steelhead for each UWR population.

   Relevance: Used in combination with habitat information to assess existing spatial structure relative to desired status.

   Approach: Spatially balanced, random surveys based on the Generalized Randomized-Tessellation Stratified (GRTS) technique (Stevens and Olsen, 2004). Snorkel and electrofishing surveys for juveniles following protocols described in Rodgers (2000[90]) and Rodgers (2001[91]). Field protocols for spawning winter steelhead will follow those outlined in ODFW (2007b[92]). Field protocols for spawning spring Chinook will follow those outlined in Schroeder et al. (2007[93]). The objective will be to detect a change in spatial distribution of ± 15% with an 80% certainty.

2. Five-year assessment of habitat conditions throughout the accessible distribution of each UWR spring Chinook and winter steelhead population.

   Relevance: Used in combination with fish distribution information to assess existing spatial structure relative to desired status. Need to know whether or not changes in observed fish distribution are due to changes in habitat conditions.

[90] http://nrimp.dfw.state.or.us/crl/Reports/WORP/WORPAN99.pdf
[91] https://nrimp.dfw.state.or.us/crl/Reports/WORP/WORPAN00.pdf
[92] http://oregonstate.edu/dept/ODFW/spawn/pdf%20files/reports/07StwManual.pdf
[93] https://nrimp.dfw.state.or.us/CRL/Reports/AnnPro/annual%2006-07_final_web%20v3.pdf

Approach: Spatially balanced, random surveys based on the Generalized Randomized-Tessellation Stratified (GRTS) technique (Stevens and Olsen, 2004). Field sampling protocols will be based on ODFW Aquatic Inventory protocols[94].

3. Annual monitoring of streamflow and temperature.

   Relevance: Distribution can be significantly influenced by streamflow and temperature (e.g., less habitat being assessable during drought years).

   Approach: TBD

Critical Uncertainty Research

1. Refinement of knowledge of the extent of historical spawning and rearing distribution of each UWR Chinook and steelhead population.

   Relevance: Needed for comparisons of desired or potential distribution to actual distribution.

   Approach: TBD

2. Refinement of knowledge of the accuracy of field protocols to detect occupancy.

   Relevance: Presence of individuals in samples is proof of occupancy, but absence can not be proven. The problem is that frequency of "false" absences depends on the abundance and distribution of individuals, the sampling method and intensity, and the grain of sampling. This can be particularly problematic for species that are rare or patchily distributed or as species and populations decline in abundance and distribution leading to errors in estimates that vary with habitat and environmental conditions and species abundance.

   Approach: TBD

3. Refinement of knowledge of relationship factors that influence annual variation in distribution (e.g., fish abundance, streamflow, water temperature).

   Relevance: Needed to refine spatial distribution measurable criteria.

   Approach: TBD

4. Refinement of knowledge of the relationship between spatial structure and viability.

   Relevance: While it is acknowledged that spatial structure has the potential to play a major role in population viability, there is little quantitative information on how the extent of this relationship.

   Approach: TBD

8.3.4 Analytical Guidelines, Measurable Criteria, and RME for Diversity

Analytical Guidelines

1. Sufficient life-history diversity must exist to sustain a population through short-term environmental perturbations and to provide for long-term evolutionary processes. The metrics and measurable criteria for evaluating the diversity of a population should be evaluated over multiple generations and should include:

[94] http://oregonstate.edu/dept/ODFW/freshwater/inventory/pdffiles/hmethd08.pdf

a. substantial proportion of the diversity of a life-history trait(s) that existed historically,
b. gene flow and genetic diversity should be similar to historical (natural) levels and origins,
c. successful utilization of habitats throughout the range,
d. resilience and adaptation to environmental fluctuations.

Measurable Criteria – Diversity

Diversity Metric #1: Effective Population Size

Effective population size relates to a minimum population level that must be maintained to minimize the genetic risks associated with small population size such as: inbreeding depression, the loss of diversity through genetic drift, and the accumulation of maladaptive mutations. Since the population abundance goals described in Chapter 6 are designed to equal or exceed abundance needed to satisfy effective population size requirements, passing the abundance and productivity thresholds described in Chapter 6 will mean that effective population size requirements are met.

Diversity Metric #2: Interbreeding with hatchery fish

See measurable criteria for hatchery related threats in section 8.4.5.

Diversity Metric #3: Anthropogenic mortality

See measurable criteria for fish harvest related threats in section 8.4.2.

Diversity Metric #4: Life-history traits

Approach TBD – see discussion below on analysis procedures for diversity metrics.

Diversity Metric #5: Habitat diversity

TBD – see discussion below on analysis procedures for diversity metrics.

Analytical Procedures for Diversity Metrics

Within-population diversity is the result of phenotypic differences among individuals. These differences provide the flexibility of the population as a whole to respond successfully to short-term environmental variations. They also are the basis by which populations are able to adapt and evolve as conditions within their home range go through changes that are more permanent. Therefore, maintaining sufficient within-population diversity is an issue of both short-term and long-term survival.

Within-population diversity is affected by a variety of forces including: evolutionary legacy, immigration from other populations, mutation, selection, and random loss of genetic variation due to small population size. However, population size (abundance) is most commonly recognized as a concern for species that are vulnerable to extinction. The genetic consequences of small population size and numerous approaches to defining minimum population abundance thresholds have been investigated widely (Soulé 1980; Lande 1995; Franklin and Frankham 1998; Rieman and Allendorf 2001). In nearly all cases, this becomes an exercise of identifying a rate at which genetic variation can be lost without causing a risk to a population’s short or long-term persistence. The diversity criterion incorporates this concept.

While there is general consensus that life-history diversity is important to the long term resilience of salmon and steelhead populations, there is little consensus or guidance available on specifically how information on life-history diversity should be analyzed in order to assess whether or not salmon and steelhead populations have the range of life-history characteristics necessary for long term resilience in the face of a changing climate. As a result, it is difficult to establish specific pass/fail thresholds for this metric. Despite this, we believe that monitoring of key life history traits (see RME needs below) are important to establish a baseline and trend for diversity evaluations. This combined with more research into what key life-history traits should be maintained in the face of future climate change and reconstruction of the historical life-history diversity of UWR spring Chinook and winter steelhead populations should help to better define future analytical approaches.

Given that there is considerable uncertainty about how and what to monitor, a monitoring approach involving stratifying the status and trend abundance sampling (described earlier) by distinct environments that are presumably the template for the expression of diversity might provide information on the relationship between diversity metrics and environmental/habitat conditions.

RME Needed to Assess Diversity

Status and Trend Monitoring Needs

1. Periodic monitoring of key life history characteristics of each UWR spring Chinook and winter steelhead population. For example:
    a. Timing of return to fresh water
        - Run time (e.g., fall vs. spring)
        - Variation within a specific run time
    b. Age at maturation
    c. Spawn timing
    d. Outmigration timing
        - Distribution to downstream or upstream rearing habitat
        - Specific nursery habitat utilization
    e. Smoltification timing
        - Entrance to marine environment
        - Duration of residence in intertidal or Columbia River plume areas
    f. Developmental rate
    g. Egg size
    h. Fecundity
    i. Freshwater distribution
    j. Ocean distribution
    k. Size at maturation
    l. Timing of ascension to the natal stream

    Relevance: Information of key life history characteristics is important to understanding the long-term resilience and adaptability of UWR spring Chinook and winter steelhead populations.

    Approach: TBD

2. Annual monitoring of the spatial distribution, abundance, and origin of adult spring Chinook and winter steelhead spawning in the wild in each UWR population area.

    Relevance: If fish spawn and rear in a variety of freshwater habitats in a subbasin, the population, as a whole, will be buffered against year-to-year environmental variations. Hatchery strays can impact the diversity of wild populations.

    Approach: See RME needs for abundance and productivity.

3. Regular hatchery monitoring.

Relevance: Hatcheries affect diversity largely through the process of domestication and introgression. Additionally, hatchery propagation may produce non-genetic effects on the expression of life history traits via non-natural rearing regimes.

Approach: TBD

4. Periodic genetic marker monitoring.

   Relevance: Monitoring of genetic changes within and among populations can reveal changes in the genetic characteristics of a population or ESU/DPS.

   Approach: TBD

5. Periodic assessment of habitat diversity, occupancy, and anthropogenic changes to habitat and the environment.

   Relevance: Assessing the effects of artificial selection must include the degree to which a population's life history diversity has been modified relative to its historical locally-adapted state.

   Approach: See RME needs for spatial structure.

Critical Uncertainty Research

1. Research into which life-history traits or other diversity parameters are the most meaningful measures of diversity, particularly in the context of future climate change impacts.

   Relevance: Development of meaningful measures of diversity is difficult largely because of the lack of understanding of the expression of individual life history traits (the genetic and environmental effects) and the degree of correlation between those traits.

   Approach: TBD

2. Reconstruction of the historical life-history diversity of UWR spring Chinook and winter steelhead populations

   Relevance: Needed in order to provide a template for life history diversity benchmarks.

   Approach: TBD

8.3.5 Summary of Strategic Approach to Monitoring VSP Parameters

The strategy for monitoring the seven UWR Chinook and four steelhead populations involves following basic components:

1. Conduct research to document the precision and bias associated with various fish monitoring protocols (e.g.. spawning surveys, snorkel surveys, smolt trapping) across the range of conditions that exist within the UWR subbasins.
2. Where field protocols for spawning surveys are deemed to provide acceptable precision and bias, and access is possible for most of the potential areas in the sample frame, implement either GRTS-based or census-based spawning surveys to provide population level information on abundance (spawners), productivity (recruits/spawner), diversity (occurrence of hatchery strays on spawning grounds, run timing, size, age, genetics), and distribution. Goal is to provide annual spawner abundance estimates at the population scale with a precision of ± 30% or better. NOTE that these surveys are preferable to fixed station counting since they have the potential to provide

information on distribution which is not available with fixed station counts. They are, however, only preferable if they can produce estimates with acceptable precision and bias.

3. Where field protocols are not amenable, use information from existing or new adult trapping facilities to provide abundance, productivity, and diversity for sub-watershed areas. (In these instances we will not be able to assess distribution criteria.) Conduct research to assess the representativeness of these index areas and evaluate magnitude of pre-spawning mortality.
4. Cross check precision and bias of GRTS-based or census-based spawning surveys by comparing the results of survey implemented above adult traps to counts made at the traps. Conduct these evaluations over the range of conditions that exist within the UWR areas.
5. Evaluate the potential for using sonar (e.g., DIDSON) to monitor abundance. Implement where feasible and cost effective in situations where surveys cannot be conducted or adult trapping facilities do not exist.
6. Develop programs to monitor fishery related mortality[95] that include reliable information on bias and precision.
7. Conduct hatchery monitoring to provide information on number of fish released, marked[96], returned to hatchery, and wild fish collected for brood stock.
8. Where field protocols for juvenile surveys provide acceptable precision and bias, and access is possible for most of the potential areas in the sample frame, implement GRTS-based surveys to provide information on an index of abundance (fish/m^2), productivity (juveniles per mile/spawners per mile), and distribution. Goal is to provide annual estimates of juvenile density at the population scale with a precision of $\pm$ 30% or greater.
9. In at least two populations trap adults in and juveniles out to provide estimates of marine and freshwater productivity (i.e., Life Cycle Monitoring sites, use Detroit facility and Cougar? Facility-or modify Leaburg to include a juvenile monitoring facility??). Goal is to provide annual estimates of adults in and juveniles out of selected watersheds with a precision of $\pm$ 30% or better.
10. Evaluate how well Life Cycle monitoring sites represent conditions outside of the index areas and investigate the potential for implementing additional trap sites that could be operated periodically on a rotating basis to "calibrate" index sites to broader areas.

Priorities

Monitoring of harvest or hatcheries basically is considered the cost doing business. Therefore, decisions to continue existing harvest or hatchery monitoring or to implement new monitoring will be primarily linked to decisions regarding the existence of these harvest or hatchery programs. If harvest or hatchery programs exist, the monitoring described in items F and G (above) become high priority. Without this information we not only will have a difficult time assessing any of the VSP parameters in any wild populations exposed to fishery or hatchery impacts, but will also not meet the management needs of harvest and hatchery programs.

For the other monitoring components (spawners, juveniles, life/cycle), when funds are limited there are three primary ways to reduce monitoring effort (and thus expenditures). In priority order these are:

1. Reduce effort throughout the sample frame[97] (may decrease precision).

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[95] Needed for productivity estimates.
[96] Needed to estimate pHOS.
[97] The sample universe or spatial extent over which the target indicator may be distributed.

2. Reduce effort in parts of the sample frame (may increase bias).
3. Eliminate one or more of the components describe above (may result in inability to provide any information on certain monitoring objectives).

Oregon's strategic approach *to fluctuations in monitoring support* is to design monitoring programs that are scalable and provide information on the variance structure of monitored indicators. This information will enable calibration of information gathered during periods of reduced effort to information gathered during periods of enhanced (or non-reduced) effort. Oregon's first priority is to use this approach to reduce effort throughout the sample frame while still keeping (at least for the short term) acceptable precision.

In instances when either calibration information has not been developed, does not show that acceptable precision and bias goals can be achieved with reduced effort, or where budget shortfalls require deeper reductions, Oregon's next priority is to reduce effort in parts of the sample frame. For UWR Chinook and steelhead populations, Oregon will follow priorities set for delisting goals in Chapter 6 of this Plan. Under the delisting scenario in the Plan the Molalla and Calapooia Chinook salmon populations are currently at very high risk of extinction, and are not targeted for recovery to viable status, and thus will be the first areas where species specific monitoring of adult escapement or juvenile abundance will be either temporarily suspended or postponed if necessary to respond to budget shortfalls.

Finally, if the two steps described above still do not yield enough fiscal reductions to meet budget shortfalls, Oregon's final step will be to eliminate entire monitoring components in the following order:

1. GRTS-based juvenile surveys
2. Life cycle monitoring
3. GRTS-based spawner surveys

By following this strategic approach, Oregon believes that with adequate funding it can provide scientifically rigorous information on the four VSP parameters that is crucial for future decisions on the status and trend of UWR spring Chinook and winter steelhead. This strategic approach also provides a rational way to establish priorities for providing quality information given available monitoring resources, and provides managers and policy makers with a better framework for making decisions regarding the funding of monitoring programs.

8.3.6 Summary of Current Monitoring for VSP Parameters

A variety of monitoring programs are currently in place that can provide some of the information needed to assess VSP parameters in the future for UWR Chinook and steelhead populations. These data and programs will need to be evaluated in the context of the approaches needed to address the VSP metrics.

8.4 Listing Factors

In addition to RME needed to address the biological criteria, to be approved by NMFS, a recovery plan must also include RME that addresses the five ESA section 4(a)(1) listing factors:

A. The present or threatened destruction, modification, or curtailment of the species' habitat or range
B. Over-utilization for commercial, recreational, scientific or educational purposes
C. Disease or predation
D. The adequacy of existing regulatory mechanisms
E. Other natural or manmade factors affecting its continued existence

In contrast to the measurable criteria developed for biological recovery (which have a direct connection to assessments of population viability), the measurable criteria described below for the listing factors are primarily related to directly tracking the success of actions designed to reduce the impact of current threats or serve as an early warning for emerging threats.

The following describes the decisions, key questions, measurable criteria, and RME needed by this Plan to assess the status of the five listing factors.

8.4.1 Decisions, Key Questions, Metrics and RME for Listing Factor A: The Present or Threatened Destruction, Modification, or Curtailment of a Species' Habitat or Range.

Decisions

1. Habitat related threats have been ameliorated such that they do not limit attainment of the desired status of the population. The desired status of each population is defined by viability criteria identified in the Recovery Plan.
2. Flood Control/Hydropower related threats have been ameliorated such that they do not limit attainment of the desired status of the populations relative to population-specific viability criteria identified in the Recovery Plan.

Key Habitat Related Threat Question

Are there significant effects of habitat degradation on the observed abundance, productivity, spatial structure, and diversity of the natural-origin fish in this population?

Measuring Habitat Related Threats

Habitat Related Metrics

Five year assessments of:

- Floodplain Connectivity and Function
- Channel Structure and Complexity
- Riparian Condition and LWD Recruitment
- Stream Substrate
- Water Quality and Stream Flow
- Fish Passage
- Pre-spawn mortality

Evaluation Thresholds for Habitat Related Metrics – All Species

Pass – Positive trend in the status of the habitat degradation metrics
Fail – Negative trend or no improvement in the status of the habitat degradation metrics

Analytical Procedures for Habitat Related Metrics

Although we may achieve passing grades for the biological population criteria, the ESU/DPS can still be deemed at risk of extinction if habitat conditions are deteriorating. Even if conditions are not declining but simply remaining the same, it is clear that that significant improvement to habitat conditions is needed to achieve recovery goals. A "status quo" in habitat conditions would also serve as an indication that recovery goals are not being met.

By establishing baseline conditions for the habitat metrics listed above, and periodically reassessing these conditions, we will be able to evaluate whether or not habitat conditions are improving, staying the same, or declining. In tributary streams we can also compare habitat conditions to those at relatively undisturbed "reference" sites to gauge how far current habitat conditions are from "pristine" conditions. Ultimately we would like to establish goals for each habitat metric that would enable us to assign a target number of stream miles in each population area that should have habitat conditions similar to reference conditions. However, our current lack of quantitative information that specifically links habitat conditions to the biological criteria (i.e., abundance, productivity, diversity, and spatial structure) makes it difficult to develop quantitative habitat status benchmarks. Instead, until more research is conducted to establish a more sound quantitative linkage between habitat conditions and the biological criteria, we have opted to establish measurable criteria evaluation thresholds that are based on the trend in habitat conditions.

An example of the types of analyses that will be conducted on the collected instream habitat data may be found in ODFW (2005b[98]). Comparison of monitored habitat conditions to undisturbed "reference" sites to gauge departure from pristine conditions has been a common goal in monitoring across the region, but it is often complicated by relatively high variability in individual parameters and limited power to detect meaningful trends. Because of this, it is critical that habitat information be regularly reviewed to assess ability of monitoring program to detect biologically meaningful changes in habitat conditions.

RME Needed to Assess Habitat Related Threats

Status and Trend Monitoring

1. Five year estimates of the spatial pattern and status of indicators of floodplain connectivity and function, channel structure and complexity, riparian condition and LWD recruitment, stream substrate, and fish passage within each UWR population area.

   Relevance: Used to establish baseline habitat conditions and habitat trend in subbasin streams reaches.

   Approach: Spatially balanced, random surveys based on the Generalized Randomized-Tessellation Stratified (GRTS) technique (Stevens and Olsen 2004). Field sampling protocols will be based on ODFW Aquatic Inventory protocols[99]. Objective will be to characterize habitat conditions at ± 15% with 80% certainty.
2. Five year estimates of the spatial pattern and status of indicators of floodplain connectivity and function, channel structure and complexity, riparian condition and LWD recruitment in the mainstem Willamette River and estuary

   Relevance: Used to establish baseline habitat conditions and habitat trend in the estuary and mainstem Willamette reaches.

   Approach: Spatially balanced, random surveys based on the Generalized Randomized-Tessellation Stratified (GRTS) technique (Stevens and Olsen 2004). Field sampling protocols will be based on ODFW Aquatic Inventory protocols, but specific methods for these larger reaches will need to be established.

3. Annual assessments of status and spatial pattern of water quality for each UWR population area, the mainstem Willamette, and in the estuary. This includes monitoring of stormwater and cropland runoff for status/trends of concentrations of malathion, diazinon, and chlorpyrifos, and identify their sources.

   Relevance: Used to establish baseline water quality conditions and water quality trend in tributary streams and the estuary

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[98]http://nrimp.dfw.state.or.us/OregonPlan/default.aspx?p=152&path=ftp/reports/Final%20Reports/Agency%20Reports/ODFW&title=&link= (select ODFWHabitatFinalReport.pdf)
[99] http://oregonstate.edu/dept/ODFW/freshwater/inventory/pdffiles/hmethd08.pdf

Approach: Spatially balanced, random water quality sampling based on the Generalized Randomized-Tessellation Stratified (GRTS) technique (Stevens and Olsen 2004). Survey design will be integrated with habitat and fish monitoring survey design. Field sampling protocols will be based on ODEQ protocols. An example of the types of analyses that will be conducted on the collected water quality data may be found in ODEQ (2005[100]), and monitoring associated with implementing TMDL's.

4. Annual assessments of status and spatial pattern of streamflow for each UWR population area and for streamflows entering the mainstem Willamette River and estuary

   Relevance: Used to establish baseline streamflow conditions and trend in streamflows in subbasin streams and entering the mainstem Willamette River and estuary.

   Approach: TBD

Implementation and Compliance Monitoring

1. Annual assessments of compliance with existing habitat protection rules and regulations (those in place at the time of the assessments).

   Relevance: Needed to assess compliance with rules and regulations designed to protect habitat conditions

   Approach: Depending on the extent of the regulatory issue, agencies responsible for managing and/or enforcing habitat protection rules and regulations will either conduct annual censuses or statistically rigorous field surveys to assess compliance

2. Annual assessments of the implementation of habitat management best management practices

   Relevance: Application of recognized best management practices is a critical component of volunteer efforts to protect and restore habitat. Regular assessments of the extent to which best management practices are being implemented is a critical component of adaptively managing volunteer habitat programs (e.g. lack of implementation may mean that more technical assistance or other incentives are needed).

   Approach: TBD

3. Annual assessments of implementation of recovery actions designed to protect and restore habitat conditions

   Relevance: Needed to assess degree of implementation of recovery plan actions designed to protect and restore habitat conditions

   Approach: Depending on the scope of the action implementation, agencies responsible for managing or implementing the actions will either conduct annual censes or statistically rigorous field surveys to assess implementation.

Effectiveness Monitoring

1. In coordination with the Pacific Northwest Monitoring Partnership (PNAMP), establish a series of Intensively Monitored Watersheds which can be used to assess the effect of habitat restoration

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[100]http://nrimp.dfw.state.or.us/OregonPlan/default.aspx?p=152&path=ftp/reports/Final%20Reports/Agency%20Reports/ODEQ&title=&link=

and protection measures and best management practices. Studies will be designed that have the ability to detect a 30-50% change in fish response.

Relevance: Needed to assess the effectiveness of habitat restoration and protection

Approach: TBD

2. Site specific monitoring of the effectiveness of habitat protection and best management practices

   Relevance: Needed to assess the effectiveness of habitat protection and best management practices

   Approach: TBD

3. Annual before and after habitat evaluations of sites where habitat restoration actions of been implemented

   Relevance: Needed to assess the effectiveness of reach specific habitat restoration efforts

   Approach: ODFW Aquatic Inventory survey protocols

Critical Uncertainty Research

1. Improved understanding of impact that habitat related limiting factors and threats have relative to other potential limiting factors and threats over the entire life-cycle of UWR spring Chinook and steelhead populations

   Relevance: Needed to better inform decisions on where to prioritize funds for recovery actions

   Approach: TBD

Key Flood Control/Hydropower Related Threat Question

There are multiple questions related to the Flood Control/Hydro threat, many of which are posed in the WP BiOp, and in subsequent WATER working groups. Those processes will be the forum for developing questions, metrics and associated RME to address Listing Factor A for hydro effects related to the observed abundance, productivity, spatial distribution, and diversity of the natural-origin fish in this population?

Flood Control/Hydropower Related Metrics

Among the annual assessments to be conducted are:

a. Fish passage (adults and juveniles)
b. Pre-spawn mortality
c. Above and below dam habitat conditions, including flow and WQ conditions

Evaluation Thresholds for Flood Control/Hydropower Related Metrics

Adult Fish passage

Pass – sufficient number of natural origin adults are allowed above barriers to seed available habitat
Fail – insufficient number of natural origin adults are allowed above barriers to seed available habitat

Juvenile Fish passage

Pass –at each dam/reservoir complex, juvenile survival through reservoir and dam is consistently within standards NMFS applies to similar complexes in other BiOps or FERC agreements
Fail – at each dam/reservoir complex, juvenile survival through reservoir and dam is consistently below standards NMFS applies to similar complexes in other BiOps or FERC agreements

Prespawn mortality (for mature female fish on or near spawning grounds)

Pass – viable populations: % mortality $\leq$ 10%[101]; non-viable populations: $\leq$ 30%
Fail – viable populations: % mortality > 10%; non-viable populations: > 30%

Physical habitat conditions (including flow)

Pass – TBD
Fail – TBD

Water quality conditions

Pass – meet TMDL load allocations for each subbasin
Fail – exceed TMDL load allocations for each subbasin

Analytical Procedures for Hydropower Related Metrics

TBD via the RME subgroups of the WATER technical teams, formed under the WP BiOp.

RME Needed to Assess Flood Control/Hydropower Related Threats

To be determined within the Comprehensive RME Plan developed for the WP BiOP and related WATER subgroups.

8.4.2 Decisions, Key Questions, Metrics, and RME for Listing Factor B: Over-utilization for commercial, recreational, scientific or educational purposes

Decision

Harvest related threats have been ameliorated such that they do not, and will not, limit attainment of the desired status of populations relative to population-specific viability criteria stated in the recovery Plan.

Key Harvest Related Threat Questions

1. Are there significant effects of fish harvest on the observed abundance, productivity, spatial structure, and diversity of the natural-origin fish in this population?
2. Does the status of the *other* listing factors modify the absolute risk posed by the current and potential future status of *this* listing factor?

Measuring Harvest Related Threats

Harvest Related Metrics

Annual estimates of the number of wild Chinook salmon and steelhead harvested from each UWR population.

Evaluation Thresholds for Harvest Related Metrics for UWR populations of spring Chinook and winter steelhead (FMEP's guidelines)

[101] Based on McKenzie estimates for a population already at a low risk of extinction

Pass – Chinook: Total freshwater mortality $\leq$ 15%; steelhead: Total freshwater mortality $\leq$ 20%;
Fail – Chinook: Total freshwater mortality >15%; steelhead: Total freshwater mortality > 20%;

Analytical Procedures for Harvest Related Threats

Apply FMEP procedures

RME Needed to Assess Harvest Related Threats

Status and Trend Monitoring

1. Annual estimates of mortality due to incidental mortality from recreational fishery for each UWR spring Chinook and winter steelhead population, and the aggregated commercial harvest impact rate of Chinook in the lower Columbia River gillnet fishery

   Relevance: Used to directly assess compliance with harvest measurable criteria.

   Approach: Implement through Willamette Chinook and steelhead FMEPs

Implementation and Compliance Monitoring

1. See item #1 under status and trend monitoring

Effectiveness Monitoring

1. Conduct studies to assess effectiveness of harvest management actions needed to achieve harvest impact goals.

   Rationale: Critical information for the adaptive management process.

   Approach: Implement through Willamette Chinook and steelhead FMEPs

Critical Uncertainty Research

1. Review existing information on mortality associated with catch and release and determine if information is adequate to assess mortality impact in potential mark-selective fisheries and if not, implement studies to assess impact that would occur in mark-selective fisheries.

   Rationale: Accurate fishery/gear specific release mortality rates are needed to estimate impacts to released stocks.

   Approach: TBD

2. Improved, population-specific understanding of impact that mortality and phenotypic selection related to fish harvest has relative to other potential limiting factors and threats over the entire life-cycle of UWR spring Chinook and winter steelhead populations.

   Relevance: Needed to better inform decisions on harvest management and where to prioritize funds for recovery actions. Maintaining existing diversity and improving diversity where impaired is critical for populations to be resilient in the face of climate change. See recent work on harvest impacts on diversity

   Approach: TBD

3. Initiate snapshot genetic sampling programs in the various fisheries designed to capture the genetic structure of the TRT populations within the specific fishery in preparation for a future

coast-wide annual coordinated genetic stock identification approach and recalibration of the FRAM model

Relevance: The Fishery Regulation Assessment Model (FRAM) is currently used by the Pacific Fishery Management Council (PFMC) to annually estimate impacts of proposed ocean and terminal fisheries on Chinook and coho salmon stocks (PFMC 2008). FRAM is a single-season modeling tool with separate processing code for Chinook and coho salmon. The Chinook version models populations from central California north to southern British Columbia, Canada. The FRAM has been used in recent years, not only to model harvest fisheries, but to determine compliance with ESA restrictions on allowable take. Currently, 3,833 stock groups are represented in the Chinook FRAM. Each of these groups have both marked and unmarked components to permit assessment of mark-selective fishery regulations. For most wild stocks and hatchery stocks without marking or tagging programs, the cohort size of the marked component is zero; therefore, the current version of FRAM has a virtual total of 76 stock groups for Chinook. The model assumes that CWT fish accurately represent the modeled stock. In nearly all cases wild stocks are aggregated with hatchery stock and both are represented by the hatchery stock. As the coast moves toward stock identification that goes beyond CWTs, the FRAM model will continue to need to be modified.

Approach: TBD

4. Research on freshwater entry migration timing.

   Relevance: One key uncertainty that could potentially reduce the commercial gillnet impact on wild UWR spring Chinook is a better understanding of when and how adult UWR fish migrate through the lower Columbia River mainstem and estuary. If they were temporally and spatially segregated from other stocks, there may be options to adjust gillnet seasons to avoid wild UWR fish. There is some timing information that can be inferred from hatchery stocks based on CWTs, but almost none on wild fish. The Willamette Falls fish counts provide some temporal resolution for wild fish for entry into the Willamette basin, but does not fill the gap for time of freshwater entry. A program of intensive radio tracking that tagged fish in the estuary, then tracked them all the way to their natal subbasins would allow managers to set fisheries to avoid or reduce impacts to sensitive stocks. PIT tagging could be used as well, but would not provide as much spatial and temporal resolution. In the lower Columbia River, these will always be mixed stock fisheries. Implementation of this kind of research could provide information that may allow for complete avoidance of listed stocks, rather than simply “reduced impacts” from mark-selective fisheries.

   Approach: TBD

8.4.3 Decisions, Key Questions, Metrics, and RME for Listing Factor C: Disease and Predation

<u>Decision</u>

Disease and predation related threats have been ameliorated such that they do not, and are not likely to limit attainment of the desired status of populations relative to viability criteria stated in the recovery Plan

<u>Key Disease and Predation Related Threat Questions</u>

1. Are there significant effects of disease on the observed abundance, productivity, spatial structure, and diversity of the natural-origin fish in this population?

2. Are there significant effects of predation by marine mammals, avian predators, or piscine predators on the observed abundance, productivity, spatial structure, and diversity of the natural-origin fish in this population?
3. Does the status of the *other* listing factors modify the absolute risk posed by the current and potential future status of *this* listing factor?

Measuring Disease and Predation Related Threats

Disease Related Metrics

None identified[102].

Predation Related Metrics

Annual assessments of the predation impact on UWR spring Chinook and winter steelhead by Caspian terns, double-crested cormorants, northern pikeminnow, and marine mammals in the estuary.

Evaluation Thresholds for Caspian Tern and Double-crested Cormorant Predation Metric

Pass – TBD
Fail – TBD

Analytical Procedures for Disease and Predation Related Threats

TBD

RME Needed to Assess Disease and Predation Related Threats

Status and Trend Monitoring

1. Monitoring of predation associated with anthropogenic alterations in the Columbia River Estuary and at Willamette Falls.

   Relevance: Needed to assess status and trend in predation rates.

   Approach: TBD

2. Sampling of natural populations in and near the hatcheries to determine the occurrence of pathogens that may cause disease in the natural population.

   Relevance: Needed to assess the extent to which pathogens and the diseases they cause exist in wild populations due to hatchery operations

   Approach: TBD

3. Watershed scale sampling for the occurrence of invasive aquatic species known to affect salmon and steelhead

   Relevance: Needed to assess the magnitude of impact of invasive aquatic species such as Chinese mitten crabs, non-native zooplankton (*Pseudodiaptomus inopinus*) on wild salmon and steelhead

   Approach: TBD

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[102] Although no specific benchmarks have been established for disease, monitoring for status and trend is needed and is described below.

Implementation and Compliance Monitoring

TBD

Effectiveness Monitoring

TBD

Critical Uncertainty Research

1. Conduct research to determine the impact of predation by out-of-ESU/DPS hatchery fish on natural origin salmon and steelhead in the subbasins, as well as the impact of non-native fish.

   Relevance: Predation by hatchery fish on natural origin spring Chinook and steelhead is listed as a secondary threat. WATER working groups are working on scoping this issue further.

   Approach: TBD

2. Compile existing invasive species information to determine which species are of threats to the health of wild salmon and steelhead

   Relevance: Needed to inform status and trend RME need #2.

   Approach: TBD

3. Research into the relationship between land management, parasitism, and the impacts of parasitism on the survival of salmon and steelhead.

   Relevance: New research conducted on Oregon Coast suggests that parasites may have a significant impact on the early ocean survival of coho salmon (Jacobson et al. 2008). Preliminary results of research being conducted by researchers at Oregon State University, Idaho State University, and ODFW suggest that the occurrence and infestation rate of certain salmonid parasites may be influenced by watershed conditions. The results of this research may be important to identifying improved land management practices and critical areas for implementing these land management practices.

   Approach: TBD

8.4.4 Decisions, Key Questions, Metrics, and RME for Listing Factor D: Adequacy of Existing Regulatory Mechanisms

<u>Decision</u>

Inadequacies of existing regulatory mechanisms have been addressed such that regulatory mechanisms do not, and likely will not, limit attainment of the desired status of populations relative to viability criteria stated in the Recovery Plan.

<u>Key Questions Related to Adequacy of Existing Regulatory Mechanisms</u>

1. Are the regulatory mechanisms in place adequate to address the limiting factors such that those limiting factors will not pose a significant threat in the future to the maintenance of the population at viability levels identified in the Recovery Plan?
2. Are the regulatory mechanisms in place adequate to prevent potential limiting factors that are not currently threats from becoming threats in the future?

Measuring Adequacy of Existing Regulatory Mechanisms

No measureable criteria have been established for this listing factor.

Analytical Procedures for Adequacy of Existing Regulatory Mechanisms

TBD

RME Needed to Assess the Adequacy of Existing Regulatory Mechanisms

Status and Trend Monitoring

None identified

Implementation and Compliance Monitoring

1. Implement a recovery plan tracking system that will be capable of recording whether local and State agencies are implementing regulatory actions needed to achieve the goals of this recovery Plan

   Relevance: Needed to provide information on whether or not regulatory actions are adequately implemented

   Approach: TBD

2. Develop a randomized sampling program to test whether permits issued under local and State regulatory actions designed to protect riparian and instream habitat are in compliance and that the provisions have been enforced.

   Relevance: Needed to assess permit compliance with riparian and instream habitat rules and regulations

   Approach: TBD

Effectiveness Monitoring

None identified.

Critical Uncertainty Research

1. Additional research is needed to continue to evaluate the adequacy of existing BMPs for forest practices, stormwater management, hydraulic permits, shoreline development, and other activities that affect the marine and aquatic areas.

   Relevance: Needed to assess if regulatory mechanisms in place are adequate to address the limiting factors such that those limiting factors will not pose a significant threat in the future to the maintenance of the population at viability levels identified in the recovery plan and whether regulatory mechanisms in place are adequate to prevent potential limiting factors that are not currently threats from becoming threats in the future

   Approach: TBD

8.4.5 Decisions, Key Questions, Metrics, and RME for Listing Factor E: Other Natural or Manmade Factors Affecting the Continued Existence of the ESU/DPS

Decisions

1. Other natural factors have been accounted for such that they do not limit attainment of the desired status of populations relative to viability criteria identified in the Recovery Plan.

2. Hatchery related threats have been ameliorated such that they do not, and will not, limit attainment of the desired status of populations relative to viability criteria stated in the Recovery Plan.

<u>Key Listing Factor E Questions</u>

1. Are there significant effects of natural factors not covered in listing factors A-C on the observed abundance, productivity, spatial structure, and diversity of the natural-origin fish in this population? Examples are:
    a. Ocean conditions
    b. Climate change
    c. Volcanic eruptions or earthquakes
2. Are there significant effects of hatchery operations on the observed abundance, productivity, spatial structure, and diversity of the natural-origin fish in this population? Specific hatchery related threats or limiting factors for which this question should be answered are:
    a. Broodstock collection
    b. Genetic introgression
    c. Domestication
    d. Disease
    e. Competition
    f. Predation
    g. Timing of egg take
    h. Rearing practices
    i. Release practices
3. Are there significant effects of any listing factors on ecosystem nutrient dynamics on the observed abundance, productivity, spatial structure, and diversity of the natural-origin fish in this population?
4. Does the status of the other listing factors modify the absolute risk posed by the current and potential future status of this listing factor?

<u>Measuring Hatchery Related Threats</u>

Hatchery Related Metrics

Annual assessments of the proportion of spawning fish that are of hatchery origin in each UWR population.

Evaluation Thresholds for Hatchery Related Metrics – Delisting

Pass – Over a nine-year period, the average percentage of the total number of spawners that are of hatchery origin is on average less than or equal to that shown in Table 6-10.
Fail – Over a nine-year period, the average percentage of the total number of spawners that are of hatchery origin is on average higher than that shown in the Table 6-10.

Evaluation Thresholds for Hatchery Related Metrics – Broad Sense Recovery

Pass – Over a nine-year period, the average percentage of the total number of spawners that are of hatchery origin is on average less than or equal to 10%.
Fail – Over a nine-year period, the average percentage of the total number of spawners that are of hatchery origin is on average greater than 10%.

Analytical Procedures for Hatchery pHOS

As outlined in Chapter 6 (Recovery Scenarios) the pHOS rates represent a decrease of hatchery fish spawning with wild fish, that when combined with the targeted reductions in other threat categories, should lead to the long term viability of the ESU/DPS (i.e., delisting). To achieve broad sense recovery, which is achieved when all populations have a very low risk of extinction, pHOS should not exceed 10 percent in any population. While the target stray rates represent what is needed over the long term (100 years), in order to conduct more timely assessments of the status and trend in hatchery stray rates, a nine-year average was used for the analysis. This average will be calculated as a whole over nine years.

RME Needed to Assess Other Natural or Manmade Factors Affecting the Continued Existence of the ESU/DPS

Status and Trend Monitoring

1. Conduct annual assessments of the abundance, distribution, and origin of hatchery fish spawning in each UWR population.

   Relevance: Needed to assess compliance with hatchery pHOS goals, and to inform managers on sources of hatchery strays so they can take appropriate actions to limit their occurrence

   Approach: Examination for hatchery fin clips of carcasses recovered during spawning surveys. These samples will be supplemented where necessary and feasible with scale and/or otolith analyses, and capture of life fish when carcasses cannot be recovered (e.g., steelhead redd surveys).

2. Annual monitoring of the spatial and temporal distribution of juvenile fish released by hatchery programs

   Relevance: Needed to evaluate the ecological (e.g., competition, predation, disease) impacts of juvenile hatchery fish on wild populations

   Approach: TBD

3. All status and trend monitoring described for fish abundance, productivity, spatial structure, and diversity, and habitat conditions

   Relevance: Needed to provide foundation for critical uncertainty research related to Key Listing Factor E questions 1 and 4.

   Approach: See previous sections

Implementation and Compliance Monitoring

1. Provide monitoring and documentation that demonstrates that HGMPs have been implemented. This should include annual monitoring, recording, and reporting of the practices and protocols employed by hatcheries during fish culture operations.

   Relevance: Needed to assess whether or not required HGMPs have been adequately implemented

   Approach: Continue normal hatchery data collection and reporting.

Effectiveness Monitoring

See item #1 under status and trend monitoring.

Critical Uncertainty of Research

Implement recommendations of the Ad Hoc Supplementation Monitoring and Evaluation Workgroup (AHSWG 2008[103]) and develop a large scale treatment/reference design to evaluate long term trends in the abundance and productivity of supplemented populations.

Relevance: Needed to provide future guidance on best management practices for hatchery fish

Approach: See AHSWG (2008) recommendations.

1. Conduct research to determine the effects of the hatchery program on the reproductive fitness of natural origin Chinook salmon and steelhead.

   Rationale: Considerable uncertainty exists about the specific quantitative impacts that hatchery programs have on the reproductive fitness of natural origin fish. A more refined understanding is needed to insure that actions are designed to address key limiting factors and threats to the long term viability of UWR spring Chinook and winter steelhead populations.

   Approach: TBD

2. Conduct research on the impact of competition with non-native and hatchery origin fish on natural origin Chinook salmon and steelhead.

   Rationale: Competition with non-native and hatchery origin fish with natural origin salmon and steelhead was identified as an immerging issue by the Upper Willamette Recovery Planning Team. Better information is needed on the nature and magnitude of the threat in order to craft appropriate management responses.

   Approach: TBD

3. Conduct research that will provide information at the population area scale on:
   a. Potential patterns and impacts of future human population growth and climate change
   b. Identify critical areas and parameters for monitoring
   c. Recommendations for specific actions to address these impacts

   Rationale: While this Recovery Plan acknowledges that climate change and human population growth will likely have considerable negative impacts on the viability of UWR spring Chinook and winter steelhead populations in the future, it is unable to directly address these future threats because of a lack of population area specific information on the exact nature of these threats. Improved information on these future impacts will allow for enhanced efforts to address them.

   Approach: TBD

8.5 Additional RME Needs

8.5.1 Development of Integrated Monitoring Plans

Each year millions of dollars are spent to monitor the status and trend of natural resources and determine the effectiveness of restoration programs in the Pacific Northwest. While there is increasing consensus among regional Federal, private, State, and tribal organizations with respect to the need for integrated and standardized monitoring information, funding for these activities is stagnant or declining. As a result, there is an increasing need to improve the efficiency and cost effectiveness of monitoring programs.

[103] http://www.cbfwa.org/csmep/web/documents/general/Documents/FINAL%20REPORT%20AHSWG.pdf

Although some monitoring questions are unique to particular agencies and organizations the need for comprehensive and efficient collection of information on metrics and indicators on all or certain aspects of the status and trend of fish, habitat, and watershed health is common to entities involved in monitoring in the Pacific Northwest. By applying well-coordinated monitoring approaches, technical and fiscal resources can be more effectively shared among interested parties, data can be shared, and resulting information can provide increased scientific credibility, cost-effectiveness in use of limited funds, and greater accountability to stakeholders.

Logical steps towards maximizing the cost -effectiveness of monitoring efforts include reducing duplication of effort and implementing programs that will allow data collected by multiple entities and programs to inform a larger regional monitoring framework. To do this, individual agencies and organizations will need to develop a survey design process that promotes data sharing with partner organizations, agree on a core set of monitoring questions with common indicators, coordinate activities, and develop common protocols and methods or ways to "crosswalk" data derived from disparate protocols.

8.5.2 Data Management and Access

Timely and efficient analysis and reporting on the RME described in this chapter will require improvements in the way that natural resource agencies manage and distribute information. In addition to building larger scale distributed data systems that can communicate between the various agencies involved in natural resources, the natural resource agencies should be given adequate resources to develop automated internal infrastructure to assess and evaluate their data and to report it through the various systems that require the information.

In addition to the need for a physical data management infrastructure that is adequate for managing and sharing information, in order to successfully use information collected by a variety of entities it is important that recovery entities strive to have elements of the PCSRF database dictionary within their databases and or/ adequate data mapping to be able to provide data to the database when NMFS is conducting a status review. Table 9-1 in this Plan and Appendix H will facilitate reporting of restoration efforts as defined in the PCSRF data dictionary so that the cumulative effects of restoration actions can be tracked and given proper credit.

Toward this end, Oregon will work with PNAMP, NMFS, and other entities to develop and implement a regional data management infrastructure. In addition, NMFS, ODFW, and other entities will establish a monitoring workgroup that will meet annually to review data management needs, and implementation.

Chapter 9: Implementation

The ability of this Plan to improve the status of the UWR Chinook salmon ESU and steelhead DPS depends on successful implementation. There are two distinct processes that must be initiated to implement this Plan. First, the actions identified in Chapter 7 must be implemented through a coordinated sequencing of effort with all of the various organizations and land managers/owners who have a responsibility and interest in the status of the UWR Chinook salmon ESU and steelhead DPS. Second, in order to evaluate the effectiveness of the actions that have been implemented, and to modify those actions if necessary, a functional adaptive management framework must be implemented with respect to the RME needs identified in Chapter 8, including review of the results of the RME activities. The successful implementation of these two processes will require significant funds and the coordinated work of ODFW, other State agencies, tribes, counties and other local governments, irrigation districts, agriculture and private forest land managers, USACE, NMFS, USFS, USBLM, other Federal agencies, municipalities, , utilities, other agencies, citizen groups, and individuals. The process to implement the actions identified in Chapter 7 must remain flexible, but this chapter identifies the key elements necessary for Plan action implementation and the process Oregon will use to adaptively manage the implementation of this Plan.

9.1 Action Details- Priority, Locations, Schedule, Costs, and Implementers

As noted in ESA section 4(f)(1)(A)(iii)), a recovery plan must contain "estimates of the time required and the cost to carry out those measures needed to achieve the plan's goal and to achieve intermediate steps toward that goal." The implementation plan for a recovery plan serves as the guidance document that describes the time-specific implementation of actions for all programs. It also should contain benchmarks of expected milestones that allows for tracking progress of action implementation in the recovery plan. An ESA implementation plan identifies the following:

- recovery actions,
- priority for completing the actions,
- timeline and duration for completion of the actions,
- lead agency/entity to implement each action, and
- cost estimates for actions over a specified period of time.

Section 9.1.4 serves as the implementation plan for this Recovery Plan. It contains limiting factors and threats from Chapter 5, actions addressing the LFTs (with a provisional priority framework), priority locations, schedule, costs, and potential implementers. Note that many implementing entities (i.e., watershed councils, tribes, State agencies, Federal agencies) have been fully involved in developing the draft UWR Salmon and Steelhead Recovery Plan.

9.1.1 Strategic Guidance for Implementing Management Actions

General Principles

This Plan provides a strategic framework for prioritization of management actions to meet recovery goals for UWR Chinook and steelhead populations. The framework recognizes that improving the viability of key populations requires a comprehensive suite of actions that: 1) improve total life cycle survival, 2) remove significant life history bottlenecks, and 3) restore key life history traits. In addition, since multiple LFTs can fragment the salmonid life cycle, impair population viability, and disrupt ecosystem function, some LFTs will need to be addressed strategically and simultaneously. For example, high summer water temperature is a key threat to many UWR Chinook and steelhead populations, and one strategy is to implement actions that reduce heat input to streams. In rural areas one of the best ways to remove a heat source is to restore shade function by planting riparian areas with native trees. Over time these trees will also serve as physical structure to lessen other habitat LFTs. In urban and rural-residential areas, impervious surfaces may play a larger heat source role (IMST 2010), and “fixes” may be different than planting riparian trees. Potential *emerging* LFTs need to be recognized and managed in the present so they do not degrade viability of UWR Chinook and steelhead populations in the future. The successful application of these actions across multiple ecosystem and jurisdictional boundaries will require an adaptable approach that considers social, cultural, political, and economic constraints.

This Plan provides a comprehensive list of actions to be applied to all populations in the ESU/DPS, and actions in subbasins that focus on remediating LFTs for individual populations. Based on the LFT assessment, critical impediments to UWR ESU/DPS viability include the poor status of accessible freshwater habitat, the lack of adult access to good freshwater habitat, and insufficient juvenile migration survival from these habitats. Where remaining high quality habitat is accessible (below dams), it represents the remnant: 1) core reproduction areas, 2) source of expression and maintenance of some key life history types, and 3) migration link to other ecological zones where UWR salmonids can complete their lifecycle. Protecting these areas from further impacts will conserve the existing productive capacity, help temporarily buffer loss of productivity in other areas, and will provide a habitat foundation upon which to start restoring the normative natural ecological processes that create good freshwater habitat in other areas. In simplistic terms the order of importance for achieving freshwater and estuary habitat goals and staging effective strategies is to:

1. *Protect and conserve existing* high quality habitats that support current fish production capacity, and natural hydrologic processes that maintain these habitats and create new habitat. Protection of existing high quality habitat is one way to insure no net loss in habitat quality and is one element in the maintenance of normative ecological and hydrological processes. At the reach scale, many habitat quality objectives will likely be met through existing habitat protection and the associated natural recovery of riparian areas. At the subbasin scale, habitat protection efforts may require greater coordination and a more comprehensive vision for watershed objectives so that for example, habitat impacts in upstream areas do not compromise conservation efforts in dowstream areas. Related to this comprehensive vision of protecting high quality habitat, a coordinating forum should be in place that can prioritize and implement land acquisitions, conservation easements, cooperative agreements, and protective land designations.
2. *Enhance* impaired habitat reaches and natural processes that are currently supporting some productive capacity. Several restoration principles can be adopted on a case by case basis to enhance specific stream reaches. Improving reach function is accomplished through improved land use practices or changes in land use laws and ordinances. Improving natural habitat forming processes requires a more comprehensive approach that targets restoring healthy ecosystem function. Comprehensive land-use and water quality planning, and associated authorities are important tools by which human growth patterns and associated land use practices can be integrated into strategies to enhance watershed functions.
3. *Restore* habitat reaches, watersheds, and natural processes at those scales that *were historically* important but do not *currently* contribute to productive capacity of UWR Chinook and steelhead populations. The success of this strategy is enhanced when actions build from existing restoration efforts and incorporate a range of project types that address the many interrelated habitat impairments.

Other things being equal, implementing actions with the following attributes will lead to more efficient strategies and a greater chance of meeting recovery goals:

- Actions where certainty of implementation is high (such as many BiOp actions), or opportunity for success is high (rather than those of limited feasibility).
- Actions that likely produce a large (rather than small) and measurable improvement in viability attributes.

- Actions that support restoration of normative ecological processes rather than short-term substitutions for normative processes.
- Actions that integrate other land management, water quality, environmental management and recreational objectives as specified in fish management, conservation, recovery, TMDL implementation plans, or other plans developed with and supported by subbasin stakeholders (rather than those that are isolated, stand-alone efforts).
- Actions that have landowner/stakeholder support and that can generate increased participation.
- Actions that demonstrate cost effectiveness relative to alternative means of achieving the same objectives.
- Actions which have high degree of certainty in effectiveness and outcome.

Identifying Priorities

In an idealized society, funding for UWR Chinook salmon and steelhead conservation efforts would be available to implement all actions that are thought to eliminate every potential LFT. However, conservation funds compete with other societal priorities, and there is limit to how much our current society is willing and able to (although not explicitly defined) contribute to the recovery of UWR Chinook and steelhead. Nonetheless, it is important to prioritize, fund, and successfully implement the key actions that are believed to be crucial for ESU/DPS recovery. This will facilitate implementation because available funding follows budget cycles, authorizations, and economic conditions. Setting priorities of fish recovery actions for management and funding entities is difficult because the specific biological recovery needs of a species with a complex life cycle may not be aligned with the diverse policy strategies of these entities. Although priorities must be guided by the trial and error of the scientific method, it is ultimately a policy choice whether or how much a priority action should be implemented. For those entities that are implementing management actions intended to support the recovery of UWR Chinook and steelhead populations, this Plan provides information on how strategies and actions are prioritized from a biological recovery perspective in terms of level of importance (a VSP ranking; see column in Table 9-1) and how they are sequenced through time (via implementation schedule).

Immediate Actions

Most actions in this Plan are designed to improve VSP attributes and address listing factors over a longer time period, and some of these may have limited short-term effect. Yet, given many of the Chinook salmon populations are already at a high or very high risk of extinction, there is a need to implement now some actions that help avoid greater extinction risk until more substantial actions can begin improving VSP attributes. The following list summarizes some priority strategies and actions to be implemented immediately.

1. Increase wild fish spawning opportunities
    a. Reduce prespawn mortality.
        i. Flood Control/Hydro BiOp RPA Actions: To the fullest extent possible and until longer-term measures can be implemented, implement the interim WP BiOp RPA (NMFS 2008a) measures for: 1) emergency fish procedures and reporting, 2) water quality and quantity, 3) other flow modifications, 4) fish handling facilities and fish handling protocols.
        ii. Initiate/expand efforts to reduce harassment and poaching of adult Chinook salmon in summer holding pools. Mixture of enforcement and awareness promotion by OSP, USFS and BLM in public areas. Harassment and poaching are included as priority items during the OSP Coordinated Enforcement Program (CEP) process. OSP and ODFW staff are

currently investigating options and resources for more enforcement presence in the McKenzie

iii. Initiate/expand efforts to enforce, report water quality/ instream work violations

iv. Prioritize RME that can identify other *short-term solutions* to reduce pre-spawn mortality

b. Put more wild fish on the spawning grounds

i. Continue to implement the new hatchery broodstock integration guidelines called for in this Plan

ii. As opportunities exist, continue to outplant wild fish (collected at collection facilities) into remaining natural production areas

2. Increase juvenile fish survival

a. Flood Control/Hydro BiOp RPA Actions: To the fullest extent possible, implement the interim WP BiOp RPA (NMFS 2008a) measures for emergency water quality and quantity, and other flow modifications, until longer term measures can be implemented.

b. Where wild fish are outplanted above WP dams, implement spill measures and other interim downstream passage improvement measures. Improved operations are needed at Foster Dam and Cougar Dam. For Cougar Dam, a draft plan is in development for implementation in 2011.

c. Where wild fish are outplanted below WP dams, increase incubation and early rearing success by adjusting dam flow releases to meet natural regimes for incubation temperature and flows.

d. Accelerate the implementation timing for WP BiOp major milestones for Detroit Dam that will improve juvenile survival. These include advancing the timeline for structural temperature control and integrated structural downstream passage improvements, because there are limits to the benefits provide by interim flow modifications.

e. Prior to the WP BiOp major milestones for the Middle Fork Willamette flood control/hydro structural modifications (and concurrent or prior to Head of Reservoir pilot studies), implement immediately the RME for survival effectiveness of reservoir drawdown in the Dexter/Lookout Point dam and reservoir complex. This will also require some immediate RME to guide infrastructure needs to make this work. Concurrent with this effort should be an evaluation of what kind of habitat reconstruction and restoration needs to occur in the old Lookout Point pool.

f. Continue to outplant unmarked Chinook salmon above Fall Creek dam and assure subsequent juvenile survival with flow releases as outlined in the WP BiOp RPAs.

g. Continue to implement FCRPS and Estuary Module actions for predation and flows in the Columbia River estuary.

Priority Population Subbasins

Although it is important to lower the extinction risk for all UWR populations to meet ESU/DPS viability criteria, some subbasins and populations represent relatively greater importance to ESU/DPS viability. In terms of prioritizing large scale habitat actions for improving subbasin conditions, this Recovery Plan applies the following population priorities:

1. McKenzie subbasin: core and genetic legacy Chinook population; good probability of recovery to desired status goal of Very Low Risk;
2. Clackamas subbasin: core Chinook population; good probability of recovery to desired status goal of Very Low Risk; actions would also benefit other listed ESUs (see LCR Plan) in the subbasin;
3. North Santiam subbasin: core Chinook and steelhead populations; large conservation gap to reach Chinook desired status goal of low risk; smaller gap to reach steelhead desired status goal of very low risk.
4. Middle Fork Willamette subbasin: core Chinook population; large conservation gap to reach desired status goal of low risk, but large recovery potential with re-introduction actions;

5. South Santiam subbasin: core steelhead population for desired status goal of very low risk, and non-core Chinook population for desired status goal of moderate risk;
6. Molalla subbasin: non-core Chinook population for desired status goal of high risk, and non-core steelhead population for desired status goal of very low risk;
7. Calapooia subbasin: non-core Chinook population for desired status goal of high risk, and non-core steelhead population for desired status goal of moderate risk.

Types of Priority Actions

This Recovery Plan applies the following principles to prioritize habitat actions:

First Priority:

- In high intrinsic potential (IP) areas for core extant populations: Actions that provide long-term protection and comprehensive restoration of habitat-forming processes.
- Flow, temperature, and physical habitat actions whose implementation can be coordinated to address several related habitat LFTs. These comprehensive suites of actions and coordination of projects are more likely to elicit a positive and detectable biological response and build long-term resilience and stability in habitat conditions. These actions are best implemented through coordinated Federal and State-wide regulatory Programs.
- Actions in locations which will result in protecting accessibility and connectivity to high quality habitat
- Actions that benefit populations which must achieve viability status (Low or Very Low extinction risk) for ESU/DPS viability status criteria.
- Actions that protect and enhance the viability of multiple Chinook salmon and steelhead populations, and multiple life history stages. Examples include actions in the mainstem Willamette River and Columbia River estuary that improve habitat quality, water quality, and flow regimes..
- Actions that support conservation of unique and rare functioning habitats, habitat diversity, life histories, and genetic attributes.
- Actions that address directly the key limiting factors and that contribute the most to closing the gap between current status and desired future status of priority populations.
- Actions that provide critical information needed for assessing success and making adaptive management decisions (RME actions).
- Actions which provide resiliency against climate change and human population growth.

Second priority:

- Actions that enhance the habitat conditions and restore natural ecological processes for core extant populations.
- Actions that enhance the viability of priority extant populations.
- Actions that are required to protect and enhance habitats for populations that are not critical for ESU/DPS viability.

Subbasin assessments are critical for providing direction to habitat strategies and projects. In a letter from NMFS letter to BPA regarding subbasin planning in 2002 there was the following passage: “As required by the Council's program, technically sound subbasin-level assessments need to be complete before credible subbasin-level management plans can be developed."[104] Also, as described earlier, assessments and plans should address the scale of the population or some analogous spatial scale.

One of the components in subbasin assessments and plans should be the identification of priority watersheds at finer scales (e.g., 6th field HUCs) for further assessment, planning, and action. In some cases, finer-scale assessments and plans may already be available and they should be used. In cases where finer scale watersheds are priorities for protection and restoration but do not have assessments and plans, those watersheds should be targeted for funding in next funding cycles and in other State and Federal watershed plan programs.

A significant step towards prioritizing the actions needed for this Plan was accomplished during the process of identifying and prioritizing the LFTs described in Chapter 5. Although ultimately all key and secondary threats and limiting factors must be addressed to achieve recovery goals, priority should be given to actions that directly address key threats and limiting factors if funds do not exist to implement all the actions simultaneously. Additional guidance on the prioritization of actions was outlined in Chapter 6, where desired status levels were defined, and where the Planning Team judged the relative importance of major actions within a scenario context. Chapter 6 described risk level goals for each UWR Chinook and steelhead population, and the scenarios scoped the relative mortality reductions needed in each of the major threat categories to close the gap between current and desired status. These projected improvements in mortality served as the side boards for determining where efforts and resources can best be allocated to achieve recovery.

9.1.2 Timeframe Considered for Schedule and Costs

The Plan is a 25-year Plan that guides conservation and recovery actions. The basis for the 25-year time frame is that actions are scheduled through this time period, as detailed in Section 9.1.3, though most actions are scheduled to be completed earlier than this. The 25-year period should not be confused with other timeframes mentioned in the Plan. These include a) the 100-year period used in population viability models to determine extinction risks (Chapter 4 and 6), b) the immediate, 5, 10, 15, or 20-year timeframes scheduled for many actions (Section 9.1.4), c) the major revision of the Plan called for after 12 years (Section 9.3), d) the required Implementation Schedules and priorities every three years (Section 9.3), or e) the ability to adaptively management specific strategies and actions on an as needed basis (Section 9.3).

In addition to 25 years being the maximum period for which actions were scheduled in Section 9.1.4, this period was also used to calculate costs for which there were recurring costs. These are also summarized in Section 9.1.3.

9.1.3 Cost Estimates

Costs were determined for many of the actions detailed in Chapter 7. Many of the actions are listed for both Chinook and steelhead. For purposes of estimating costs, we only counted costs associated with implementing new actions or increasing programs resulting from this Recovery Plan and avoided 'double counting'. Other costs, referred to as "baseline" costs, which are part of an entities base program or mission, or which are required by regulatory processes (e.g., FERC permits, TMDL implementation actions, BiOp actions), were not considered part of the recovery costs. In addition, although actions resulting from the Plan will potentially have a wide economic impact (e.g., modified land use), these "opportunistic" costs were also not considered as recovery costs since they are not direct costs to

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[104] http://www.nwcouncil.org/fw/subbasinplanning/admin/esa/esaletter.htm

implement actions, and a in-depth economic analysis would be required to assess these costs. However, it is advisable to more precisely understand or determine these wider economic benefits or detriments when recovery actions are implemented, or when seeking funding or policy changes.

The approach used to estimate costs varied based on the different threat categories, due to the nature of the actions required in these categories, and the ability to estimate the amount of actions necessary to achieve the desired statuses for populations. If there was not enough information to determine costs or make assumptions about the exact nature of the action or its quantity, cost estimates were deferred until implementation of that action (noted as "TBD" in Section 9.1.4). Table 9.1 follows the stratified organizational format of the action table in Chapter 7, and costs were subtotaled by for the strata. Some significant costs were not calculated (listed as "TBD" under the cost basis column; e.g., water conservation; easements and habitat protection) because not enough information to determine or make assumptions about unit costs, quantities, or action scope was available. In addition, costs to maintain capital projects were not included.

Costs were subtotaled across these categories and Plan elements:

1. Higher-level strategies/actions/processes to decrease general threats across ESU/DPS, or administer & support adaptive management/RME
    a. We considered many of these actions to be ‘baseline’ actions, therefore no costs were added for implementing these programs
    b. Some actions called for expansion of existing programs/initiatives or creation of new monitoring or other RME elements; costs were estimated based on expert opinion, a similar cost based on an Estuary Module action, or TBD.
2. Strategies and actions focused mainly on decreasing LFTs in the estuary
    a. We assume that the Estuary Module would be implemented for recovery of other Columbia Basin species, so we did not count the associated costs here. However, we did count one action because this Plan calls for expanded RME of the predation threat as it pertains to UWR populations.
3. Strategies and generalized actions focused on decreasing LFTs in freshwater
    a. It was difficult to assign costs to most of these actions. They are associated with large scale actions that are intended to improve freshwater habitat and water quality. They are mostly protective type strategies; with conservation easements, acquisitions, RME, and increased coordination among regulatory agencies.
4. Strategies and actions focused on decreasing LFTs in the mainstem Willamette River
    a. At present, there are no cost estimates for actions in this category because we don’t have sufficient information yet. One of the actions in this section details a prioritization framework and better quantification and understanding of habitat restoration needs in the mainstem Willamette, specific to addressing LFTs; this should provide the needed information.
5. Strategies and actions focused on decreasing LFTs in subbasins
    a. Many, but not all, of the actions within subbasins are associated with implementing the WP BiOp, and are considered baseline costs.
    b. Clackamas Chinook action cost estimates were part of a larger cost estimate for other species in the OrLCR Plan. They are added into the costs for this Plan.
    c. Habitat restoration unit costs are established for many subbasin actions, based on the cost estimates developed for riparian buffers and instream habitat restoration in ODEQ (2010),

where costs were developed as part of TMDL implementation plans. At this time, the amount of acreage or miles of habitat that need to be improved is unknown, so quantity and total costs for some actions are TBD. Uncertainty of the survival effect of many of the habitat actions also makes estimation of the full extent of habitat action costs difficult This Plan calls for greater quantification and understanding of the amount of habitat restoration needed.

The total cost at the end of Table 9-1 ($265M) represents a minimal cost for recovery, given all of the costs and uncertainty which are not included in this Plan.

9.1.4 Action Table

Table 9-1 organizes actions identified in Chapter 7 to the LFTs and life stages and species to which they apply (from Chapter 5), their influence on VSP parameters, locations identified in the planning process where they should be implemented, time period or schedule within which they should be completed, the basis, unit cost, quantity, and total cost, and key entities that could be potential implementers. A total cost for all recovery actions is provided at the end of the table.

The schedule timeframe for individual actions was consistent with timeframes used in SLAM modeling to determine the effect of time lags for recovery actions on achievement of desired statuses. Although this modeling was based on conditions in tributaries below Willamette Falls, projections indicated that lags in tributary habitat improvement would have the most significant negative impact on extinction risk. However, the longer implementation period for most subbasin habitat actions (15 years) was used as the schedule due to the inability to actually immediately conduct the number of restoration activities needed. Thus, for subbasin habitat action schedules, as well as for all other threat categories, the number of years indicated for the action should not be considered the time when projects get implemented, but the time when all projects are implemented for that category. In most cases, action implementation should occur immediately. The three-year Implementation Schedules discussed below will determine more specific schedule timeframes, and site and action priorities. Several actions which are required for overarching coordination of Plan implementation are noted as immediate needs.

Table 9-1. Summary of actions identified in this Plan, species which benefit, locations, schedule, costs and potential implementers for conservation and recovery of UWR salmon and steelhead.

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
ESU: Higher-level Strategies/Actions/Processes to decrease General Threats across ESU/DPS, or Administer & Support Adaptive Management/RME ADM: Adaptive Management / Implementation / RME / Information and Education / Plan Support and Administration PHQ: Actions that decrease Physical Habitat Quality Limiting Factors WQH: Actions that decrease Water Quality / Water Quantity / Hydrograph Limiting Factors CPP: Actions that decrease Competition, Predation, and Population Trait Limiting Factors											
Listing Factor: N/A LFT: not specified	Strategy: not specified, via, Implementation Reporting, Funding to address issue of - Action Priorities	1 - ESU-ADM Priority: not specified	Develop three-year Implementation Schedules across and within populations for priority actions at a site-specific scale based on existing reach-specific habitat assessments, identified regulatory requirements, other threat reduction needs, research and monitoring needs, and adaptive management.	1. Where no reach-specific assessment or assessment information at the appropriate scale for specific limiting factors or threats, exist, find funding and conduct assessments in order to develop the Implementation Schedule.	TBD	immediate	TBD	---	---	---	ODFW

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: N/A LFT: not specified	Strategy: not specified, via, Funding/incentives to address issue of - Action Priorities	2 - ESU-ADM Priority: not specified	NMFS support coordination of organizations and funders who help provide and implement incentive programs for landowners.	1. Create incentives by matching funds for projects that meet recovery plan goals in high priority subbasins. 2. Recommend to entities that project solicitations and selection should reflect recovery plan priorities, and that the majority of funds should be directed to high priority locations and actions, while reserving funding for other appropriate actions to meet goals in all pop areas. 3. Actions resulting from funding should be reported in metrics that allow tracking of progress toward recovery goals (requires initial work with an implementation coordination entity to develop or identify appropriate metrics).	TBD	on-going	Baseline	---	---	N/A	ODFW, NMFS
Listing Factor: N/A LFT: not specified	Strategy: not specified, via, Implementation Reporting, Funding to address issue of - Adaptive Management	3 - ESU-ADM Priority: not specified	Complete annual reporting for this plan and coordinate adaptive management actions as necessary and indicated by monitoring and reporting results.	TBD	TBD	immediate	TBD	---	---	---	ODFW

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: N/A LFT: not specified	Strategy: not specified, via, Program Coordination to address issue of - Adaptive Management	4 - ESU-ADM Priority: not specified	Regularly update inventories and maps of instream habitat conditions, water quality, wetlands, and riparian conditions (including restoration projects) to more accurately capture current habitat conditions.	1. Incorporate information into 3-year implementation schedules and WS Council action plan processes to improve likelihood of achieving desired population status goals.	natal subbasins	within 15 yrs	TBD	---	---	---	ODFW, ODF, ODSL, ODEQ, ODA, USFS
Listing Factor: N/A LFT: not specified	Strategy: not specified, via, RME: Critical Uncertainty to address issue of - Population Designation	5 - ESU-ADM Priority: 3	Identify whether there are dependent and independent winter steelhead populations in West-side tributaries, and if appropriate, determine status goals for them.	1. ID threat reduction strategies and actions as appropriate.	West-Side tributaries	within 15 yrs	Baseline	---	---	---	ODFW, NMFS
Listing Factor: D LFT: not specified	Strategy: not specified, via, RME: Implementation / Compliance to address issue of - Adequacy	6 - ESU-ADM Priority: not specified	Assess adequacy of local regulatory programs to address listing threat factors within the federal ESA framework (e.g., 5-year status reviews, delisting decision, other).	TBD	TBD	within 5 yrs	Baseline	---	---	N/A	NMFS

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: D LFT: not specified	Strategy: not specified, via, Program Coordination to address issue of - Adequacy	7 - ESU-ADM Priority: not specified	Implement credible, science-based programs, policies and rules that contribute collectively to protect fish and water resources.	TBD	ESU-wide	within 15 yrs	TBD	---	---	---	ODFW, OWEB, ODF, ODSL, ODEQ, OWRD, ODLCD, ODOT, ODOGAMI, ODA, OPRD, USFS, Counties, Municipalities
Listing Factor: D LFT: not specified	Strategy: not specified, via, Program Coordination to address issue of - Adequacy	8 - ESU-ADM Priority: not specified	Provide adequate funding and staffing for existing programs to achieve their mandates.	TBD	TBD	on-going	Baseline	---	---	N/A	Legislature, other governing bodies
Listing Factor: D LFT: not specified	Strategy: not specified, via, Program Coordination /Reform to address issue of - Adequacy	9 - ESU-ADM Priority: not specified	Enhance efforts to enforce existing land use regulations, laws, and ordinances.	TBD	ESU-wide	within 15 yrs	TBD	---	---	---	ODFW, ODF, ODSL, ODEQ, ODLCD, ODOGAMI, ODA, Legislature, Counties, Metro, Municipalities

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: E.1 LFT: 3a	Strategy: 13 , via, RME to address issue of - Critical uncertainty in Hatchery Management	10 - ESU-ADM Priority: 1	Form a UWR-specific hatchery genetic technical group (HGTG; comprised of RIST and other experts) to conduct scientific review of current UWR hatchery programs and develop recommendations for achieving a conservation (reintroduction) hatchery program or suite of strategies that promotes and maintains a locally adapted population in the short term (until other LFT conditions are improved), and how to maintain VSP attributes and recovery goals while managing within a split basin management framework where there are hatchery mitigation goals in lower subbasins.	1. Implement the recommendations of that review and guidelines and how to identify and manage risk associated with psuedo-isolation.	TBD	immediate	TBD	---	---	---	ODFW, NMFS, USACE, technical experts
Listing Factor: E.2 (Climate Change) LFT: not specified	Strategy: not specified , via, RME to address issue of - Critical Uncertainty with Emerging Threat (Climate Change)	11 - ESU-ADM Priority: not specified	(similar to FCRPS RPA 7) To address forecasting and climate change/variability, hold annual forecast performance reviews and report on effectiveness of experimental or developing/emerging technologies.	TBD	TBD	within 25 yrs	Baseline	---	---	N/A	ODFW

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: E.2 (Climate Change) LFT: not specified	Strategy: not specified, via, RME to address issue of - Critical Uncertainty with Emerging Threat (Climate Change)	12 - ESU-ADM Priority: not specified	Conduct detailed climate change risk analysis for all populations and use this to help prioritize existing actions, or develop new ones. Incorporate these into the Implementation Schedule.	TBD	TBD	immediate	Expert Opinion (based on 50% of OrLCR Plan)	73500	2 yrs	$1,837,500	ODFW
Listing Factor: N/A LFT: not specified	Strategy: not specified, via, Funding RME to address issue of - Critical Uncertainty, Implementation / Compliance	13 - ESU-ADM Priority: not specified	Adequately fund and implement RME needed to answer critical uncertainties related to the assumptions under which the recovery plan was developed.	TBD	ESU-wide	within 15 yrs	TBD	---	---	---	ODFW, OWEB, Legislature, NMFS
Listing Factor: N/A LFT: not specified	Strategy: not specified, via, Program Development to address issue of - Implementation facilitation	14 - ESU-ADM Priority: not specified	Participate in the development of emerging ecosystem markets and ensure they are shaped to be consistent with recovery goals and actions.	TBD	ESU-wide	on-going	Baseline	---	---	N/A	ODFW, OWEB, ODF, ODSL, ODEQ, OWRD, ODLCD, ODOT, ODOGAMI, ODA, OPRD, OGNRO, NRCS, SWCD

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: N/A LFT: not specified	Strategy: not specified, via, Implementation Reporting, Funding of RME to address issue of - Implementation / Compliance	15 - ESU-ADM Priority: not specified	Fund development and maintenance of web-based data management and reporting, including tracking needs and accomplishments by entity through a map-based depiction of prioritized actions and locations.	TBD	TBD	within 5 yrs	Expert Opinion (based on 50% of OrLCR Plan)	$100,000 to develop; $50,000 / yr to maintain	25 yrs	$1,350,000	ODFW, NMFS
Listing Factor: All LFT: not specified	Strategy: not specified, via, Program Coordination /Development to address issue of - Implementation coordination	16 - ESU-ADM Priority: 1	ODFW and NMFS provide expanded staffing support as needed to develop and coordinate Recovery Plan Implementation schedules and actions with associated processes and programs (example: WP BiOP RME and other WP BiOP WATER teams).	TBD	ESU-wide	immediate	Expert Opinion (based on 50% of OrLCR Plan)	$50,000 / person / yr	25 yrs	$1,250,000	ODFW, OWEB, NMFS, Legislature

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A LFT: not specified	Strategy: not specified , via, Coordination to address issue of - Implementation facilitation	17 - ESU-ADM Priority: 2	State of Oregon agencies clearly describe the large wood goals in subbasins and potential ways to achieve these goals.	1. Develop joint ODF/ODFW/ODA/DSL team with deliverable recommendations. 2. Streamline the delivery of large wood to restoration sites. 2.1. designate coordinating entity and creating an online database of large wood that links entities that have large wood to offer with those in need of large wood for restoration projects. 2.2. develop storage/staging areas to enable storage of wood for future projects. 2.3. work with federal, state, and private forests and other land managers to ID ways to improve access to available large wood. 2.4. provide technical advice on what should be done with the large wood that is legally removed (e.g. during dredging operations). 2.5. streamline permitting process for large wood placement for streams not covered by Forest Practices Act.	within natal subbasins	within 15 yrs	Baseline	---	---	N/A	ODA, ODFW, OWEB, ODF, ODSL, ODOT, OPRD, USFS, USACE, WS Councils, Municipalities, Port of Portland

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A LFT: not specified	Strategy: not specified, via, Program Coordination to address issue of - Implementation facilitation	18 - ESU-ADM Priority: not specified	Provide liability protection for landowners that participate in restoration projects.	TBD	ESU-wide	within 15 yrs	TBD	---	---	---	Legislature, OR Attorney General
Listing Factor: A and D LFT: not specified	Strategy: not specified, via, Program Coordination to address issue of - Implementation facilitation	19 - ESU-ADM Priority: not specified	Explore land use strategies and regulations to reduce ownership fragmentation, including, but not limited to, acknowledging the importance of family owned forests and supporting actions that help sustain working family owned forests.	TBD	ESU-wide	within 15 yrs	TBD	---	---	---	ODF, ODLCD, Counties, Municipalities
Listing Factor: A LFT: not specified	Strategy: not specified, via, Program Development to address issue of - Implementation facilitation	20 - ESU-ADM Priority: not specified	Promote and provide technical support for volunteer efforts of private landowners and user groups to increase the amount of large wood in stream channels (e.g. site-specific riparian management plans, placement of large wood, reducing removal).	TBD	ESU-wide	within 5 yrs	Expert Opinion (based OrLCR Plan)	$90,000 / person / yr	6 staff; 15 yrs	$8,100,000	WS Councils, ODFW, OWEB, ODF, ODSL, ODEQ, NRCS, SWCD

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A LFT: not specified	Strategy: not specified, via, Program Development to address issue of - Implementation facilitation	21 - ESU-ADM Priority: not specified	Provide technical and financial assistance to landowners with property damage due to beavers, and provide incentives to landowners that want to manage their land to achieve the habitat benefits provided by beaver dams.	1. Develop agreements with landowners to establish benchmarks for amount of damage done by beavers. Once damage exceeded the benchmark, a management entity would remove or reduce the beaver population from the affected property.	TBD	within 15 yrs	TBD	---	---	---	ODFW, OWEB, ODA, NRCS, SWCD
Listing Factor: N/A LFT: not specified	Strategy: not specified, via, Funding/Coordination of RME to address issue of - Status/Trend	22 - ESU-ADM Priority: not specified	Expand monitoring of populations to track status and trends of VSP metrics and improve understanding of the composition of natural spawners (what type/pHOS? how many? where from? timing?), other life history information, and habitat.	1. Coordinate with WP BiOp monitoring.	within natal subbasins	expand on on-going	add WP BiOP	---	---	N/A	ODFW, WP Action Agencies
Listing Factor: N/A LFT: not specified	Strategy: not specified, via, Funding RME to address issue of - Status/Trend	23 - ESU-ADM Priority: not specified	Determine funding sources and strategies to implement monitoring needed to track progress towards achieving recovery goals.	TBD	TBD	immediate	Expert Opinion (based on 50% of OrLCR Plan)	$141,633/yr	25 yrs	$3,540,825	ODFW, USACE, BPA, NMFS, LCREP, OWEB, Legislature

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: N/A LFT: not specified	Strategy: not specified, via, I&E to address issue of - Outreach	24 - ESU-ADM Priority: not specified	Provide education on the goals of recovery plans, what is needed to achieve these goals, and how citizens can contribute.	1. Develop subbasin "guidebooks" on Plan priorities, habitat needs, BMP's, and networking/program resources.	ESU-wide	ongoing	TBD	---	---	---	NOAA, ODFW, OWEB, ODF, ODSL, ODEQ, OWRD, ODLCD, ODOT, ODOGAMI, ODA, OPRD, WS Councils
Listing Factor: N/A LFT: not specified	Strategy: not specified, via, I&E to address issue of - Outreach	25 - ESU-ADM Priority: 2	Continue to fund outreach efforts that have known success in educating and engaging landowners.	1. Evaluate effectiveness of such events as Coffee Klatches, Oregon Small Woodland Owner's Howdy Neighbor, and other venues. 1.1. fund and develop materials as appropriate	ESU-wide	on-going	TBD	---	---	---	OWEB, ODF
Listing Factor: N/A LFT: not specified	Strategy: not specified, via, Fund I&E to address issue of - Outreach	26 - ESU-ADM Priority: not specified	Fund OSU Extension Service to provide Riparian Function Workshops for all Oregon Plan participants to improve success rate of volunteer projects.	TBD	ESU-wide	within 15 yrs	TBD	---	---	---	OWEB, OSU Extension Service
Listing Factor: N/A LFT: not specified	Strategy: not specified, via, I&E to address issue of - Outreach	27 - ESU-ADM Priority: not specified	Provide education and outreach to contractors, developers, and resource owners.	1. Include education and outreach materials on the benefit of beaver dams to ecosystem function in general and specifically to juvenile rearing habitat.	ESU-wide	on-going	Baseline	---	---	N/A	WS Councils, ODFW, ODF, ODSL, ODEQ, OWRD, SWCD, Metro

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: N/A LFT: not specified	Strategy: not specified , via, I&E to address issue of - Outreach	28 - ESU-ADM Priority: 3	Implement and expand upon I&E to use demonstration sites where landowners can view the results of various types of restoration efforts. Focus on demonstration sites where the landowner was active in the restoration activity.	TBD	0	within 15 yrs	TBD	---	---	---	WS Councils, ODFW, ODF, ODSL, ODEQ, OWRD, SWCD, Metro
Listing Factor: E.1 LFT: not specified	Strategy: 13 , via, RME to address issue of - Hatchery Management	29 - ESU-ADM Priority: not specified	Mark all hatchery fish to support harvest management goals and hatchery managements goals.	TBD	PNW region	on-going	Baseline	---	---	N/A	ODFW, NMFS
Listing Factor: E.1 LFT: not specified	Strategy: 13 , via, RME to address issue of - Hatchery Management	30 - ESU-ADM Priority: 1	Support tagging efforts and different tagging types and technologies from each hatchery release to meet RME and management goals.	1. Use to ID hatchery origin of strays, evaluate rearing and/or release techniques, survival studies, etc.	natal subbasins	on-going	Baseline	---	---	N/A	ODFW, NMFS, USACE

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A LFT: 8a Key Factor: CHS winter parr Secondary Factor: CHS fry-summer parr	Strategy: 1, 2, 3, 4, 5, 6 , via, Land Use Management to address issue of - Physical Habitat Quality	31 - ESU-PHQ Priority: 1	Develop proactive framework to minimize future development impacts in key reaches and floodplains.	1. Evaluate/synthesize existing regulatory urbanization provisions/projections relative to salmonid needs. 2: Review/revise as needed the county/municipal codes regarding development in floodplain, riparian, and meander zones. 2.1. revise/develop regulations that ensure no impact from future new development and re-development in the 100-year floodplain (including stormwater, wetlands, vegetation, etc.). 2.2. develop model code ordinances accounting for stormwater management and floodplain development 3. Prohibit new revetments, dikes, levees, and floodwalls in 100-year floodplain unless they will not increase flood volume, size, and/or intensity. 3.1. develop regulations ensuring new/existing levees and floodwalls are vegetated 4. Lessen future impact of floodplain development on listed species. 4.1.encourage Willamette Basin communities to incorporate into their land-use planning, new elements of the guidance developed	ESU-wide	within 15 yrs	TBD	---	---	---	ODLCD, ODAGAMI, ODSL, ODEQ, ODA, ODF, ODFW, Legislature, FEMA, USACE, USFS, NGO's, PUC's, Counties, Cities, WS Councils

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
				under the FEMA BiOp for the Puget Sound Region (NMFS 2008h) that calls for revising how FEMA administers discretionary elements of the National Flood Insurance Program. These include: 4.1.1. update floodplain and channel migration maps, ensure revisions consider the effects on listed species, and encourage communities to identify and evaluate the risk of flooding behind 100 year levees based on anticipated future conditions and the cumulative effects from future land-use change 4.1.2. strengthen FEMA Model Floodplain Ordinance for minimum criteria to include prohibiting development in the 100 yr floodplain, and consider revisions in how permitting authorities demonstrate how proposed development in a FEMA-designated floodway does not adversely affect water quality water quantity, flood volumes, flood velocities, spawning substrate, and/or floodplain refugia for listed, salmonids. 4.1.3. change the Community Rating System (CRS) stormwater credits and criteria and associated policies and programs to a) create an incentive for the use of Low Impact Development methods that							

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
				decrease the need for added stormwater treatment, b) increase the number of CRS points available for preservation of open space where listed species are present, giving additional credits for areas to be preserved that have been identified in NMFS adopted salmon recovery plans, c) award points for retaining and increasing riparian functions, particularly in areas where riparian function has been identified as a limiting factor for listed ESUs by the limiting factors analysis in salmon recovery plans, d) reduce the number of points available for structural changes that reduce the amount of functional floodplain, such as levees, berms, floodwalls, diversions, and storm sewer improvements, including enclosing open channels; see additional CRS changes in NMFS (2008h). 5. Provide FEMA funding for land acquisition in 100-year floodplain; prioritize acquisitions based on recovery plan priority areas. 6. Implement other appropriate incentives and educational programs.							

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A LFT: 8a Key Factor: CHS winter parr Secondary Factor: CHS fry-summer parr	Strategy: 1, 2, 3, 4, 5, 6 , via, Land Use Management to address issue of - Physical Habitat Quality	32 - ESU-PHQ Priority: 1	Where habitat restoration targets exist and progress toward them is tracked, but where targets are not being met in the first five years of implementation.	1. Develop population-specific strategies (e.g., funding, incentives, outreach, regulations, etc...) to meet those targets, with priority given to populations where desired status is low or very low extinction risk.	ESU-wide	within 15 yrs	Baseline	---	---	N/A	ODLCD, Counties, Municipalities
Listing Factor: A LFT: 8a	Strategy: 1, 2, 3, 4, 5, 6 , via, Land Use Management to address issue of - Physical Habitat Quality	33 - ESU-PHQ Priority: 1	DSL will work within existing mandates to facilitate implementing habitat actions in this Plan.	1. Continue efforts to streamline the permitting process for fish habitat and wetland restoration projects. 2. Strengthen interagency coordination on projects that may impact natural ecological processes. 3. For restoration projects identified in this Recovery Plan, facilitate efforts to implement the action. 4. Require avoidance/minimization of impacts to State waters in priority areas identified in this Recovery Plan. 5. Work with landowners to design projects that avoid/minimize impacts to	ESU-wide	On-going	Baseline	---	---	N/A	ODSL, ODLCD, Counties, Municipalities

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
				wetlands and other State waters. 6. Provide education/technical assistance to implementers of voluntary wetland restoration, creation, or enhancement projects. 7. Explore opportunities to target compensatory mitigation towards areas with high intrinsic potential for UWR Chinook and steelhead and/or have been identified as priority areas for restoration in watershed assessments and this recovery plan. 8. Explore conservation easements for state-owned lands with high ESU/DPS recovery value.							
Listing Factor: A LFT: 8a	Strategy: 1, 2, 3, 4, 5, 6 , via, Land Use Management to address issue of - Physical Habitat Quality	34 - ESU-PHQ Priority: 2	(similar to CRE-15) Reduce the introduction and spread of invasive plants by implementing education and monitoring projects that increase public awareness of exotic plant species and proper stewardship techniques.	1. Enforce existing laws. 2. Inventory exotic plant species infestations and develop a GIS layer with detailed metadata files. 2.1. Implement projects to address exotic plant infestations on public and private lands 2.2. Monitor infestation sites	ESU-wide	within 25 yrs	Estuary Module: $12,500,000 For FW: 50% of EM: $6,250,000	---	---	$6,250,000	ODFW, ODA, USACE, BPA, LCREP

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A LFT: 8a	Strategy: 1, 2, 3, 4, 5, 6 , via, Land Use Management to address issue of - Physical Habitat Quality	35 - ESU-PHQ Priority: not specified	Provide enhanced incentives for habitat restoration work.	1. Reward and assist landowners doing the 'extra' work needed to achieve recovery goals. 2. Develop an equitable system of recognition and rewards for regulated and non-regulated landowners.	CM: Eagle Crk; Clear Crk; mainstem Clackamas R -- R Mill Dam to Goose Crk; mainstem Clackamas R -- R Mill Dam to Abernathy Crk; Deep Crk; Johnson Cr	within 15 yrs	TBD	---	---	---	WS Councils, ODFW, OWEB, ODF, ODSL, ODA, OGNRO, Legislature, NMFS, NRCS, Counties, Municipalities, Metro
Listing Factor: A LFT: 7a Key Factor: none Secondary Factor: CHS eggs-alevins STW eggs-alevins	Strategy: 1, 2, 3, 4, 5, 6, 8 , via, Land Use Management to address issue of - Physical Habitat Quality	36 - ESU-PHQ Priority: not specified	Conduct sediment source analysis and then implement actions to reduce sediment from identified sources.	TBD	TBD	within 15 yrs	TBD	---	---	---	ODEQ, ODA

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A LFT: 8a	Strategy: 1, 2, 3, 4, 5, 6 , via, Land Use Management to address issue of - Physical Habitat Quality	37 - ESU-PHQ Priority: 2	Improve coordination and streamlining of habitat restoration efforts for a) impaired instream habitat complexity, b) floodplain processes and access to off-channel habitat by increasing lateral movement with improvements in revetments, dikes and floodwalls, and c) riparian conditions	1. Make this a task of the ESU Coordination Team. 1.1 identify specific coordination and implementation barriers and entities involved 1.2 work with entities to improve coordination and project streamlining	TBD	within 15 yrs	TBD	---	---	---	USACE, FEMA, USFS, NRCS,ODFW, ODF, ODSL, ODA, SWCD, Counties, Municipalities, WS Councils

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A LFT: 9h Key Factor: multiple populations and life stages; refer to population-specific LFT tables in CH 5 Secondary Factor: multiple populations and life stages; refer to population-specific LFT tables in CH 5	Strategy: 8 , via, Land Use Management to address issue of - Water Quality / Quantity / Hydrograph	38 - ESU-WQH Priority: 1	(similar to CRE-20 but expanded to include FW areas) Reduce non-point sourcing and loading of nutrients and pesticides from land use activities in subbasin streams, the Willamette River mainstem, and estuary. Implement pesticide and fertilizer BMP's to reduce loading.	1. Implement "toxin" TMDL WQMP's and identify other problem areas by reviewing findings of the USGS Water Quality Study in the Willamette Basin (Wentz et al. 1998), and the ODEQ WQ Assessment Report 2009. 2. Reduce existing impervious development on stormwater runoff effects with parking lot, rooftop, roadside treatments such as vegetation, swales, infiltration, retention, etc. 2.1. evaluate effectiveness of existing pesticide and fertilizer Agriculture BMP's and implement resulting recommendations on county and municipal lands to help reduce input from runoff to aquatic habitat. 2.2. revise and update IPM for PDX owned property. 2.3 incentivize BMP's. 2.4 increase funding for education and outreach programs targeted to professional and leisure agricultural activities and hold workshops and partner with OSU extension on education/outreach. 3. Promote development and use of natural treatment systems in urban areas. 3.1. reduce discharge of wastewater by expanding use of recycled water.	EST: see estuary Module FW: need review of WQ plans and reports	within 25 yrs (See EM and other basin WQ plans)	Estuary Module: $12,500,000 For FW: TBD	---	---	For FW: TBD	ODEQ, ODOT, ODA, SWCD, FHWA, NRCS, ACWA, LCREP, Counties, private landowners, local governments, municipalities, OSU extension

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
				Identify and remove institutional barriers that diminish recycled water use opportunities. 4. Implement actions associated with SB 737 that promote effective toxic reduction programs that improve water quality for fish, such as legacy pesticide return programs or improved erosion control program. 5. Implement Oregon Association of Nurseries agricultural land spraying proposals that describe better management practices for grass seed farming in Polk, Marion, Clackamas, and Yamhill counties.							

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A LFT: 9i Key Factor: multiple populations and life stages; refer to population-specific LFT tables in CH 5 Secondary Factor: multiple populations and life stages; refer to population-specific LFT tables in CH 5	Strategy: 8 , via, Land Use Management to address issue of - Water Quality / Quantity / Hydrograph	39 - ESU-WQH Priority: 2	Support RME that evaluates cumulative and interactive effects of contaminants on different salmonid life stages.	TBD	ESU-wide	within 15 yrs	TBD	---	---	---	ODEQ, City of Portland, Port of Portland

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A LFT: 9i	Strategy: 8 , via, Land Use Management to address issue of - Water Quality / Quantity / Hydrograph	40 - ESU-WQH Priority: 1	(CRE-23) Implement stormwater BMP's in cities, towns, and rural areas.	1. Monitor stormwater outputs to measure treatment compliance with existing local and state regulations throughout the basin. 1.1. develop a network of monitoring sites and establish a data repository that includes data collected by permittees. 2. Establish a fund source for regulatory agencies and local governments to use when insufficient resources are available to (a) access best available science, (b) develop standards beyond requirements, or (c) adequately enforce regulations. 3. Evaluate adequacy of best management practices and update as needed. 4. Provide incentives for low impact development practices.	ESU-wide	within 25 yrs	Estuary Module: $19,500,000 For FW: Assume same as EM	---	---	$19,500,000	ODEQ, ODOT, FHWA, LCREP, Municipalities
Listing Factor: A LFT: 9i	Strategy: 8 , via, Land Use Management to address issue of - Water Quality / Quantity / Hydrograph	41 - ESU-WQH Priority: 2	Provide more technical resources and incentives to small (non-metropolitan) communities so they have the infrastructure to better manage runoff from impervious surfaces.	TBD	ESU-wide	within 15 yrs	TBD	---	---	---	WS Councils, OWEB, ODEQ, small municipalities

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A LFT: 9i	Strategy: 8 , via, Land Use Management to address issue of - Water Quality / Quantity / Hydrograph	42 - ESU-WQH Priority: 1	(similar to CRE-21) Identify and reduce terrestrially and marine-based industrial, commercial, and public sources of pollutants.	1. Identify sources, loads, and pathways of point and non-point pollutants and take enforcement actions where needed. 2. Provide cost-share incentives for National Pollution Discharge Elimination System (NPDES) permit holders to upgrade effluent above their permit requirements. 3. Study and establish threshold treatment standards for pharmaceuticals and other unregulated substance discharges; update existing NPDES permits to reflect the new standards. 4. Provide grants and low-cost loans to permit holders required to treat effluent to standards established in the study above.	mostly in Estuary	within 25 yrs	Estuary Module: $46,000,000 FW: TBD	---	---	---	ODEQ, LCREP, Counties, Municipalities
Listing Factor: A LFT: 9i	Strategy: 8 , via, Land Use Management to address issue of - Water Quality / Quantity / Hydrograph	43 - ESU-WQH Priority: not specified	Develop, update, implement stormwater management plans for urban areas and roads.	1. Revise and update stormwater management manuals.	PDX Metro: Pork Chop and Portland-wide CM: Deep Crk; Johnson Crk; all areas within urban growth boundaries	within 15 yrs	FW: # Plans TBD Expert Opinion (from OrLCR Plan) 1yr-$90,000	$90,000 / yr /each plan	---	---	WS Councils, ODFW, ODEQ, NRCS, SWCD, Counties, Municipalities

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A LFT: 9, not specific	Strategy: 8 , via, Land Use Management to address issue of - Water Quality / Quantity / Hydrograph	44 - ESU-WQH Priority: not specified	Develop recommendations for land management scenarios that address hydrograph changes due to climate change, impervious surfaces, and other factors that result in altered water runoff.	TBD	ESU-wide	within 15 yrs	Baseline	---	---	N/A	ODFW, ODF, OWRD, ODLCD, ODA, Counties, Municipalities
Listing Factor: A LFT: 9, not specific	Strategy: 8 , via, Land Use Management to address issue of - Water Quality / Quantity / Hydrograph	45 - ESU-WQH Priority: not specified	Develop options for water banking and implement.	TBD	ESU-wide	within 15 yrs	TBD	---	---	---	OWRD, Counties, Municipalities
Listing Factor: E.1 LFT: 4a, 4c juveniles	Strategy: 7, 10, 13 , via, Hatchery Management to address issue of - Competition	46 - ESU-CPP Priority: 1	Continue the release of hatchery fish as smolts to reduce competition and predation with wild fish in tributaries and estuaries.	TBD	mostly in natal subbasins	on-going	Baseline	---	---	N/A	ODFW, (WDFW)

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: E.1 LFT: 4a, 4c juveniles	Strategy: 7, 10, 13 , via, Hatchery Management to address issue of - Competition	47 - ESU-CPP Priority: not specified	Investigate the feasibility of coordinated release timing among hatcheries, to reduce the numbers of out-migrating hatchery fish in-river at any one time.	TBD	mostly in natal subbasins	within 15 yrs	Baseline	---	---	N/A	ODFW, NMFS, (WDFW)
Listing Factor: E.1 LFT: 4a, 4c juveniles	Strategy: 7, 10, 13 , via, Hatchery Management to address issue of - Competition	48 - ESU-CPP Priority: not specified	Eliminate/reduce/shift hatchery programs to decrease mainstem and estuary competition and predation and reduce straying of hatchery fish onto natural spawning grounds	1. Investigate and/or implement hatchery release reductions or program shifts to lower river terminal areas. 1.1 include out-of-ESU programs and programs with surplus hatchery fish returns which are not harvested.	PNW region	on-going	Baseline	---	---	N/A	ODFW, NMFS, (WDFW)
								Sub Total		**$41,828,325**	

EST: Strategies and Actions focused mainly on decreasing LFT's in the Estuary ALL: All populations											
Listing Factor: A LFT: 5a Key Factor: CHS and STW parr-smolt Secondary Factor:	Strategy: 5, 7, 9 , via, Flood Control / Hydropower & Land Use Management to address issue of - Physical Habitat Quality	50 - EST-ALL Priority: 1	(see Estuary Module actions that improve habitat and flows)	TBD	Estuary	within 25 yrs (See EM)	see other EM costs	---	---	N/A	see other EM entities

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
none											
Listing Factor: A LFT: 5b Key Factor: CHS and STW parr-smolt Secondary Factor: none	Strategy: 1, 2, 5, 6 , via, Flood Control / Hydropower to address issue of - Physical Habitat Quality	51 - EST-ALL Priority: 1	(see Estuary Module actions that improve flows)	TBD	Estuary	within 25 yrs (See EM)	see other EM costs	---	---	N/A	see other EM entities
Listing Factor: A LFT: 8a Key Factor: CHS parr smolt	Strategy: 1, 2, 3, 4, 5, 6 , via, Land Use Management to address issue of - Physical Habitat	52 - EST-ALL Priority: 2	Work with various stakeholders to restore and develop complex habitat for rearing juveniles in the lower Willamette River.	TBD	Estuary	within 15 yrs	Baseline	---	---	N/A	ODFW, NMFS, Counties, City of Portland, Metro, Municipalities

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
STW smolt Secondary Factor: none	Quality										
Listing Factor: A LFT: 8a	Strategy: 1, 2, 3, 4, 5, 6 , via, Land Use Management to address issue of - Physical Habitat Quality	53 - EST-ALL Priority: not specified	Protect remaining shallow water habitat in estuary, especially high quality habitat in the lower estuary.	TBD	Estuary	within 15 yrs	Baseline	---	---	N/A	LCREP
Listing Factor: A LFT: 8a	Strategy: 1, 2, 3, 4, 5, 6 , via, Land Use Management to address issue of - Physical Habitat Quality	54 - EST-ALL Priority: not specified	Coordinate with the Portland Harbor Natural Resource Damage Assessment and Restoration process to implement restoration in the Lower Willamette River that will aid salmon and steelhead recovery.	TBD	lower Willamette River	within 15 yrs	Baseline	---	---	N/A	ODFW, NMFS, Counties, City of Portland, Metro

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A LFT: 8a	Strategy: 1, 2, 3, 4, 5, 6 , via, Land Use Management to address issue of - Physical Habitat Quality	55 - EST-ALL Priority: not specified	Identify and acquire conservation flexibility in key salmonid habitats in the estuary.	TBD	lower Willamette River	within 15 yrs	TBD	---	---	---	ODFW, OWEB, City of Portland, Metro
Listing Factor: A LFT: 8a	Strategy: 1, 2, 3, 4, 5, 6 , via, Land Use Management to address issue of - Physical Habitat Quality	56 - EST-ALL Priority: not specified	Expand upon current efforts to remove invasive plant species where they inhibit natural or deliberate re-establishment of native riparian plant species.	TBD	lower Willamette River	within 15 yrs	TBD	---	---	---	City of Portland, Metro
Listing Factor: A LFT: 8a	Strategy: 1, 2, 3, 4, 5, 6 , via, Land Use Management to address issue of - Physical Habitat Quality	57 - EST-ALL Priority: not specified	Acquire conservation management flexibility for priority sites in the PDX Metro area.	1. Fund and implement the Gray2Green program.	Pork Chop and Portland-wide	within 15 yrs	TBD	---	---	---	City of Portland

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A LFT: 8a	Strategy: 1, 2, 3, 4, 5, 6 , via, Land Use Management to address issue of - Physical Habitat Quality	58 - EST-ALL Priority: not specified	As feasible, re-establish connection between Columbia Slough and Columbia River to improve flushing and water quality.	TBD	Columbia Slough	within 15 yrs	TBD	---	---	---	ODFW
Listing Factor: A LFT: 8a	Strategy: 1, 2, 3, 4, 5, 6 , via, Land Use Management to address issue of - Physical Habitat Quality	59 - EST-ALL Priority: not specified	(CRE-10) Breach or lower dikes and levees to establish or improve access to off-channel habitats.	1. Breach or lower the elevation of dikes and levees to create and/or restore tidal marshes, shallow-water habitats, and tide channels. 2. Vegetate dikes and levees. 3. Remove tide gates to improve the hydrology between wetlands and the channel and to provide juvenile fish with physical access to off-channel habitat. 3.1. use a habitat connectivity index to prioritize projects. 4. Upgrade tide gates or perched culverts where (a) no other options exist, (b) upgraded structures can provide appropriate access for juveniles, and (c) ecosystem function would be improved over current conditions.	Estuary	within 25 yrs (See EM)	Estuary Module $75,000,000	---	---	N/A	ODFW, ODSL, USACE, BPA, LCREP

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quanti ty	Total Cost	Key Entities / Potential Implement ers
Listing Factor: A LFT: 8a	Strategy: 1, 2, 3, 4, 5, 6 , via, Land Use Managemen t to address issue of - Physical Habitat Quality	60 - EST-ALL Priority: not specified	(similar to CRE-11) Reduce the square footage of over-water structures in the estuary and lower mainstem Willamette River. Where possible, modify remaining overwater structures to provide beneficial habitat.	1. Inventory over-water structures in the estuary and develop a GIS layer with detailed metadata files. 2. Initiate a planning process to evaluate existing and new over-water structures for their economic, ecological, and recreational value. 3. Remove or modify over-water structures to provide beneficial habitats. 4. Establish criteria for new permit applications to consider the cumulative impacts of over-water structures in the estuary. 5. Conduct research, monitoring, and evaluation of modifications that can be made to overwater structures to assess ecological benefits.	Estuary, Lower Willamette Mainstem	within 25 yrs (See EM)	Estuary Module $5,800,000	---	---	N/A	ODSL, ODLCD, USACE, LCREP, ODSL, City of Portland

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A LFT: 8a	Strategy: 1, 2, 3, 4, 5, 6 , via, Land Use Management to address issue of - Physical Habitat Quality	61 - EST-ALL Priority: not specified	(CRE-6) Reduce the export of sand and gravels via dredge operations by using dredged materials beneficially.	1. Establish a forum to develop a region-wide sediment plan for the estuary and littoral cell. 2. Identify and implement dredged material beneficial use demonstration projects, including the notching and scrape-down of previously disposed materials and placement of new materials for habitat enhancement and/or creation. 3. Dispose of dredged materials using techniques identified through the demonstration projects and region-wide planning.	Estuary	within 25 yrs (See EM)	Estuary Module $6,000,000	---	---	N/A	ODSL, NMFS, USACE, LCREP, Port of Portland
Listing Factor: A LFT: 8a	Strategy: 1, 2, 3, 4, 5, 6 , via, Land Use Management to address issue of - Physical Habitat Quality	62 - EST-ALL Priority: not specified	(CRE-12) Reduce the effects of vessel wake stranding in the estuary.	1. Analyze factors contributing to ship wake stranding to determine potential approaches to reducing mortality in locations where juveniles are most vulnerable. Design and implement demonstration projects and monitor their results. 2. Implement projects identified in analysis above that are likely to result in the reduction of ship wake stranding events. 3. Use existing and new research results documenting stranding by ship wakes to estimate juvenile mortality throughout the estuary. Modeling could	Estuary	within 25 yrs (See EM)	Estuary Module $13,000,000	---	---	N/A	ODFW, USACE, LCREP, Port of Portland

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
				use newly emerging Light Detection and Ranging (LIDAR) satellite imagery to conduct analyses.							
Listing Factor: A LFT: 8a	Strategy: 1, 2, 3, 4, 5, 6 , via, Land Use Managemen t to address issue of - Physical Habitat Quality	63 - EST-ALL Priority: not specified	(CRE-7) Reduce entrainment and habitat effects resulting from main and side-channel dredge activities and ship ballast intake in the estuary.	1. Identify and evaluate dredge operation techniques designed to reduce entrainment and other habitat effects. 2. Initiate demonstration projects designed to test and evaluate dredge operations. 3. Implement best management techniques for dredging. 4. Study the effects of entrainment of juvenile salmonids from ship ballast water intake. 5. Implement a demonstration project to evaluate the feasibility of reducing entrainment of juvenile salmonids from ship ballast intake.	Estuary	within 25 yrs (See EM)	Estuary Module $4,500,000	---	---	N/A	ODFW, ODSL, USACE, LCREP

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A LFT: 8a	Strategy: 1, 2, 3, 4, 5, 6 , via, Land Use Management to address issue of - Physical Habitat Quality	64 - EST-ALL Priority: not specified	(CRE-8) Remove or modify pilings and pile dikes when removal or modification would benefit juvenile salmonids and improve ecosystem health.	1. Inventory, assess, and evaluate in-channel pile dikes for their economic value and their negative and positive impacts on the estuary ecosystem; develop working hypotheses for removal or modification. 2. Implement demonstration projects designed to test working hypotheses and guide future program priorities. 3. Remove or modify priority pilings and pile dikes. 4. Monitor the physical and biological effects of pile dike removal and modification.	Estuary	within 25 yrs (See EM)	Estuary Module $27,250,000	---	---	N/A	ODFW, ODSL, USACE, BPA, LCREP
Listing Factor: A LFT: 7h Key Factor: CHS parr-smolt; STW smolt Secondary Factor: none	Strategy: 1, 2, 5, 6 , via, Flood Control / Hydropower to address issue of - Physical Habitat Quality	65 - EST-ALL Priority: not specified	(CRE-5) Study and mitigate the effects of entrapment of fine sediment in Columbia basin reservoirs, to improve nourishment of the littoral cell.	1. Identify the effects of reservoir sediment entrapment on economic and ecological processes; this includes effects on ship channels, turning basins, port access, jetty activities, littoral cell erosion and accretion, and habitat availability. 2. Develop region-wide sediment plan for the estuary and littoral cell to address salmonid habitat-forming processes. 3. Implement projects recommended in the plan to mitigate the effects of sediment entrapment.	Estuary, FCRPS	within 25 yrs (See EM)	Estuary Module $8,000,000	---	---	N/A	USACE, LCREP

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A LFT: 10f Key Factor: CHS parr-smolt; STW smolt Secondary Factor: none	Strategy: 1, 5, 8 , via, Flood Control / Hydropower to address issue of - Water Quality / Quantity / Hydrograph	66 - EST-ALL Priority: not specified	(CRE-3) Establish minimum instream flows for the lower Columbia River mainstem that would help prevent further degradation of the ecosystem.	1. Explore technical options and develop policy recommendations on instream flows. 1.1. implement instream flow regulations in accordance with the policy recommendations.	Estuary	within 25 yrs (See EM)	Estuary Module $44,500,000	---	---	N/A	USACE, LCREP

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A LFT: 10f	Strategy: 1, 5, 6, 7, 8 , via, Flood Control / Hydropower to address issue of - Water Quality / Quantity / Hydrograph	67 - EST-ALL Priority: not specified	(CRE-4) Adjust the timing, magnitude and frequency of flows (especially spring freshets) entering the estuary and plume to better reflect the natural hydrologic cycle, improve access to habitats, and provide better transport of coarse sediments and nutrients in the estuary, plume, and littoral cell.	1. Conduct a flood study to determine the risks and feasibility of returning to more normative flows in the estuary. 2. Conduct a study to determine the habitat effects of increasing the magnitude and frequency of flows (i.e., how much access of river to off-channel habitats would increase). 3. Conduct additional studies to determine the extent of other constraints (international treaties, system-wide fish management objectives, and power management). 4. Make policy recommendations to action agencies on flow (consider beneficial estuary flows, flood management, power generation, irrigation, water supply, fish management, and other interests). 5. Implement modified estuary flow regime (all reaches and plume) annually in concert with other interests (including hydroelectric, flood control, water withdrawals.	Estuary, FCRPS	within 25 yrs (See EM)	Estuary Module $10,000,000	---	---	N/A	USACE, LCREP

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A LFT: 10f	Strategy: 1, 5, 6, 7, 8 , via, Flood Control / Hydropower to address issue of - Water Quality / Quantity / Hydrograph	68 - EST-ALL Priority: not specified	(FCRPS RPA's 10-13) Columbia River Treaty and non-Treaty storage management, agreements, and coordination.	TBD	FCRPS	within 25 yrs	Baseline	---	---	N/A	USACE
Listing Factor: A LFT: 10f	Strategy: 1, 5, 6, 7, 8 , via, Flood Control / Hydropower to address issue of - Water Quality / Quantity / Hydrograph	69 - EST-ALL Priority: not specified	(FCRPS RPA 14) Manage flow during dry years to maintain and improve habitat conditions for ESA-listed species.	TBD	FCRPS	within 25 yrs	Baseline	---	---	N/A	USACE
Listing Factor: A LFT: 10f	Strategy: 1, 5, 6, 7, 8 , via, Flood Control / Hydropower to address issue of - Water Quality / Quantity / Hydrograph	70 - EST-ALL Priority: not specified	(OrLCR Plan) Draft storage reservoirs to meet lower Columbia summer flow and velocity equivalent objectives on a seasonal and weekly basis.	TBD	FCRPS	within 25 yrs	Baseline	---	---	N/A	USACE

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A LFT: 10f	Strategy: 1, 5, 6, 7, 8 , via, Flood Control / Hydropower to address issue of - Water Quality / Quantity / Hydrograph	71 - EST-ALL Priority: not specified	(OrLCR Plan) Operate reservoirs at rule curves and seek additional flow augmentation volumes from Snake River and Canadian reservoirs to better meet spring and summer flow and velocity objectives.	TBD	FCRPS	within 25 yrs	Baseline	---	---	N/A	USACE
Listing Factor: A LFT: 10f	Strategy: 1, 5, 6, 7, 8 , via, Flood Control / Hydropower to address issue of - Water Quality / Quantity / Hydrograph	72 - EST-ALL Priority: not specified	(FCRPS RPA 4) Operate the FCRPS storage projects for flow management to aid anadromous fish.	TBD	FCRPS	within 25 yrs	Baseline	---	---	N/A	USACE
Listing Factor: A LFT: 10f	Strategy: 1, 5, 6, 7, 8 , via, Flood Control / Hydropower to address issue of - Water Quality / Quantity / Hydrograph	73 - EST-ALL Priority: not specified	(FCRPS RPA 5) Operate the FCRPS run-of-river mainstem lower Columbia River and Snake River projects to minimize water travel time through the lower Columbia River to aid in juvenile fish passage.	TBD	FCRPS	within 25 yrs	Baseline	---	---	N/A	USACE

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A LFT: 10f	Strategy: 1, 5, 6, 7, 8 , via, Flood Control / Hydropower to address issue of - Water Quality / Quantity / Hydrograph	74 - EST-ALL Priority: not specified	(FCRPS RPA 6) In-season water management via water management plans and by the Regional Forum.	TBD	FCRPS	within 25 yrs	Baseline	---	---	N/A	USACE
Listing Factor: A LFT: 9i Key Factor: multiple populations and life stages; refer to population-specific LFT tables in CH 5 Secondary Factor: multiple populations and life stages; refer to	Strategy: 8 , via, Flood Control / Hydropower to address issue of - Water Quality / Quantity / Hydrograph	75 - EST-ALL Priority: not specified	(CRE-22) Monitor the estuary for contaminants and restore or mitigate contaminated sites.	1. Implement contamination monitoring recommendations identified in the Federal Columbia River Estuary Research, Monitoring, and Evaluation Program (Pacific Northwest National Laboratory 2006). 2. Develop criteria/process for evaluating contaminated estuarine sites to establish their restoration potential. 3. Develop an integrated multi-state funding strategy to address contamination cleanup in the estuary from non-identifiable upstream sources. 4. Restore those contaminated estuarine sites that will yield the greatest ecological and economic benefits.	mostly in Estuary	within 25 yrs (See EM)	Estuary Module $60,500,000	---	---	N/A	ODFW, ODEQ, NMFS, LCREP

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
population-specific LFT tables in CH 5											
Listing Factor: A LFT: 9i	Strategy: 8 , via, Land Use Management to address issue of - Water Quality / Quantity / Hydrograph	76 - EST-ALL Priority: not specified	Incorporate and coordinate Recovery Plan actions in lower Willamette River with habitat mitigation actions to be funded with the Port of Portland Superfund Clean-Up.	TBD	lower Willamette River	within 15 yrs	Baseline	---	---	N/A	Trustee Council
Listing Factor: A LFT: 9j Key Factor: none Secondary Factor: CHS parr-smolt STW smolt	Strategy: 1, 5, 6, 7, 8 , via, Flood Control / Hydropower to address issue of - Water Quality / Quantity / Hydrograph	77 - EST-ALL Priority: not specified	(CRE-2) Operate Columbia basin hydrosystem to reduce the effects of reservoir surface heating, or conduct mitigation measures.	1. Conduct a reservoir heating study to determine the extent of the issue and identify hydrosystem operational changes (including design) that would reduce effects and/or mitigate downstream temperature issues. 2. Implement hydrosystem operational changes to reduce temperature effects; if no change is possible, mitigate effects by restoring tributary riparian areas.	FCRPS	within 25 yrs (See EM)	Estuary Module $20,000,000	---	---	N/A	USACE, LCREP

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A LFT: not specified	Strategy: 1, 5, 6, 7, 8 , via, Flood Control / Hydropower to address issue of - Water Quality / Quantity / Hydrograph	78 - EST-ALL Priority: not specified	(FCRPS RPA's 8-9) Manage the FCRPS for operations and fish emergencies.	TBD	FCRPS	within 25 yrs	Baseline	---	---	N/A	USACE
Listing Factor: A, C, and D LFT: undefined for UWR ESU's	Strategy: not specified , via, not defined to address issue of - Other species	79 - EST-ALL Priority: 2	(CRE-19) Prevent new introductions of aquatic invertebrates and reduce the effects of existing infestations.	1. Assemble existing technical information on introduced aquatic invertebrates in the estuary and develop a plan for managing existing infestations and preventing new infestations. 1.1. implement recommendations from the plan above for managing existing and preventing new infestations	Estuary	within 25 yrs (See EM)	Estuary Module: $3,000,000	---	---	N/A	ODFW, ODA, LCREP, Port of Portland
Listing Factor: E.1 LFT: 4a Key Factor: none Secondary Factor: CHS parr-smolt	Strategy: 7, 10, 13 , via, Hatchery Management RME to address issue of - Competition	80 - EST-ALL Priority: not specified	To decrease juvenile salmonid competition in the estuary and straying by adults, investigate other hatchery release strategies, reductions, or program shifts to lower river terminal areas for commercial and/or sport harvest, including those from out-of-ESU and especially if there are surplus hatchery fish which are not harvested.	1. Evaluate impact of competition with hatchery origin fish on wild salmon and steelhead in the estuary. 1.1. develop a plan to reduce competition with hatchery origin fish if evaluation shows significant impact	Estuary	within 25 yrs (See EM)	Estuary Module	---	---	N/A	ODFW, NMFS, WDFW, LCREP

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
STW smolt											
Listing Factor: E.1 LFT: 4 (similar to 4a, but from shad introductions, not hatchery fish) not ID'd as key or secondary threat to UWR populations	Strategy: 10 , via, Other RME to address issue of - Competition	81 - EST-ALL Priority: not specified	(similar to CRE-18) Reduce competition with non-native fish in the estuary.	1. Organize existing technical information about shad and other invasive fishes and identify data gaps and potential control methods. 1.1. implement demonstration projects to evaluate effective management methods 1.2. implement shad population management techniques 1.3. monitor and evaluate shad management techniques	Estuary	within 25 yrs (See EM)	Estuary Module: $5,500,000	---	---	N/A	ODFW, NMFS, WDFW, LCREP

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A and C.1 LFT: 6b Key: CHS fry-winter parr (SSA) Secondary: uncertainty of CHS and STW juveniles in other areas	Strategy: 11, via, Land Use / Introductions to address issue of - Predation	82 - EST-ALL Priority: not specified	(similar to CRE-13) Manage pikeminnow and non-native piscivorous fishes to reduce predation on juvenile salmonids.	1. Initiate status/trend monitoring of abundance and occurrence of pikeminnow, centrarchids, walleye, and channel catfish. 2. Initiate diet studies to resolve critical uncertainty regarding impact on UWR Chinook and steelhead. 2.1. as needed and feasible, implement habitat actions that are known to prevent population growth of these fish or that reduce their interactions with juvenile salmonids. 3. Increase the northern pikeminnow bounty program in the estuary. 3.1. evaluate relative effectiveness of expanding this program to other areas 4. Promote liberal sport fish regulations of exotic game fish where co-occurring with UWR Chinook and steelhead.	Estuary	within 25 yrs (See EM)	Estuary Module: $13,000,000 FW (assume same as EM)	---	---	13000000	ODFW, USACE, LCREP, Metro
Listing Factor: A and C.1 LFT: 6e Key: CHS parr-	Strategy: 11, via, Land Use Management to address issue of - Predation	83 - EST-ALL Priority: not specified	(CRE-16) Implement projects to redistribute part of the Caspian tern colony currently nesting on East Sand Island.	1. Enhance or create tern nesting habitat at alternative sites in Washington, Oregon, and California. 1.1. reduce tern nesting habitat on East Sand Island to 1 to 1.5 acres 1.1.1. monitor the regional tern population	Estuary	within 25 yrs (See EM)	Estuary Module $10,000,000	---	---	N/A	ODFW, USACE, USFWS, LCREP

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
smolt STW smolt Secondary: none											
Listing Factor: A and C.1 LFT: 6e Key: CHS parr-smolt STW smolt Secondary: none	Strategy: 11, via, Land Use Management to address issue of - Predation	84 - EST-ALL Priority: not specified	(CRE-17) Implement projects to reduce double-crested cormorant habitats and encourage dispersal to other locations.	1. Identify, assess, and evaluate methods of reducing double-crested cormorant abundance numbers. 1.1. implement demonstration projects resulting from assessment above (i.e., decoys and audio playback methods) 1.1. 1. implement projects resulting in reduced predation by cormorants	Estuary	within 25 yrs (See EM)	Estuary Module: $10,500,000	---	---	N/A	ODFW, USACE, USFWS, LCREP
Listing Factor: B.1 LFT: 11a adults	Strategy: 12, via, Harvest Management to address issue of - Population Traits	85 - EST-CM Priority: not specified	Shift mainstem commercial spring Chinook harvest to terminal areas during low return years (de facto "sliding scale").	TBD	Estuary	within 20 yrs	Baseline	---	---	N/A	ODFW, WDFW

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: B.1 LFT: 11a adults	Strategy: 12 , via, Harvest Management to address issue of - Population Traits	86 - EST-CM Priority: not specified	Monitor harvest levels in all fishery areas for all species (direct and indirect mortality).	TBD	Estuary	on-going; modify as needed	Baseline	---	---	N/A	ODFW, PFMC, WDFW
								Sub Total		**$13,000,000**	
FW: Strategies and Generalized Actions focused on decreasing LFT's in Freshwater ALL: All populations											
Listing Factor: A.2 LFT: 2b Key Factor: CHS adult STW adult Secondary Factor: none LFT: 10b Key Factor: none	Strategy: 4, 8 , via, Land Use Management to address issue of - Habitat access & Water Quality / Quantity / Hydrograph	87 - FW-ALL Priority: 3	Improve the maintenance of fish screens and fish passage structures.	1. Implement best fish management practices on all new hydropower generating facilities on water diversion canal(s) developed in the future in Willamette subbasins. 2. ID if any current diversion projects need better maintenance or additions. 2.1. prioritize diversions for improvements and screen diversions appropriately to reduce fish mortality	ESU-wide	on-going	Baseline	---	---	N/A	owners, ODFW, local governments, NMFS, Water Control Districts

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Secondary Factor: CHS summer parr STW fry-summer parr											

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A LFT: 8a Key Factor: CHS parr-smolt Secondary Factor: CHS parr-smolt STW parr-smolt	Strategy: 1, 2, 3, 4, 5, 6 , via, Land Use Management to address issue of - Physical Habitat Quality	88 - FW-ALL Priority: 1	(similar to CRE-1 but for FW areas above Willamette Falls) Protect and restore riparian areas on private lands throughout the rearing zones for Chinook and steelhead that are not covered by of riparian actions in TMDL implementation plans.	1. Assure adequate regulations are in place to protect existing high quality habitat and eliminate/reduce and fully mitigate, impacts of future development (within cities, rural-residential, and rural-agriculture zones). 1.1. encourage and provide incentives for local, state, and federal regulatory entities to maintain and restore key riparian areas 1.2. enforce consistent riparian area protections throughout the Willamette River basin. 2. Actively purchase key riparian areas from willing landowners in urban and rural settings when the riparian areas cannot be effectively protected through regulation or voluntary or incentive programs and (a) are intact, or (b) are degraded but have good restoration potential. 3. Maintain and restore ecological benefits in key riparian areas with active management. 3.1. manage vegetation on dikes and levees to enhance ecological function and adding shoreline/instream complexity for juvenile salmonids	above Willamette Falls	within 25 yrs	Assume same estimate as in Estuary Module: $38,000,000	---	---	38000000	ODA, ODFW, OWEB, ODLCD, ODSL, ODEQ, USACE, SWCD, BPA, LCREP, Counties, Municipalities, WS Councils

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A LFT: 8a Key Factor: CHS parr-smolt Secondary Factor: CHS parr-smolt STW parr-smolt	Strategy: 1, 2, 3, 4, 5, 6 , via, Land Use Management to address issue of - Physical Habitat Quality	89 - FW-ALL Priority: 1	(similar to CRE-9 but for FW areas above Willamette Falls) Protect remaining high-quality off-channel habitat from degradation and restore degraded areas with high intrinsic potential for high quality habitat.	1. Encourage and provide resources for local, state, and federal regulatory entities to maintain, improve (where needed), and consistently enforce habitat protections throughout the Willamette River basin. 2. Actively purchase off-channel habitats in urban and rural settings that (a) cannot be effectively protected through regulation, (b) are degraded but have good restoration potential, or (c) are highly degraded but could benefit from long-term restoration solutions. 3. Restore degraded off-channel habitats with high intrinsic potential for increasing habitat quality.	above Willamette Falls	within 25 yrs	Assume same estimate as in Estuary Module: $68,000,000	---	---	68000000	WS Councils, ODFW, OWEB, ODSL, ODLCD, NMFS, USACE, SWCD, BPA, LCREP, Counties, Municipalities
Listing Factor: A LFT: 8a Key Factor: CHS parr-smolt Secondary Factor: CHS parr-smolt	Strategy: 1, 2, 3, 4, 5, 6 , via, Land Use Management to address issue of - Physical Habitat Quality	90 - FW-ALL Priority: 1	Where population-level habitat monitoring indicates statistically-significant temporal degradation of key habitat features, encourage new/revised regulatory measures for key habitat feature(s) that eliminate further degradation, protect existing high quality areas, and allow long-term/"passive" restoration in other areas.	TBD	TBD	within 15 yrs	Baseline	---	---	N/A	NRCS, FSA, USACE, OWEB, ODFW, OPRD, SWCD, ODLCD, land trusts, NGOs, private landowners, WS Councils, Counties, Municipalities

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
STW parr-smolt											
Listing Factor: A LFT: 8a Key Factor: CHS parr-smolt Secondary Factor: CHS parr-smolt STW parr-smolt	Strategy: 1, 2, 5, 6 , via, Flood Control / Hydropower to address issue of - Physical Habitat Quality	91 - FW-ALL Priority: 1	Restore substrate recruitment to the mainstem Willamette River from tributary areas using a combination of peak flows and substrate supplementation.	1. Provide substrate supplementation downstream of dams and for the revetments blocking recruitment.	above Willamette Falls	within 15 yrs	TBD	---	---	---	USACE

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A LFT: 8a Key Factor: CHS winter parr Secondary Factor: CHS fry-summer parr	Strategy: 1, 2, 3, 4, 5, 6 , via, Land Use Management to address issue of - Physical Habitat Quality	92 - FW-ALL Priority: 1	Maintain and restore the best available spawning, rearing, and migration habitats, and acquire reaches or management flexibility where ecological processes (function) and salmonid historical habitat are impaired or lost.	1. Available Habitat: ID existing core spawning and rearing areas, and ID reaches in these areas that are vulnerable to existing point source or upslope activities through modification to riparian structure/function or water quality impacts. 1.1. Maintain/protect them by evaluating/implementing/enforcing existing land management guidelines and protections, to result in no net loss in structure/function and water quality 2. Impaired Habitat: improve long-term productivity and capacity by improving reach processes, and link restored reaches to regain some subbasin function 2.1. ID low-cost, high-return restoration areas of the lower subbasin floodplains. Use USACE floodplain restoration study or other plans to help ID candidate reaches 2.2. ID reach-specific opportunities and treatments to improve riparian structure/function to a reference condition 2.3. Develop cooperative agreements, habitat conservation plan and/or habitat improvement projects with land owners to protect and improve fish	SS: Hamilton, Crabtree, McDowell, Wiley, Thomas Creeks CA: Adults and early juveniles: upper subbasin older juveniles: subbasin-wide MO: Majority of current CHS spawning occurs on the mainstem Molalla from Glen Avon Bridge to Henry Creek Falls. The most concentrated spawning occurs from Gawley Creek to Henry Creek (Schmidt et al. 2008).	within 15 yrs	TBD	---	---	---	USFS, USBLM, NRCS, FSA, USACE, OWEB, ODFW, SWCD, McKenzie River Trust, NGOs, local governments, WS Councils, Molalla River Watch, Molalla River Stewards, private landowners

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
				habitat. 2.4. improve instream habitat structure (LWD, etc), in situ water quality, and fish access to these areas 2.5. ID criteria by which reach improvement is prioritized at a subbasin scale to serve as building blocks for restoring and linking processes (see reach slice approach developed by the PNW Ecosystem Research Consortium and related framework developed by the WATER HTT) 3. Lost Habitat: Regain habitat capacity through conservation easements and reach acquisitions.							

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A LFT: 8a Key Factor: CHS winter parr Secondary Factor: CHS fry-summer parr	Strategy: 1, 2, 3, 4, 5, 6 , via, Land Use Management to address issue of - Physical Habitat Quality	93 - FW-ALL Priority: 1	Remediate adverse effects of rural roads and trails on aquatic physical habitat quality and water quality. Develop funding methods for retiring USFS/USBLM roads and private roads.	1. On federal lands in upper subbasins, support implementation of the USFS Willamette NF Legacy Roads and Trails and other Federal watershed restoration efforts to improve or decommission roads on Federal forest and private roads. 2. On non-federal lands, support implementation of projects that reduce negative effects of rural roads 2.1. ID these projects or problem areas through WS Action Plans (see provisional MF Willamette WS Council Action Plan) and other resources related to roads and public ordinances. 3. ID and fix constraints with out-of-jurisdiction domain areas where known problems exist.	upper reaches in natal subbasins	within 15 yrs	TBD	---	---	---	USFS, USBLM, WS Councils, counties, private landowners, local governments
Listing Factor: A LFT: 8a Key Factor: CHS winter parr Second	Strategy: 1, 2, 3, 4, 5, 6 , via, Land Use Management to address issue of - Physical Habitat Quality	94 - FW-ALL Priority: 3	When reviewing new permits or activities, apply road and bridge fluvial performance standards that allow free passage of fish, sediment, and flows.	TBD	ESU-wide	on-going	baseline	---	---	N/A	ODOT, USBLM, USFS, OWEB, SWCD, NRCS, FHWA, County Road departments

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
ary Factor: CHS fry-summer parr											
Listing Factor: A LFT: 8a Key Factor: CHS winter parr STW winter parr Secondary Factor: CHS fry-summer parr	Strategy: 1, 2, 3, 4, 5, 6 , via, Land Use Management to address issue of - Physical Habitat Quality	95 - FW-ALL Priority: 3	Work with landowners on alternatives to installing riprap along the banks of rivers and streams.	1.1. Provide technical support to WS Councils to explore different approaches.	CA: Middle reaches of the Calapooia River, Brush Creek and Courtney Creek sub-basins	within 15 yrs	TBD	---	---	---	WS Councils, OWEB

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A LFT: 8a Key Factor: CHS winter parr STW winter parr Secondary Factor: CHS fry-summer parr	Strategy: 1, 2, 3, 4, 5, 6 , via, Land Use Management to address issue of - Physical Habitat Quality	96 - FW-ALL Priority: 2	Protect and conserve rare and unique functioning habitats that may exert different selective pressures on segments of the population, thereby increasing genetic and life history diversity.	TBD	NS: Opal Creek Wilderness area is protected, focus action elsewhere (Little N. Santiam)	within 15 yrs	TBD	---	---	---	USFS, private landowners, Watershed councils, OWEB, ODFW, SWCD
Listing Factor: A LFT: 8a Key Factor: CHS winter parr STW winter parr Secondary Factor: CHS fry-summer	Strategy: 1, 2, 3, 4, 5, 6 , via, Land Use Management to address issue of - Physical Habitat Quality	97 - FW-ALL Priority: not specified	Support WS Councils to conduct watershed education and outreach activities for landowners and in schools.	1. Set up demonstration sites where landowners can view the results of various types of restoration efforts. 1.1. emphasize importance of channel meandering for maintaining healthy habitat for fish. 1.2. focus on demonstration sites where the landowner was active in the restoration activity. 1.3. involve middle school and high school classes in monitoring and restoration efforts within the watershed 2: Provide elementary teachers with printed materials about the ecology of fish and wildlife in the	Long term I&E	within 15 yrs	TBD	---	---	---	WS Councils, OWEB

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
parr				watershed. 2.1. help arrange field trips to interesting sites along the river, streams, and wetlands.							
Listing Factor: A LFT: 8a	Strategy: 1, 2, 3, 4, 5, 6 , via, Land Use Management to address issue of - Physical Habitat Quality	98 - FW-ALL Priority: not specified	Develop methodology to assess and identify, and then protect, stream reaches and population strongholds which will be resilient/resistant to climate change impacts.	TBD	TBD	within 15 yrs	TBD	---	---	---	WS Councils, ODFW, ODSL, Counties, Municipalities

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A LFT: 8a	Strategy: 1, 2, 3, 4, 5, 6 , via, Land Use Management to address issue of - Physical Habitat Quality	99 - FW-ALL Priority: not specified	ID and restore priority non-functioning wetlands.	1. ID strategic wetland areas that would contribute to connectivity and hyporheic processes. 2. Encourage farmers and other landowners to restore or release non-functioning wetlands on marginally productive land through the use of wetland banks or other measures.	Best suited for former wetland areas located near remnant/residual stream channels so that hyporheic processes are linked	within 15 yrs	TBD	---	---	---	NRCS, WS Councils, private landowners
Listing Factor: A LFT: 8a Key Factor: CHS winter parr Secondary Factor: CHS fry-summer parr	Strategy: 1, 2, 3, 4, 5, 6 , via, Land Use Management to address issue of - Physical Habitat Quality	100 - FW-ALL Priority: 1	Restore natural riparian communities and their function.	1. ID impacted areas that are strategic reaches where expansion of riparian width would increase stream shading. 2. Plant riparian forest at historic confluences. 2.1. determine feasible riparian width and work with constituents to develop specific riparian vegetation actions 3. Look for further improvements of riparian habitat and increase instream habitat complexity over the long-term through forest management on federal and private lands.	TBD	within 15 yrs	ODEQ Rpt (2010 Table 4) For Ag DMA	$4700 / acre (w/o fence) $1100 / (w fence)	TBD	---	USFS, USBLM, NRCS, FSA, SWCD, counties, local governments, WS Councils, private landowners

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A LFT: 10b Key Factor: none Secondary Factor: CHS summer parr STW fry-summer parr	Strategy: 8 , via, Land Use Management to address issue of - Water Quality / Quantity / Hydrograph	101 - FW-ALL Priority: not specified	Support local governments to meet future water allocation and treatment needs, and stormwater management to minimize human population growth impacts on listed Chinook and steelhead.	1. (In coordination with supporting actions for LFT 9a) Focus future water rights on the mainstem Willamette, not on the over-allocated subbasins. 2. (In coordination with supporting actions for LFT 9a) Municipalities and counties develop and adopt BMP's and incentives for water conservation such as gray water use, low flow appliances, etc. 3. Improve stormwater management in municipalities and counties by enacting guidance developed by the Stormwater Solutions Team convened by the Oregon Environmental Council, or other tools.	undetermined	within 15 yrs	TBD	---	---	---	ODEQ, ODFW, local governments, private landowners
Listing Factor: A LFT: 10b Key Factor: none Secondary Factor: CHS summer parr STW fry-	Strategy: 8 , via, Land Use Management to address issue of - Water Quality / Quantity / Hydrograph	102 - FW-ALL Priority: 1	(In coordination with supporting actions for LFT 9a) Increase protection and implementation of appropriate instream flows for UWR salmonids by a) removing barriers to coordinating with relevant management agencies on water withdrawals, b) encouraging BMP's to conserve water and reduce pollution loads, and c) not issuing anymore water rights within subbasins.	1. Designate instream flow targets at the mouth of the tributaries (or other appropriate passage bottleneck) to ensure sufficient water is available for fish. 1.1. Planning Team subgroup to ID priority or problem reaches and future designation of target flows 1.2. ID process to get designation established 1.3. Encourage RME of flow needs for various life stages 2. OWRD to pass rules to enforce and protect stored	needs to be established; maybe be reach specific MO: Mouth of Molalla to confluence of NF Molalla, Trout Creek. Major water right holders include Cities of Molalla, Silverton, Canby CO: With	within 15 yrs	TBD	---	---	---	NRCS, OWRD, USBOR, USACE, ODFW, SWCD, Molalla Water Division, Freshwater Trust, Santiam Water Control District, Cities of Salem/Stayton, WS

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
summer parr				water released from USACE reservoirs for fish purposes, and ensure that water is not diverted by water users with natural water rights or by illegal water use. 3. Monitor diversions in real-time to ensure OWRD can enforce instream flows. 4. Restrict use of water rights during work windows to reduce impacts on spawners and rearing juveniles. 5. Revise integrated flow management or water diversion plan to ensure sufficient water remains instream for fish during critical periods. Plan should define coordination among the management agencies and users (USACE, USBOR, OWRD, ODFW, irrigation districts, and local water users). 5.1. ensure future USBOR water service contracts do not reduce instream flow protections. 5.2. USBOR water service contracts should allow for interruption of service during low water years to protect instream flows 5.3. release additional flows from storage dams to meet USBOR water service contracts while still meeting instream flows	CWC's partnership in the Willamette Model Watershed Program, focus of outreach and monitoring is Courtney Creek sub-basin and middle Calapooia River NS: Lower mainstem side channels (dewatered when juveniles are present)						Councils, landowners

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
				5.4. for non USBOR contracts, OWRD stop issuing new live flow rights 6. OWRD to complete conversion of Minimum Perennial Streamflows for stored water (in USACE/USBOR reservoirs) to instream water rights in NS, SSA, MK, and MF subbasins. 7. Promote voluntary flow restoration options with incentives. 7.1. ID "low hanging fruit" in problem areas 7.2. ID who will promote or develop these incentives 8. Purchase or lease strategic water rights							
Listing Factor: A LFT: 9a,c, h, i	Strategy: 8 , via, Land Use Management to address issue of - Water Quality / Quantity / Hydrograph	103 - FW-ALL Priority: 1	Work with ODEQ TMDL program (DMA Implementation Plans) to improve temperature and other water quality standards, to prioritize implementation on high priority CHS and STW areas. Also incorporate other reporting to ID other priority reaches for LFT's 9h and 9i (toxins and nutrients)	1. See other LFT's 9a and 9c (Temperature). 2. for toxins and nutrients, review relevant TMDL's for 303 (d) reaches, and other WQ reports to ID priority reaches. 3. for toxins, review Pesticides BiOp for effects, and USGS reports on reaches with high levels.	All subbasins and Mainstem Willamette	within TMDL WQMP timelines	TBD	---	---	---	ODEQ, Designated Management Agencies (DMA's)

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A LFT: 9a Key Factor: CHS summer parr for MO, NS, SSA, CA Secondary Factor: STW fry-summer parr; CHS summer parr for CM, MK, MF	Strategy: 8 , via, Land Use Management to address issue of - Water Quality / Quantity / Hydrograph	104 - FW-ALL Priority: not specified	Implement RME of headwater springs to investigate the concern that they may be drying up due to land management practices.	TBD	All subbasins	within 15 yrs	TBD	---	---	---	ODFW, OWRD
Listing Factor: A LFT: 9a	Strategy: 8 , via, Land Use Management to address issue of - Water Quality / Quantity / Hydrograph	105 - FW-ALL Priority: not specified	Inventory and protect seeps, springs, and other coldwater sources.	TBD	natal subbasins	within 15 yrs	TBD	---	---	---	WS Councils, ODFW, USFS, USBLM

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A LFT: 9, not specific	Strategy: 8 , via, Land Use Management to address issue of - Water Quality / Quantity / Hydrograph	106 - FW-ALL Priority: not specified	Limit future in-river and groundwater withdrawals so that they do not impede achievement of recovery goals.	TBD	ESU-wide	on-going	Baseline	---	---	N/A	OWRD, Legislature, Counties, Municipalities
								Sub Total		**$106,000,000**	
OC: Strategies and Actions focused on decreasing LFT's in the Ocean ALL: All populations											
Listing Factor: B.1 LFT: 11a, 11g adults	Strategy: 12 , via, Harvest Management to address issue of - Population Traits	107 - OC-ALL Priority: not specified	Implement the new Pacific Salmon Treaty (reduce ocean fisheries on Chinook).	TBD	ocean	on-going	Baseline	---	---	N/A	ODFW, PSC, WDFW
Listing Factor: B.1 LFT: 11a, 11g adults	Strategy: 12 , via, Harvest Management to address issue of - Population Traits	108 - OC-ALL Priority: not specified	Support mark-selective ocean fisheries when a new PST is negotiated in 10 years.	TBD	ocean	~2017	Baseline	---	---	N/A	ODFW, NMFS, WDFW

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
								Sub Total		$0	

MST: Strategies and Actions focused on decreasing LFT's in the Mainstem Willamette River
MST/SUB: Flow actions focused in subbasins to decrease LFT's in the Mainstem Willamette River for multiple populations

ALL: All populations
AMO: Actions for populations upstream of the Molalla River (NS, SSA, CA, MK, MF)

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A.2 LFT: 2n Key Factor: none Secondary Factor: none	Strategy: 4 , via, Flood Control / Hydropower to address issue of - Habitat access	109 - MST-ALL Priority: 3	Maintain safe passage of juvenile and adult Chinook and steelhead at Willamette Falls.	1. Ensure conditions for passage of juvenile and adult fish will remain adequate so that passage mortality does not become a concern in the future.	Sullivan Plant	on-going	Baseline	---	---	N/A	PGE

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A LFT: 8a Key Factor: CHS parr-smolt Secondary Factor: CHS parr-smolt STW parr-smolt	Strategy: 1, 2, 3, 4, 5, 6 , via, Land Use Management to address issue of - Physical Habitat Quality	110 - MST-ALL Priority: 2	Look for opportunities to remove unnecessary revetments or increasing setbacks in the Mainstem Willamette and in subbasins. Minimize new ones in the future.	1. For sites that were funded or placed by the USACE, the WP BiOp Action Agencies conduct assessment to identify high priority revetment through WP BiOp RPA 7.4, and fund restoration at these sites. 2. Replace revetment segments with bioengineering and natural features such as vegetation, and large wood structures.	First Priority: Modify or remove up to 43 miles of USACE revetments and with more natural bank treatments containing large wood, riparian vegetation, and altered slope. Other priority areas for revetment removal or setback are: 1) Eugene-Corvallis, 2) Albany-Salem.	within 15 yrs	TBD	---	---	---	USACE, NOAA, ODLCD, cities, counties, private landowners
Listing Factor: A LFT: 10c Key Factor: STW adult Secondary Factor: none	Strategy: 1, 5, 6, 7, 8 , via, Flood Control / Hydropower to address issue of - Water Quality / Quantity / Hydrograph	111 - MST-ALL Priority: 1	Release flows from WP dams and other storage dams to meet flow targets in mainstem Willamette River for rearing and migration.	1. Ensure sufficient spring flows to allow downstream migration of juveniles, including those in side channels. 2. Coordinate annual flow operations with ODFW and NMFS and other parties to optimize project operations for UWR ESU's, while meeting flood control and other mandatory project purposes.	At Albany: USACE proposed minimum and maximum flow objectives At Salem: USACE proposed minimum and maximum flow objectives	within 15 yrs	TBD	---	---	---	USACE

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A LFT: 8a Key Factor: CHS parr-smolt Secondary Factor: CHS parr-smolt STW parr-smolt	Strategy: 1, 2, 3, 4, 5, 6 , via, Land Use Management to address issue of - Physical Habitat Quality	112 - MST-AMO Priority: 1	Restore structure and function to strategic natural riparian reaches in the mainstem Willamette River	1. Develop a prioritization framework and ID strategic reaches specific to UWR salmonids by collating work from several sources, including the Willamette River Basin Planning Atlas (Hulse et al. 2002), TNC Synthesis Mapping, Willamette Subbasin Plan (WRI 2004), WATER HTT selection process, ODEQ 303 (d) reaches, and others. Some principles include: - integrating project "reach" objectives to larger basin scale objectives - focus on spatial strategies that link coldwater refugia for salmonids. - look for opportunities to reconnect river reaches with remnant gravel pits. - increase short term aquatic habitat complexity by increasing the amount of large wood, boulders, or other structures at appropriate locations. - increase long term channel complexity, floodplain connectivity, and flood storage capacity by restoring riparian structure and function, and reconnecting main channel to side-channels, wetlands and other floodplain features. - look for reaches where there is opportunities to expand riparian width and increase shading in areas	Emphasize restoration in already identified "candidate focal areas" by the Willamette Planning Atlas in the area around Harrisburg (e.g. Harkens Lake).	Within 15 yrs	TBD	---	---	---	NRCS, FSA, USACE, OWEB, ODFW, OPRD, SWCD, land trusts, WR, NGOs, Private landowners, WS Councils

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
				that have been degraded by human actions. - focus on areas where other plans or programs have implementation plans (example: TMDL plans) that would also ameliorate efforts to restore function. 2. Plant, protect, maintain, and restore native riparian vegetation using combination of setbacks, easements, or acquisition. 3. Provide meaningful financial incentives to landowners for riparian protection (e.g. increase Oregon's tax credit)							

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quanti ty	Total Cost	Key Entities / Potential Implement ers
Listing Factor: A LFT: 8a	Strategy: 1, 2, 3, 4, 5, 6 , via, Land Use Managemen t to address issue of - Physical Habitat Quality	113 - MST-AMO Priority: 1	Increase overall channel complexity, floodplain connectivity, and flood storage to the mainstem Willamette River to increase and improve salmonid rearing and migration habitat.	1. Work with regional federal and state entities to resolve larger issues related to future increased channel meandering and the factors that inhibit it now. 2. Use multiple analytical and planning sources to ID the type of projects and reaches where restoration success will be high. 3. Find opportunities within these priority reaches with willing landowners by offering economic incentives, conservation easements, leases, or acquisition. Provide technical assistance and analyses on risks and benefits to landowners.	Priority reaches in Willamette Planning Atlas for increasing channel complexity, flood water storage, and floodplain forest restoration are 1) Eugene-Corvallis, 2) mouth of the Santiam River, 3) Salem-Newburg.	within 15 yrs	TBD	---	---	---	NRCS, FSA, USACE, OWEB, ODFW, SWCD, land trusts, WR NGOs, WS Councils, private landowners
Listing Factor: A LFT: 8a	Strategy: 1, 2, 3, 4, 5, 6 , via, Land Use Managemen t to address issue of - Physical Habitat Quality	114 - MST-AMO Priority: 1	Protect existing highest quality salmonid rearing and migration habitats through conservation measures, acquisition, and/or regulation.	1. Increase floodplain and riparian vegetation, and reduce development in existing functional riparian/ floodplain vegetation. 1.1. restrict new floodplain development with impervious surfaces unless water quality treatment and runoff volume reduction are addressed with stormwater treatments 2. Encourage cities/counties to adopt zoning regulations that provide setbacks from streams to protect riparian habitat and to restrict new floodplain development.	TBD	within 15 yrs	TBD	---	---	---	NMFS, NRCS, FSA, OWEB, USACE, ODFW, ODLCD, OPRD, SWCD, , land trusts, NGOs, counties, cities, Private landowners, WS Councils

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
				2.1. adopt ODLCD Goal 5 land use planning guidelines							
Listing Factor: A LFT: 8a	Strategy: 1, 2, 3, 4, 5, 6 , via, Land Use Management to address issue of - Physical Habitat Quality	115 - MST-AMO Priority: 1	Consistently apply BMP's and existing regulations to protect and conserve natural ecological processes, with a focus on those that affect UWR CHS and STW and the LFT's identified in this Recovery Plan.	1: ID any constraints or coordination issues that limit full protective intent of BMP's and regulations. 1.1. specify which BMP's are not being consistently applied and under what conditions 1.2. determine and correct impediments to implementation of BMP's	ESU-wide	within 15 yrs	TBD	---	---	---	Federal, state, local governments and private landowners

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A LFT: 8a	Strategy: 1 , via, Land Use Management & Flood Control / Hydropower to address issue of - Physical Habitat Quality	116 - MST-AMO Priority: 1	Protect and restore aquatic habitat function at confluence areas of Willamette River tributaries.	1. Prioritize some BPA funding of the WP BiOp habitat restoration projects (WATER HTT) to these areas. See WP-RPA's 7.1.2 and 7.1.3. 2: Identify other funding or coordination opportunities so that restoration at confluence sites is substantial enough to provide meaningful ecological benefits to anadromous fishes.	Willamette mainstem	within 15 yrs	Baseline	---	---	N/A	NRCS, FSA, USACE, OWEB, ODFW, OPRD, SWCD, land trusts, WR, NGOs, private landowners, WS councils
Listing Factor: A LFT: 8a	Strategy: 1, 2, 3, 4, 5, 6 , via, Land Use Management to address issue of - Physical Habitat Quality	117 - MST-AMO Priority: 3	Use road and bridge fluvial performance standards that allow free passage of fish, sediment, and flows in the Mainstem Willamette River and subbasins.	TBD	ESU-wide	within 15 yrs	TBD	---	---	---	ODOT, FHWA

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A LFT: 9h Key Factor: multiple populations and life stages; refer to population-specific LFT tables in CH 5 Secondary Factor: multiple populations and life stages; refer to population-specific LFT tables in CH 5	Strategy: 8 , via, Land Use Management to address issue of - Water Quality / Quantity / Hydrograph	118 - MST-ALL Priority: 2	Implement and evaluate the effectiveness of the "Agricultural Water Quality Management Area Rules" (SB 1010 plans) for the mainstem Willamette River and subbasins.	1. Monitor at appropriate scale to evaluate the sufficiency of these plans to reduce erosion and other stated objectives. 2. ID known problem areas and pursue getting them fixed, especially if near salmon and steelhead production areas. 2.1. enforce set back requirements where fields are adjacent to river	ESU-wide	on-going	Baseline	---	---	N/A	DMA's, NRCS, ODEQ, ODA, SWCD, private landowners

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A LFT: 9h	Strategy: 8 , via, Land Use Management to address issue of - Water Quality / Quantity / Hydrograph	119 - MST-AMO Priority: 1	(see other actions involving TMDL's) Support implementation plans associated with TMDL compliance and focus salmonid habitat restoration efforts in those reaches where other LFT's are being improved and productivity can be restored	TBD	ESU-wide	on-going	Baseline	---	---	N/A	ODEQ, ACWA, private landowners, local governments
Listing Factor: A LFT: 10d Key Factor: CHS fry-winter parr Secondary Factor: none	Strategy: 1, 5, 6, 7, 8 , via, Land Use Management to address issue of - Water Quality / Quantity / Hydrograph	120 - MST/SUB-AMO Priority: 1	Evaluate the potential for releasing habitat-forming flows from WP Project storage dams to complement habitat restoration activities in the mainstem Willamette River.	1. WP BiOp RPA 2.7; Work through WATER Flow Management Team to identify opportunities to provide environmental pulse flows that can create new and sustain existing fish habitat in the lower subbasins and the mainstem Willamette River 1.1. these types of flows may not be met in low flow years, so evaluate the likely occurrence and magnitude of these flows. 2. Complete The Nature Conservancy's Sustainable Rivers study process. 2.1. implement and evaluate the study recommendations in Coast Fork and Middle Fork, and conduct similar Nature Conservancy studies in other subbasins where flows have been significantly modified	above Willamette Falls	Type 1 flows: MF 2009 other schedules dependant upon WATER Flow Team	Baseline	---	---	N/A	USACE, Nature Conservancy
								Sub Total		**$0**	

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quanti ty	Total Cost	Key Entities / Potential Implement ers
SUB: Strategies and Actions focused on decreasing LFT's in subbasins ALL: All populations CM: Clackamas; MO: Molalla; NS: North Santiam: SSA: South Santiam: SAN: North and South Santiam STW populations; CA: Calapooia; MK: McKenzie; MF: Middle Fork Willamette; SSB: all STW subbasins											
Listing Factor: A.2 LFT: 2a Key Factor: none Second ary Factor: STW fry-adult	Strategy: 4 , via, Land Use Managemen t to address issue of - Habitat access	121 - SUB -ALL Priority: 2	ODFW District staff lead the coordination and updating of ODFW's Fish Passage Program database to document status of remaining high priority barriers or passage problem areas.	1. Objective is to identify and fix ESU-specific "high priority" fish passage impediments, with priority projects being those where success is high for restoring STW spawning and rearing capacity and productivity into productive areas above barriers. 1.1. continue to coordinate with WS Councils and other subbasin entities to update, refine, and expand fish passage assessments 1.1.1. ID funding constraints or other factors that limit WS Council participation 1.1.2. develop partnerships and funding opportunities for small private landowners to improve passage in high priority areas 2. Ensure the database is available and useable to municipalities, counties, and state and federal agencies to inform their passage prioritization processes.	CA: middle CA subbasin assessment complete (2004 Calapooia WS Council); used by ODFW and Linn Co. Road Dept. SSA: The SSA and NS WS Councils have worked with OSU to assess and prioritize passage barriers. The SSA WS Council has a list of ~40 to date, within which a prioritization process is established	on-going	Baseline	---	---	N/A	ODFW, ODF, ODOT, WS Councils, private landowners, local government s

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A LFT: 8a Key Factor: CHS winter parr STW winter parr Secondary Factor: CHS fry-summer parr	Strategy: 1, 2, 3, 4, 5, 6 , via, Land Use Management to address issue of - Physical Habitat Quality	122 - SUB -ALL Priority: 1	Pursue development of a cooperative agreement or habitat conservation plan with land owners to further protect fish habitat in the future.	1. Evaluate the utility of a Habitat Conservation Plan, or something similar.	above Willamette Falls	within 15 yrs	TBD	---	---	---	Private landowners, OWEB, ODFW, SWCD
Listing Factor: A LFT: 8a	Strategy: 1, 3, 4, 8, 9 , via, Land Use Management to address issue of - Physical Habitat Quality & Water Quality / Quantity / Hydrograph	123 - SUB -ALL Priority: 1	Protect and restore headwater rivers and streams (salmon and non-salmon bearing) to protect the sources of cool, clean water and normative hydrologic conditions.	TBD	upper reaches in natal subbasins	within 15 yrs	TBD	---	---	---	WS Councils, ODFW, ODF, ODSL, OWRD, ODA, USFS, Counties, Municipalities

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A LFT: 9a Key Factor: CHS summer parr for MO, NS, SSA, CA Secondary Factor: STW fry-summer parr; CHS summer parr for CM, MK, MF	Strategy: 8 , via, Land Use Management to address issue of - Water Quality / Quantity / Hydrograph	124 - SUB -ALL Priority: 1	Evaluate allocation policies and legal and illegal water withdrawals, and look for opportunities to keep more water instream.	1. OWRD evaluate their policy regarding whether a basin is over-allocated or under-allocated. - Policy should protect instream flows by accounting for fish and/or reflect a smaller HUC size - Protection is limited if instream rights are junior to other rights 1.1. identify and implement flow improvements 2. Ensure future USBOR water service contracts do not reduce instream flow protections. 2.1. USBOR water service contracts should allow for interruption of service during low water years to protect instream flows 2.2. release additional flows from storage dams to meet USBOR water service contracts while still meeting instream flows 2.3. ID priority areas for increased instream flows 3. Eliminate illegal water withdrawals. 3.1. ID constraints to enforcing illegal withdrawals, and fix them 3.1.1. increase reporting of violations-fishing guides, citizen groups 3.1.2. increase enforcement capabilities 3.2. consider flow monitoring program to	All subbasins and Mainstem Willamette	within 15 yrs	Baseline	---	---	N/A	OWRD, SWCD, ODFW, USBLM, Private landowners, interest groups, WS Councils, Freshwater trusts

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
				assure that flow from leased water rights is not used by holders of junior rights 4. Evaluate existing rights for conservation outreach opportunities 4.1. explore options with landowners along selected tributaries for leasing their water rights to the State to have more water in the stream during summer for fish - focus leasing options on cooler streams with higher quality habitat							
Listing Factor: A LFT: 9a	Strategy: 8 , via, Land Use Management to address issue of - Water Quality / Quantity / Hydrograph	125 - SUB -ALL Priority: 1	Support the funding and implementation of Water Quality Management Plans (TMDL Implementation Plans) of Designated Management Agencies (DMA's) to meet their objective of restoring riparian vegetation as part of a larger strategy to restore and protect streams.	1 Expand cool water zones within the Willamette River mainstem and tributary reaches in the lower subbasins by meeting TMDL temperature load allocations for approved TMDL's (see ODEQ Willamette basin and Molalla basin TMDL reports). 1.1. conduct analysis to ID strategic and priority reaches for the purposes of this Recovery Plan and specific LFT's 1.1.1 provide resources to conduct this analysis, then fund and fix these reaches first 2. Increase amount of riparian forest buffer to improve shading function, and restore hyporheic function and capacity. 2.1. protect and restore	ODEQ 303 (d) temperature reaches: MO: -Lower Molalla Mainstem (mouth to Henry Creek), Table Rock Fork, Pudding River	within TMDL WQMP timelines	Baseline ODEQ Rept 2010 (Average Method, Table 16 = $902,666,575) To fund priority review Expert Opinion $100,00	---	---	100000	NRCS, FSA, ODEQ, OWEB, SWCD, DMA's

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
				extensive vegetative riparian shade buffers in lower subbasins. 2.1.1. use fencing, weed control, and planting of native conifers and other species at appropriate sites 2.2. increase conservation easements through incentive programs or land retirement programs (CREP) throughout subbasins 3. Evaluate further the extent to which gravel augmentation or channel reconnection will increase hyporheic capacity. 4. Examine feasibility of building greater water retention capacity with side channel reservoirs to augment summer flows. 5. Assure through separate actions that instream flows are protected and that future allocations do not increase summer water temperatures.							
Listing Factor: A.2 LFT: 1a Key Factor: CHS smolts	Strategy: 4 , via, Flood Control / Hydropower to address issue of - Habitat access	126 - SUB -CM Priority: not specified	Provide / improve fish passage in Clackamas subbasin tributaries.	TBD	Miller Crk confluence, Tryon Crk-Highway 43 Culvert, Clear Crk, Deep Crk, Johnson Crk	within 15 yrs	Expert Opinion (from OrLCR Plan)	$2,500,000 / site	5 sites	12500000	ODFW, ODOT

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Secondary Factor: none											
Listing Factor: A.2 LFT: 1a Key Factor: CHS smolts Secondary Factor: none	Strategy: 4 , via, Flood Control / Hydropower to address issue of - Habitat access	127 - SUB -CM Priority: not specified	Implement all measures in the Clackamas River Hydroelectric Project (FERC Project No. 2195) Fish Passage and Protection Plan, including measures for downstream fish passage (3% or less mortality at River Mill and North Fork dams), Oak Grove Mitigation and improvements to North Fork fish ladder/trap.	TBD	PGE's Clackamas R Hydroelectric Project	within 15 yrs	Baseline	---	---	N/A	ODFW, PGE
Listing Factor: A LFT: 8a	Strategy: 1, 2, 3, 4, 5, 6 , via, Land Use Management to address issue of - Physical Habitat Quality	128 - SUB -CM Priority: not specified	Breach, lower, remove, or relocate dikes and levees to establish or improve access to off-channel habitats; vegetate dikes and levees.	TBD	Columbia Slough; Joslin Property	within 15 yrs	Expert Opinion (from OrLCR Plan)	---	---	3300000	WS Councils, ODFW, City of Portland, Metro

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A LFT: 8a	Strategy: 1, 2, 3, 4, 5, 6 , via, Land Use Management to address issue of - Physical Habitat Quality	129 - SUB -CM Priority: not specified	Review land use plans in context of salmon recovery needs (i.e., forest lands of higher value to salmon recovery than urbanized lands).	TBD	Eagle Crk; Clear Crk; mainstem Clackamas R -- R Mill Dam to Goose Crk; mainstem Clackamas R -- R Mill Dam to Abernathy Crk; Deep Crk; Johnson Cr	within 15 yrs	Baseline	---	---	N/A	ODFW, ODLCD, USFS, Counties, City of Portland, Metro, Municipalities
Listing Factor: A LFT: 8a	Strategy: 1, 2, 3, 4, 5, 6 , via, Land Use Management to address issue of - Physical Habitat Quality	130 - SUB -CM Priority: not specified	Finish Clackamas Fish Habitat Analysis.	TBD	subbasin-wide	within 15 yrs	TBD	---	---	---	WS Councils, ODFW, USFS

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A LFT: 8a	Strategy: 1, 2, 3, 4, 5, 6 , via, Land Use Management to address issue of - Physical Habitat Quality	131 - SUB -CM Priority: not specified	Protect remaining high-quality off-channel habitat from degradation.	TBD	Priority urban areas in lower watershed; Cathedral Park; Centennial Mills; Johnson Crk confluence; Columbia Slough; Johnson Crk confluence; Linnton Neighborhood; Saltzman Crk; Willamette Cove; Forest Park area; Stephens Crk confluence	within 15 yrs	TBD	---	---	---	WS Councils, ODFW, ODSL, Counties, City of Portland, Metro, Municipalities
Listing Factor: A LFT: 8a	Strategy: 1, 2, 3, 4, 5, 6 , via, Land Use Management to address issue of - Physical Habitat Quality	132 - SUB -CM Priority: not specified	Restore or create off-channel habitat and/or access to off-channel habitat: side channels.	TBD	TBD	within 15 yrs	Calculated	$330,000 / mi	114 miles	37620000	WS Councils, ODFW, NRCS, SWCD, City of Portland, Metro

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A LFT: 8a	Strategy: 1, 2, 3, 4, 5, 6 , via, Land Use Management to address issue of - Physical Habitat Quality	133 - SUB -CM Priority: not specified	Restore or create off-channel habitat and/or access to off-channel habitat: alcoves, wetlands, and floodplains. - Restoration includes revegetation.	TBD	Linnton Neighborhood; Owens-Corning Banks and Floodplain; Ross Island; Swan Island lagoon; Columbia Slough confluence; Ramsey lake wetland; Tryon Slough confluence; Powerline Corridor; Forest Park area; Kelley Point Park; Miller Crk confluence; Oaks Bottom Wildlife Refuge; West Hayden Island; Willamette Cove; Willamette Park; Cathedral Park; Centennial Mills; Johnson Crk confluence; Saltzman Crk; watershed-wide	within 15 yrs	Calculated	$53/m2	34,738 m2	1841114	WS Councils, ODFW, NRCS, SWCD, PGE, City of Portland, Metro

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A LFT: 8a	Strategy: 1, 2, 3, 4, 5, 6 , via, Land Use Management to address issue of - Physical Habitat Quality	134 - SUB -CM Priority: not specified	Improve or regrade/revegetate streambanks.	TBD	Linnton Neighborhood; Oaks Bottom Wildlife Refuge; Owens-Corning Banks and Floodplain; Swan Island lagoon; Tryon Cr confluence; West Hayden Island; Willamette Cove; Willamette Park; Balch Cr confluence; Cathedral Park	within 15 yrs	TBD	---	---	---	ODFW, Counties, City of Portland, Metro, Municipalities

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A LFT: 8a	Strategy: 1, 2, 3, 4, 5, 6 , via, Land Use Management to address issue of - Physical Habitat Quality	135 - SUB -CM Priority: not specified	Protect intact and functioning riparian areas through riparian easements and acquisition	TBD	Eagle Crk; Clear Crk; mainstem Clackamas R (River Mill Dam to Goose Crk, R Mill Dam to Abernathy Cr); tributaries below R Mill Dam; Deep Crk; Johnson Crk; Forest Park area; Willamette R; West Hayden Island	within 15 yrs	Expert Opinion (from OrLCR Plan)	---	---	7500000	WS Councils, ODFW, OWEB, ODSL, USFS, NRCS, SWCD, City of Portland, Metro
Listing Factor: A LFT: 8a	Strategy: 1, 2, 3, 4, 5, 6 , via, Land Use Management to address issue of - Physical Habitat Quality	136 - SUB -CM Priority: not specified	Restore (plant and/or fence) and protect (conservation easements, acquisition) riparian areas that are degraded.	TBD	Eagle Crk; Clear Crk; mainstem Clackamas R (River Mill Dam to Goose Crk, R Mill Dam to Abernathy Cr); tributaries below R Mill Dam; Deep Crk; Johnson Crk; Forest Park area; Willamette R; West Hayden Island	within 15 yrs	Calculated	$330,000 / mi (with fence); $310,000 / mi (without fence)	8 miles (with fence); 54 miles (without fence)	19380000	WS Councils, ODFW, OWEB, ODSL, NRCS, SWCD, City of Portland

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A LFT: 8a	Strategy: 1, 2, 3, 4, 5, 6 , via, Land Use Management to address issue of - Physical Habitat Quality	137 - SUB -CM Priority: not specified	Annually place 8,000 yd3 of spawning sized gravel below River Mill Dam as per FERC settlement agreement.	TBD	Mainstem Clackamas R below R Mill Dam	within 15 yrs	Baseline	---	---	N/A	PGE
Listing Factor: A LFT: 8a	Strategy: 1, 2, 3, 4, 5, 6 , via, Land Use Management to address issue of - Physical Habitat Quality	138 - SUB -CM Priority: not specified	Utilize the Clackamas Hydroelectric Project Mitigation and Enhancement Fund to provide for habitat mitigation and enhancements in the Clackamas Basin.	TBD	subbasin-wide	within 15 yrs	Baseline	---	---	N/A	ODFW, PGE
Listing Factor: A LFT: 8a	Strategy: 1, 2, 3, 4, 5, 6 , via, Land Use Management to address issue of - Physical Habitat Quality	139 - SUB -CM Priority: not specified	Restore instream habitat complexity, including large wood placement (mitigate for loss of spring Chinook habitat complexity due to Clackamas hydropower dams).	TBD	High intrinsic potential rearing areas for spring Chinook; subbasin-wide	within 15 yrs	TBD	---	---	---	ODFW, PGE, City of Portland

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A LFT: 8a	Strategy: 1, 2, 3, 4, 5, 6 , via, Land Use Management to address issue of - Physical Habitat Quality	140 - SUB -CM Priority: not specified	Restore instream habitat complexity, including large wood placement.	TBD	Johnson Crk confluence; Tryon Crk confluence; Eagle Crk; Clear Crk; mainstem Clackamas R -- R Mill Dam to Goose Crk; mainstem Clackamas R -- R Mill Dam to Abernathy Crk; Johnson Cr)	within 15 yrs	Calculated	$80,000 / mi	192 miles	15360000	WS Councils, ODFW, USFS, NRCS, SWCD, PGE, Metro
Listing Factor: A LFT: 8a	Strategy: 1, 2, 3, 4, 5, 6 , via, Land Use Management to address issue of - Physical Habitat Quality	141 - SUB -CM Priority: not specified	Daylight stream.	TBD	lower Doane Crk/Railroad Corridor; lower Saltzman Crk, Centennial Mills	within 15 yrs	TBD	---	---	---	City of Portland
Listing Factor: A LFT: 8a	Strategy: 1, 2, 3, 4, 5, 6 , via, Land Use Management to address issue of - Physical Habitat	142 - SUB -CM Priority: not specified	Create confluence habitat with cool water, restore channel and reconnect upper creek.	TBD	Doane Crk/Railroad Corridor; Saltzman Crk	within 15 yrs	TBD	---	---	---	ODFW

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
	Quality										
Listing Factor: A LFT: 8a	Strategy: 1, 2, 3, 4, 5, 6 , via, Land Use Management to address issue of - Physical Habitat Quality	143 - SUB -CM Priority: not specified	Reconnect tributary to Willamette River and create high quality habitat at tributary junction.	TBD	Historical Swan Island channel; Saltzman Crk; Miller Crk confluence	within 15 yrs	TBD	---	---	---	ODFW

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A LFT: 7i Key Factor: none Secondary Factor: CHS egg-alevin	Strategy: 1, 2, 5, 6 , via, Flood Control / Hydropower to address issue of - Physical Habitat Quality	144 - SUB -CM Priority: not specified	(similar to LFT 7f [MF] and 7e [MK]) Within authority of current FERC license, increase retention and sourcing of gravels and other materials below PGE facilities with a combination of habitat improvements, targeted flows, and augmentation.	1. Improve channel complexity below dams with existing habitat restoration and enhancement program on PGE lands. 2. Augment depleted areas below dams with most appropriate source and size composition. 2.1. provide appropriate channel complexity to retain material. 3. Prioritize some projects within the comprehensive habitat restoration program to include projects that improve incubation habitat. 4. Implement to collect large wood in PGE reservoirs, and strategically promote placement of this wood in areas below dams that promote sourcing of incubation gravels. 5. Couple these improvements with pulse flows to distribute gravel and other materials.	lower subbasin	see FERC agreement	---	---	---	---	PGE

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A LFT: 9a Key Factor: CHS summer parr for MO, NS, SSA, CA Secondary Factor: STW fry-summer parr; CHS summer parr for CM, MK, MF	Strategy: 8 , via, Land Use Management to address issue of - Water Quality / Quantity / Hydrograph	145 - SUB -CM Priority: not specified	Establish minimum ecosystem-based instream flows.	TBD	Johnson Crk	within 15 yrs	TBD	---	---	---	ODFW, OWRD
Listing Factor: A LFT: 8a	Strategy: 8 , via, Land Use Management to address issue of - Water Quality / Quantity / Hydrograph	146 - SUB -CM Priority: not specified	Reduce impact that roads have on impaired hydrograph.	TBD	upper Clackamas and Collawash rivers	within 15 yrs	TBD	---	---	---	WS Councils, ODFW, USFS, Counties, City of Portland, Municipalities

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A LFT: 9k Key: none Secondary: CHS summer parr, adults	Strategy: 1, 5, 6, 7, 8 , via, Flood Control / Hydropower to address issue of - Water Quality / Quantity / Hydrograph	147 - SUB -CM Priority: not specified	Implement all water quality and hydrograph measures in the Clackamas River Hydroelectric Project (FERC Project No. 2195) Fish Passage and Protection Plan.	TBD	lower subbasin	see FERC agreement	---	---	---	---	PGE
Listing Factor: E.1 LFT: 3a Key Factor: CHS and STW adult Secondary Factor: none	Strategy: 4, 13 , via, Hatchery Management to address issue of - Population Traits	148 - SUB -CM Priority: not specified	Maintain existing wild fish sanctuary.	1. Sort fish at North Fork Dam.	upper subbasin	on-going	Baseline	---	---	N/A	ODFW, PGE
Listing Factor: E.1 LFT: 3a Key Factor: CHS adult Second	Strategy: 4, 13 , via, Hatchery Management to address issue of - Population Traits	149 - SUB -CM Priority: not specified	Operationally open the hatchery trap for a longer period.	TBD	Eagle Crk Nat'l Hatchery	within 15 yrs	Expert Opinion (from OrLCR Plan)	$20,000 / yr	25 yrs	500000	ODFW, USFWS

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
ary Factor: none											
Listing Factor: A, C, and D LFT: not specified	Strategy: not specified , via, not defined to address issue of - Other species	150 - SUB -CM Priority: not specified	(Purchase a freezer trailer to aid the logistical disposition to carcass placement, tribes, and food banks if program is maintained).	TBD	Eagle Crk Nat'l Hatchery	within 15 yrs	Expert Opinion (from OrLCR Plan)	$5,000 / unit	1 unit	5000	ODFW, USFWS
Listing Factor: A.2 LFT: 2a Key Factor: none Secondary Factor: STW fry-adult	Strategy: 4 , via, Land Use Management to address issue of - Habitat access	151 - SUB -MO Priority: 1	Improve known high priority STW passage impediments in the Molalla subbasin	1. Improve the entrance to the fish ladder at City of Silverton's water diversion on Abiqua Creek and evaluate effectiveness. 2. Where ladders exist in the subbasin, evaluate their effectiveness consistent with established standards. 3. Fix known unscreened diversions. 4. Where culverts in the subbasin are known to restrict juvenile access to juvenile rearing habitat, work with appropriate entity to replace or improve culvert.	1: Abiqua Creek 2: Butte, Abiqua, Silver creeks 3: mainstem Molalla (Shady Cove), Labish Ditch	within 15 yrs	Expert Opinion	$2,500,000 / site	3 sites	7000000	NRCS, other entities

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A LFT: 8a Key Factor: CHS winter parr STW winter parr Secondary Factor: CHS fry-summer parr	Strategy: 1, 2, 3, 4, 5, 6 , via, Land Use Management to address issue of - Physical Habitat Quality	152 - SUB -MO Priority: 1	Identify priority reaches in Molalla subbasin where habitat restoration projects can be implemented and monitored.	1. Develop a prioritization framework and ID strategic reaches specific to UWR salmonids by collating work from several sources, including the Willamette Subbasin Plan (WRI 2004), WS Council Action Plans, watershed assessments, ODEQ 303 (d) reaches, and others. 2. Provide meaningful financial incentives to landowners (e.g. increase Oregon's tax credit) in priority locations to implement riparian protection and habitat improvement projects. 2.1. advertise ODFW's Wildlife Habitat Conservation and Management Program (WHCMP) and Riparian Tax Incentive Program (RTIP) 2.2. Explore other opportunities to acquire setbacks, easements, or acquisition. 3. Implement priority projects. 3.1. initiate restoration by increasing instream habitat complexity, including use of large wood and other strategies 3.2. provide for long-term restoration by planting, protecting, maintaining, and restoring native riparian vegetation	Mouth of Molalla to confluence of NF Molalla, Focus reaches include: Table Rock Fork to Cooper Creek, Copper Creek to Henry Creek, Pine Creek to Table Rock Fork, Glen Avon Bridge to Pine Creek	within 15 yrs	TBD	---	---	---	Private landowners, USBLM, Molalla River Watch, Molalla River Stewards, OWEB, ODFW, SWCD

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quanti ty	Total Cost	Key Entities / Potential Implement ers
Listing Factor: A LFT: 8a	Strategy: 1, 2, 3, 4, 5, 6 , via, Land Use Managemen t to address issue of - Physical Habitat Quality	153 - SUB -MO Priority: 1	Reconnect floodplains to channels.	1. Within the Molalla mainstem, reconnect side channels and off-channel habitats to stream channels. 2. Use outreach to encourage cities and county to not approve development in known floodplains.	Focus on mouth of Molalla to confluence of NF Molalla, with focus groups being non-forest age landowners that comprise the majority ownership here	within 15 yrs	Calculated	$330,000 / mi	TBD	---	USBLM, Molalla River Watch, Molalla River Stewards, OWEB, ODFW, SWCD, Private landowners
Listing Factor: A LFT: 8b Key Factor: CHS adult Second ary Factor: none	Strategy: 1, 2, 3, 4, 5, 6 , via, Land Use Managemen t to address issue of - Physical Habitat Quality	154 - SUB -MO Priority: 1	Reduce harassment of adult spring Chinook while they are holding during the summer.	1. Determine where the problems exists. 1.1. work with appropriate entities to reduce interaction by limiting access, increasing enforcement, and increasing public awareness 2. Increase law enforcement in the Molalla River Recreation Corridor. 3. Continue and increase public outreach and education. 3.1. increase signage on the river 3.2. work with Trout Creek landowners to minimize impacts at Trout Creek	upper subbasin	on-going	---	---	---	---	OSP, ODFW, Molalla River Watch, Molalla River Stewards

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A LFT: 9c	Strategy: 8 , via, Land Use Management to address issue of - Water Quality / Quantity / Hydrograph	155 - SUB -MO Priority: 1	Improve summer water quality of headwater areas for oversummering Chinook by implementing sufficient riparian buffers .	1. ID strategic areas in coordination with actions for LFT 9a, but focus on problem areas in upper subbasin.	upper subbasin	within 15 yrs	TBD	---	---	---	ODEQ, OWEB, ODFW, ODF, SWCD, USBLM, Molalla River Watch, Molalla River Stewards, Private landowners
Listing Factor: E.1 LFT: 3a Key Factor: CHS and STW adult Secondary Factor: none	Strategy: 4, 13 , via, Hatchery Management to address issue of - Population Traits	156 - SUB -MO Priority: 1	Reform the existing harvest augmentation hatchery CHS program (non-local stock) into separate augmentation and conservation programs. (See Molalla Reintroduction proposal, Appendix E)	1. Evaluate how to implement a new hatchery Program. 2. After Recovery Plan adoption, develop new HGMP for this new program that specifies goals and objectives of the program.	subbasin-wide	within 15 yrs	TBD	---	---	---	ODFW, Molalla River Stewards, Native Fish Society

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A.2 LFT: 1d Key Factor: CHS smolt STW smolt Secondary Factor: none	Strategy: 4 , via, Flood Control / Hydropower to address issue of - Habitat access	157 - SUB -NS Priority: 1	Implement WP-RPA's 4.12.3 and 4.13 to provide safe and effective downstream passage through Detroit reservoir and Detroit and Big Cliff dams for juveniles and kelts.	1: Study conceptual alternatives for downstream passage through dam complex and fish distribution in reservoir(s). 1.1. based on studies and design alternatives, construct and operate new downstream fish passage facility by 2023 or sooner	Detroit/Big Cliff complex	Major Milestone go/no go decision: Complete construction: Operation: 2023	WP BiOP	---	---	N/A	WP BiOp action agencies
Listing Factor: A.2 LFT: 2a Key Factor: none Secondary Factor: STW fry-adult	Strategy: 4 , via, Land Use Management to address issue of - Habitat access	158 - SUB -NS Priority: 2	Work with and assist landowners with grants, funding, and design to screen the known water diversions.	TBD	1: Salem Ditch / Mill Creek 2: Rock Creek 3: Sydney Ditch	immediate	TBD	---	---	---	1: City of Salem, Santiam Water Control District 2: NRCS, NSWCouncil 3: Sidney Ditch Cooperative, ODFW

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A.2 LFT: 2a Key Factor: none Secondary Factor: STW fry-adult	Strategy: 4 , via, Land Use Management to address issue of - Habitat access	159 - SUB -NS Priority: 2	As needed, evaluate effectiveness of success of upstream passage of adults at the Salem Ditch / Mill Creek headgate structure.	Comments: The City of Salem invested between $700-$800 K in fish screening for the Mill Race and fish passage improvements to Waller Dam in 2004. What more is currently needed for Waller Dam?	Salem Ditch/Mill Creek	on-going	---	---	---	---	Santiam Water Control District, ODFW
Listing Factor: A.2 LFT: 2a Key Factor: none Secondary Factor: STW fry-adult	Strategy: 4 , via, Land Use Management to address issue of - Habitat access	160 - SUB -NS Priority: 2	Evaluate juvenile fish passage efficiency at the Mill Creek millrace diversion dam and modify the existing fishway if necessary.	TBD	Mill Creek	within 15 yrs	TBD	---	---	---	City of Salem, ODFW

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A.2 LFT: 2b Key Factor: CHS adult STW adult Secondary Factor: none	Strategy: 4 , via, Flood Control / Hydropower to address issue of - Habitat Access	161 - SUB -NS Priority: 1	(see relation to LFT 2k) Reduce pre-spawn mortality by reducing injury and stress related to fish handling at and above USACE facilities.	1. WP-RPA 4.6 to rebuild, operate, and maintain the Minto Adult Fish Collection and handling facility below Big Cliff Dam for expanded and improved sorting and handling of wild and hatchery fish. 1.1. support objective WP-RPA 4.6 with other RPA's 1.1.1. implement WP-RPA's 4.3, 4.4, and 4.5 to improve and standardize handling and transport protocols 1.1.2. implement WP- RPA 4.7 to improve and increase the number of suitable outplanting sites above Detroit Dam. 1.2. assess through RME whether these show demonstrable improvement	Detroit/Big Cliff complex	RPA 4.6: Completion date 2012, begin operation in March 2013	WP BiOP	---	---	N/A	WP BiOp action agencies, ODFW

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quanti ty	Total Cost	Key Entities / Potential Implement ers
Listing Factor: A.2 LFT: 2b Key Factor: CHS adult STW adult Second ary Factor: none	Strategy: 4 , via, Flood Control / Hydropower to address issue of - Habitat Access	162 - SUB -NS Priority: 1	Until downstream passage facilities are completed and have demonstrated safe and timely passage, supplement natural production in the subbasin by implementing the interim trap-and-haul measures described in the 2008 WP BiOp to outplant adult fish into historical habitat above the Big Cliff/Detroit flood control/hydropower complex.	1. Continue to implement and evaluate the experimental Outplant Program (described in WP-RPA 4.1), using hatchery fish to seed habitat above Detroit Dam, and evaluate outplant strategies and levels relative to best way to transition to a more formal reintroduction program using only NOR fish. 2. Based on Outplant evaluation studies, develop timelines and measurable criteria within the COP for eventual transition to a reintroduction program whereby above-dam natural fish production makes a significant contribution to overall population abundance and productivity to meet recovery goals. 3. Once the above conditions have been met, implement reintroduction of NOR fish to meet TRT diversity criteria and Recovery Plan diversity and spatial structure criteria. 3.1. discontinue hatchery outplants	Detroit/Big Cliff complex	on-going	WP BiOP	---	---	N/A	WP BiOp action agencies, ODFW

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A.2 LFT: 2f Key Factor: CHS adult Secondary Factor: none	Strategy: 4 , via, Land Use Management to address issue of - Habitat Access	163 - SUB -NS Priority: 1	Reduce fish loss and migration delays of juvenile and adult fish at Santiam Water Control District irrigation canal/hydro projects.	Comments: Mill Creek Irrigation canal?	0	within 5 yrs	TBD	---	---	---	Santiam Water Control District, City of Stayton
Listing Factor: A.2 LFT: 2f Key Factor: CHS adult Secondary Factor: none	Strategy: 4 , via, Land Use Management to address issue of - Habitat Access	164 - SUB -NS Priority: 1	(related to LFT 9a coordination action) Ensure adequate streamflows exist for upstream migration of salmon during summer low flow periods at Geren/Stayton Island, and evaluate if there are other stream flow-related passage barriers in the subbas in summer.	1. Determine minimum instream flows needed downstream of Geren/Stayton Island complex. 2. Evaluate best way to coordinate subbasin water withdrawals and flows to keep the minimum amount of water needed for successful adult passage in the river. 2.1. develop an integrated plan with a conservation component for all water right holders withdrawals (as part of LFT 9a actions), including integration with WP BiOp flows	0	within 20 yrs	TBD	---	---	---	OWRD, ODFW, USBOR, USACE, NMFS, Cities of Salem and Stayton, SWCD

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A.2 LFT: 2f Key Factor: CHS adult Secondary Factor: none	Strategy: 4 , via, Land Use Management to address issue of - Habitat Access	165 - SUB -NS Priority: 1	Improve fishway function and efficiency at Lower Bennett dams for both juvenile and adult fish.	1. Fund redesign, reconstruction, and evaluation of fish ladder at Lower Bennett dam. 2. Salem headgate at Mill Creek/NSR??	0	within 20 yrs	TBD	---	---	---	City of Salem, ODFW, Santiam Water Control District
Listing Factor: A.2 LFT: 2i Key Factor: none Secondary Factor: STW kelt	Strategy: 4 , via, Flood Control / Hydropower to address issue of - Habitat Access	166 - SUB -NS Priority:	(see related LFT 1d actions for NS juveniles)	TBD	0	within 25 yrs	WP BiOP	---	---	N/A	WP BiOp action agencies

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A.2 LFT: 2k Key Factor: none Secondary Factor: CHS adult	Strategy: 4 , via, Flood Control / Hydropower to address issue of - Habitat Access	167 - SUB -NS Priority: 1	(see LFT 2b for handling actions) Resolve uncertainty of any remaining pre-spawn mortality not associated with injury and stress associated with Minto Collection facility.	1: Improve water quality in subbasin below Big Cliff Dam by implementing the WP RPA's 5.1, 5.2 and 5.3 for water quality to meet adult fish needs by resolving inadequacies of temperature and TDG profiles. 1.1. build temperature control structure at Detroit Dam; WP- RPA 5.3. 2. Monitor metrics of fish health at different times and locations above Willamette Falls to further delineate whether the problem is solely related to Flood Control/hydropower effects, or is exacerbated by other issues that impact fish condition and maturity (i. e. disease, toxins). - this is not a current WP BiOp RPA)	0	within 25 yrs	WP BiOP	---	---	N/A	WP BiOp action agencies
Listing Factor: A LFT: 7b Key Factor: none Secondary Factor: CHS egg-alevin STW	Strategy: 1, 2, 5, 6 , via, Flood Control / Hydropower to address issue of - Physical Habitat Quality	168 - SUB -NS Priority: 2	(see actions associated with LFT 7c) Restore substrate recruitment and reduce streambed coarsening below dam projects.	TBD	Below Big Cliff Dam	within 25 yrs	WP BiOP	---	---	N/A	WP BiOp action agencies

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quanti ty	Total Cost	Key Entities / Potential Implement ers
egg-alevin											

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A LFT: 7c Key Factor: none Secondary Factor: CHS egg-alevin STW egg-alevin	Strategy: 1, 2, 5, 6 , via, Flood Control / Hydropower to address issue of - Physical Habitat Quality	169 - SUB -NS Priority: 2	(same as for LFT 7f [MF] and 7e [MK]) Increase retention and sourcing of gravels and other materials below USACE facilities with a combination of habitat improvements, targeted flows, and augmentation.	1. (WP RPA 7.2) Improve channel complexity below dams with existing habitat restoration and enhancement program on USACE lands. 2. Augment depleted areas below dams with most appropriate source and size composition. - Provide appropriate channel complexity to retain material. 3. (WP RPA 7.1.2) Prioritize some projects within the comprehensive habitat restoration program to include projects that improve incubation habitat. 4. (WP RPA 7.3) Implement to collect large wood in USACE reservoirs, and strategically promote placement of this wood in areas below dams that promote sourcing of incubation gravels. 5. To the extent that restoration at revetment sites implemented through WP RPA 7.4 leads to greater interaction and movement of floodplain substrates, fund as high priority projects those that produce incubation gravels. 6. Couple these improvements with	Below Big Cliff Dam	within 25 yrs	WP BiOP	---	---	N/A	WP BiOp action agencies

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
				Environmental Flow opportunities as described in RPA 2.7. to distribute gravel and other materials.							

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A LFT: 8a Key Factor: CHS winter parr STW winter parr Secondary Factor: CHS fry-summer parr	Strategy: 1, 2, 3, 4, 5, 6 , via, Land Use Management to address issue of - Physical Habitat Quality	170 - SUB -NS Priority: 1	Identify priority reaches in North Santiam subbasin where habitat restoration projects can be implemented and monitored.	1. Develop a prioritization framework and ID strategic reaches specific to UWR salmonids by collating work from several sources, including the Willamette Subbasin Plan (WRI 2004), WS Council Action Plans, watershed assessments, ODEQ 303 (d) reaches, and others. 1.1. map existing intact areas for protection 1.2. map degraded priority areas for restoration/enhancement 1.3. update and implement the NSA WS Council's Work Plan to cross-walk priority projects with Recovery Plan 2. ID willing landowners and local governments to protect intact areas through BMPs, incentives, and other mechanisms. 3. Streamline incentive programs and process. 3.1. provide meaningful financial incentives (e.g. increase Oregon's tax credit) in priority locations to implement riparian protection and habitat improvement projects 3.2. advertise ODFW's Wildlife Habitat Conservation and Management Program (WHCMP) and Riparian Tax Incentive Program (RTIP) 3.3. explore other	natal subbasin	within 15 yrs	see action 175 ODEQ Rpt (2010 Table 4) For Ag DMA (fencing)	$6,308 / acre (fencing)	TBD	---	NRCS, FSA, OWEB, SWCD, North Santiam Watershed Council, private landowners

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quanti ty	Total Cost	Key Entities / Potential Implement ers
				opportunities to acquire setbacks, easements, or acquisition.							

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A LFT: 8a	Strategy: 1, 2, 3, 4, 5, 6 , via, Land Use Management to address issue of - Physical Habitat Quality	171 - SUB -NS Priority: 1	In priority moderate-gradient stream reaches in the NS subbasin, increase habitat complexity to provide juvenile fish refugia during high flows, and to augment other channel forming processes and habitat/water quality actions in this Plan.	1. Implement priority projects. 1.1. initiate restoration by increasing instream habitat complexity, including use of large wood and ther bank stabilization strategies 1.2. provide for long-term restoration by planting, protecting, maintaining, and restoring native riparian vegetation	Good candidate streams include Bear Branch, Stout, Rock, Mad, Sinker, Elkhorn, LNF Santiam.	within 15 yrs	ODEQ Rpt (2010 Table 4) For Ag DMA	$12,333 / acre	TBD	---	North Santiam WS Council, USBLM, OWEB, private landowners
Listing Factor: A LFT: 8a	Strategy: 1, 2, 3, 4, 5, 6 , via, Land Use Management to address issue of - Physical Habitat Quality	172 - SUB -NS Priority: 1	Restore natural function of the North Santiam River near Stayton Ponds	1. Use a controlled diversion of water from the N. Santiam River to restore side channel habitat and floodplain function. 1.1. ensure upstream passage through this channel	Stayton Ponds	within 15 yrs	TBD	---	---	---	North Santiam Watershed Council, ODFW
Listing Factor: A LFT: 10a Key Factor: STW eggs-alevin Secondary Factor: none	Strategy: 1, 5, 6, 7, 8 , via, Flood Control / Hydropower to address issue of - Water Quality / Quantity / Hydrograph	173 - SUB -NS Priority: 1	(WP BiOp Water Quality RPA's) Release flows from Detroit/Big Cliff dams to meet flow targets in the North Santiam River that protect spawning, incubation, rearing and migration of salmonids.	1. Operate facilities to minimize adverse effects of ramping on fish stranding, redd desiccation, and loss of habitat.	0	within 25 yrs	WP BiOP	---	---	N/A	WP BiOp action agencies

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A LFT: 10b Key Factor: none Secondary Factor: CHS summer parr STW fry-summer parr	Strategy: 5 , via, Land Use Management & Flood Control / Hydropower to address issue of - Water Quality / Quantity / Hydrograph	174 - SUB -NS Priority: 1	Modify dam operations for multiple diversions at Geren/Stayton Island, e.g. Upper and Lower Bennett, SWCD pill dam.	TBD	0	within 10 yrs	TBD	---	---	---	City of Salem
Listing Factor: A LFT: 9b Key Factor: CHS egg-alevin Secondary Factor: none	Strategy: 1, 5, 6, 7, 8 , via, Flood Control / Hydropower to address issue of - Water Quality / Quantity / Hydrograph	175 - SUB -NS Priority: 1	(WP RPA 5.2) Construct, operate, and evaluate a temperature control structure at Detroit Dam to release water that more closely resembles normative water temperatures, reduces TDG exceedences, and meets TMDL temperature targets downstream of NS dams and operating dams to maximize benefits to Chinook and steelhead	1. Operate facility to provide cooler water in the fall for Chinook egg and alevin life stages. 2. Operate facility to provide warmer water during steelhead early life stages.	0	Operational by 2019	WP BiOP	---	---	N/A	WP BiOp action agencies, NMFS

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A LFT: 9d Key Factor: none Secondary Factor: STW egg-alevin	Strategy: 1, 5, 6, 7, 8 , via, Flood Control / Hydropower to address issue of - Water Quality / Quantity / Hydrograph	176 - SUB -NS Priority: 1	(see WP RPA 5.2 to address LFT 9b; temperature control facility action)	1. Resolve any potential conflicts between meeting TMDL temperature targets downstream of dams and operating dams to maximize benefits to steelhead.	reaches below Big Cliff Dam	Operational by 2019	WP BiOP	---	---	N/A	WP BiOp action agencies, ODEQ

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: E.1 LFT: 3a Key Factor: CHS and STW adult Secondary Factor: none	Strategy: 4, 13 , via, Hatchery Management / RME / WP BiOP RPA's to address issue of - Population Traits	177 - SUB -NS Priority: 1	Manage current CHS Harvest Mitigation Hatchery Program (HMP) facilities and broodstock to meet mitigation goals, but do so in a manner that the genetic and demographic impacts of program do not pose unacceptable risk to extant NOR fish populations or compromise long term productivity of a reintroduction stock that would preclude success of conservation reintroduction/supplementation program above Detroit Dam.	1. In the long term the VSP diversity target is to maintain an average total basin pHOS rate <10%, which is coupled with improvements in access and passage and other LFT's affecting capacity and productivity. 1.1. promote a short and long term conservation hatchery strategy that will lead to a viable naturally-produced population. 2. In the short term, implement actions and associated RME below Minto facility that will reduce genetic and demographic risk to extant NOR population 2.1. improve trap attraction, operation, and sorting at new Minto facility; (open earlier and longer) 2.2. modify hatchery fish recycling program (end sooner)? 2.3. acclimate, release, or evaluate other rearing strategy modifications 2.4 modify other hatchery rearing practices 2.5. encourage greater harvest of hatchery fish above Upper Bennett Dam 2.6. maintain HOR tagging efforts and CHS spawning surveys to support above efforts 2.7. adopt new ODFW recommendations for level of integration of NOR	0	on-going	---	---	---	---	ODFW, NMFS, USACE

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
				broodstock 2.8. look for annual opportunities to "outplant" NOR fish to other locales in lower subbasin 3. Over long term, increase NOR production below Minto through WP BiOp RPA water quality/quantity improvements at Detroit, and other actions addressing LFT's. 3.1. further develop a conservation supplementation (reintroduction) program (CSP) or set of strategies to be implemented above Detroit dam 3.2. adopt as template the new ODFW recommendations for reintroduction and modify as needed based on results of scientific review of program type 4: If above actions and WP BiOp RPA actions related to access, temperature, and flow do not get pHOS to acceptable levels below Minto, and after a period of 2 life cycles (depending on ocean conditions) install and operate sorter at Upper and Lower Bennett Dams and modify angling regulations accordingly. 5: After Recovery Plan is adopted, develop a new							

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
				HGMP with conservation details.							
Listing Factor: E.1 LFT: 3a Key Factor: CHS and	Strategy: 4, 13 , via, Hatchery Management to address issue of - Population Traits	178 - SUB - SAN Priority: 1	For Steelhead, conduct RME to identify most effective means to reduce inter-basin pHOS, so that over the long term average total basin pHOS < 5% (for the out-of-ESU stock).	1. Potential strategies include modifying hatchery STS rearing and release practices. - pHOS goal is coupled with passage and other LFT improvements	0	on-going	WP BiOP	---	---	N/A	ODFW, NMFS, WP BiOp Action Agencies

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
STW adult Secondary Factor: none											
Listing Factor: E.1 LFT: 4c Key Factor: STW fry-winter parr Secondary Factor: none	Strategy: 7, 10, 13 , via, Hatchery Management to address issue of - Competition	179 - SUB - SAN Priority: 1	Ensure hatchery summer steelhead smolts migrate quickly to the ocean by evaluating a suite of acclimation and release strategies.	TBD	0	within 25 yrs	WP BiOP	---	---	N/A	WP BiOp action agencies
Listing Factor: E.1 LFT: 4c	Strategy: 7, 10, 13 , via, Hatchery Management to address issue of - Competition	180 - SUB - SAN Priority: 1	Convene a BiOp WATER working group to further examine the competition risk of STS on NOR STW fry and winter parr.	TBD	0	within 25 yrs	WP BiOP	---	---	N/A	WP BiOp action agencies

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: E.1 LFT: 4d Key Factor: STW summer parr-winter parr Secondary Factor: none	Strategy: 7, 10, 13 , via, Hatchery Management to address issue of - Competition	181 - SUB - SAN Priority: 1	Allow retention of fin-clipped trout in areas open to fishing to reduce residual STS smolts.	TBD	0	within 10 yrs	Baseline	---	---	N/A	ODFW
Listing Factor: C.1 LFT: 6c Key Factor: none Secondary Factor: CHS fry-winter parr	Strategy: 10, 11, 13 , via, Hatchery Management to address issue of - Predation	182 - SUB - SAN Priority: 1	Reduce natural spawning of non-native summer steelhead.	1. Increase harvest of adult summer steelhead. 2: Stop recycling adult summer steelhead and remove them. 3: Scatterplant smolt releases so that returning adults are more spread out to increase harvest.	0	within 10 yrs	Baseline	---	---	N/A	ODFW

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A.2 LFT: 1e Key Factor: CHS smolt STW smolt Secondary Factor: none	Strategy: 4 , via, Flood Control / Hydropower to address issue of - Habitat access	183 - SUB - SSA Priority: 1	Improve downstream passage through Foster reservoir and dam for juveniles and kelts.	1. Implement WP-RPA's 2.8 and 2.10) to evaluate the Foster Dam Spring Spill window for improved passage of CHS and STW. 1.1. based on these studies, implement WP-RPA 4.8 requiring interim downstream fish passage measures 1.2. if more extensive improvements are needed, WP BiOP Action Agencies will proceed with evaluation through COP process, described in WP-RPA 4.13	0	within 5 yrs	WP BiOP	---	---	N/A	WP BiOp action agencies
Listing Factor: A.2 LFT: 1e Key Factor: CHS smolt STW smolt Secondary Factor: none	Strategy: 4 , via, Flood Control / Hydropower to address issue of - Habitat access	184 - SUB - SSA Priority: 2	Evaluate further whether safe and effective downstream passage through Green Peter reservoir and dam is a viable alternative and highly beneficial in supporting improvements in VSP criteria for desired status risk level (CHS-Moderate, STW-Very Low).	1. Evaluate within the WP BiOp COP process. - there are no WP BiOp RPA's for downstream passage improvements at Green Peter Dam 1.1. as other LFT's are improved, monitor STW population status to determine whether it is necessary to have STW upstream passage at Green Peter as identified in WP-RPA 4.2, in which case some STW collected at Foster Dam facility are "outplanted" above Green Peter. 1.2. in support of this effort, implement WP-RPA's 4.10 and 4.11. that require juvenile downstream passage assessments	0	within 25 yrs	WP BiOP	---	---	N/A	WP BiOp action agencies

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A.2 LFT: 2a Key Factor: none Secondary Factor: STW fry-adult	Strategy: 4 , via, Land Use Management to address issue of - Habitat Access	185 - SUB - SSA Priority: 2	Provide technical and funding assistance to the SSA Watershed Council in restoring consistent fish passage into Ames Creek.	TBD	0	within 10 yrs	TBD	---	---	---	SSA WS Council, OWEB
Listing Factor: A.2 LFT: 2a Key Factor: none Secondary Factor: STW fry-adult	Strategy: 4 , via, Land Use Management to address issue of - Habitat Access	186 - SUB - SSA Priority: 1	Evaluate whether juvenile fish can pass the breached Jordan Dam on Thomas Creek.	1. Remedy if necessary.	Jordan Dam (Thomas Creek)	within 10 yrs	TBD	---	---	---	SSA Watershed Council, ODFW
Listing Factor: A.2 LFT: 2a Key Factor: none Secondary Factor:	Strategy: 4 , via, Land Use Management to address issue of - Habitat Access	187 - SUB - SSA Priority: 1	As needed, finalize evaluation of velocity testing and adjustment of baffles at the Lebanon diversion, to assure screen is still working within intent of NMFS design criteria.	1. Maintain and test as necessary.	Lebanon Dam	on-going	---	---	---	---	City of Albany

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
STW fry-adult											
Listing Factor: A.2 LFT: 2a Key Factor: none Secondary Factor: STW fry-adult	Strategy: 4 , via, Land Use Management to address issue of - Habitat Access	188 - SUB - SSA Priority: 3	Determine whether the diversion screen on Lacomb Creek meets current juvenile fish standards.	TBD	0	within 10 yrs	TBD	---	---	---	owner, SSA WS Council, ODFW
Listing Factor: A.2 LFT: 2c Key Factor: CHS adult STW adult Secondary Factor: none	Strategy: 4 , via, Flood Control / Hydropower to address issue of - Habitat Access	189 - SUB - SSA Priority: 1	(see relation to LFT 2l) Reduce pre-spawn mortality by reducing injury and stress related to fish handling at and above USACE facilities.	1. Implement WP-RPA 4.6 to rebuild, operate, and maintain the Foster Adult Fish Collection and handling facility below Foster Dam for expanded and improved sorting and handling of wild and hatchery fish. 1.1. support objective of WP-RPA 4.6 by implementing WP-RPA's 4.3, 4.4, and 4.5 to improve and standardize handling and transport protocols, and by implementing WP- RPA 4.7 to improve and increase the number of suitable outplanting sites above	0	RPA 4.6: Completion Date 2013, Begin Operation by March 2014	WP BiOP	---	---	N/A	WP BiOp action agencies, ODFW

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
				Foster Dam (and potentially above Green Peter Dam) 1.1.1. assess through RME whether these show demonstrable improvement							
Listing Factor: A.2 LFT: 2c Key Factor: CHS adult STW adult Secondary Factor: none	Strategy: 4 , via, Flood Control / Hydropower to address issue of - Habitat Access	190 - SUB - SSA Priority: 2	Within the WP BiOp COP process, evaluate further whether access to and production above Green Peter Dam is a viable alternative and highly beneficial in supporting improvements in VSP criteria for desired status risk level (CHS-Moderate, STW-Very Low).	1. Determine whether it is necessary to have steelhead upstream passage at Green Peter Dam as identified in WP-RPA 4.2, in which case some steelhead collected at Foster Dam facility are "planted" above Green Peter. In support of this effort, implement the juvenile downstream passage assessments described in WP-RPA's 4.10 and 4.11. 1.1. use these data and results within language of WP-RPA 4.12 to support SLAM modeling to reduce uncertainty regarding need to improve downstream survival in the future - evaluation is needed to support decisions regarding need to construct and	0	within 25 yrs	WP BiOP	---	---	N/A	WP BiOp action agencies, ODFW

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
				operate new downstream fish passage facility at Green Peter Dam in next term of the WP BiOp							

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quanti ty	Total Cost	Key Entities / Potential Implement ers
Listing Factor: A.2 LFT: 2c Key Factor: CHS adult STW adult Second ary Factor: none	Strategy: 4 , via, Flood Control / Hydropower to address issue of - Habitat Access	191 - SUB - SSA Priority: 1	Until downstream passage facilities are completed and have demonstrated safe and timely passage, supplement natural production in the subbasin by implementing the interim trap-and-haul measures described in the 2008 WP BiOp to outplant adult fish into historical habitat above Foster Dam.	1. Continue to implement and evaluate the experimental Outplant Program (described in WP-RPA 4.1), using hatchery fish to seed habitat above Foster Dam. 1.1. evaluate outplant strategies and levels relative to best way to transition to a more formal reintroduction program using only NOR fish 1.2. based on Outplant evaluation studies, develop timelines and measurable criteria within the COP for eventual transition to a reintroduction program whereby above-dam natural fish production makes a significant contribution to overall population abundance and productivity to meet recovery goals. 2. Once the above conditions have been met, discontinue hatchery outplants and implement reintroduction of NOR fish to meet TRT diversity criteria and Recovery Plan diversity and spatial structure criteria.	0	on-going	WP BiOP	---	---	N/A	WP BiOp action agencies, ODFW

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quanti ty	Total Cost	Key Entities / Potential Implement ers
Listing Factor: A.2 LFT: 2g Key Factor: CHS adult Second ary Factor: none	Strategy: 4 , via, Land Use Managemen t to address issue of - Habitat Access	192 - SUB - SSA Priority: 3	Clarify if passage criteria are being met, or if further RME is needed for the new fishways at Lebanon Dam.	Comment: These fishways were built to NMFS hydraulic design criteria and appear to be working well, and NOAA considers passage evaluation a low priority given other needs.	Lebanon Dam	within 5 yrs	TBD	---	---	---	City of Albany. ODFW
Listing Factor: A.2 LFT: 2j Key Factor: none Second ary Factor: STW kelt	Strategy: 4 , via, Flood Control / Hydropower to address issue of - Habitat Access	193 - SUB - SSA Priority: 1	(see related LFT 1e actions for SSA juveniles)	TBD	0	within 25 yrs	WP BiOP	---	---	N/A	WP BiOp action agencies

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A.2 LFT: 2l Key Factor: none Secondary Factor: CHS adult	Strategy: 4 , via, Flood Control / Hydropower to address issue of - Habitat Access	194 - SUB - SSA Priority: 2	(see LFT 2c for handling actions) Resolve uncertainty of any remaining pre-spawn mortality not associated with injury and stress associated with Foster Dam Collection facility.	1. Improve water quality in subbasin below Foster Dam by implementing the WP RPA's 5.1 and 5.2 for water quality to meet adult fish needs by resolving inadequacies of temperature and TDG profiles. 2. Monitor metrics of fish health at different times and locations above Willamette Falls to further delineate whether the problem is solely related to Flood Control/hydropower effects, or is exacerbated by other issues that impact fish condition and maturity (i. e. disease, toxins). - this is not a current WP BiOp RPA	0	within 25 yrs	WP BiOP	---	---	N/A	WP BiOp action agencies

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A LFT: 7d Key Factor: none Secondary Factor: CHS egg-alevin STW egg-alevin	Strategy: 1, 2, 5, 6 , via, Flood Control / Hydropower to address issue of - Physical Habitat Quality	195 - SUB - SSA Priority: 2	(WP RPA 2.7) Implement environmental pulse flows and combine with WP RPA actions below to restore substrate recruitment and reduce streambed coarsening below dam projects.	1. (WP RPA 7.2) Improve channel complexity below dams with existing habitat restoration and enhancement program on USACE lands. 2. (WP RPA 7.1.2) Prioritize some projects within the comprehensive habitat restoration program to include projects that improve incubation habitat. 3. (WP RPA 7.3) Implement to collect large wood in USACE reservoirs, and strategically promote placement of this wood in areas below dams that promote sourcing of incubation gravels. 4. To the extent that restoration at revetment sites implemented through WP RPA 7.4 leads to greater interaction and movement of floodplain substrates, fund as high priority projects those that produce incubation gravels. 5. Couple these improvements with Environmental Flow opportunities as described in RPA 2.7 to distribute gravel and other materials.	0	within 25 yrs	WP BiOP	---	---	N/A	WP BiOp action agencies

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A LFT: 8a	Strategy: 1, 2, 5, 6 , via, Flood Control / Hydropower to address issue of - Physical Habitat Quality	196 - SUB - SSA Priority: 1	Identify priority reaches in South Santiam subbasin where habitat restoration projects can be implemented and monitored.	1. Develop a prioritization framework and ID strategic reaches specific to UWR salmonids by collating work from several sources, including the Willamette Subbasin Plan (WRI 2004), WS Council Action Plans, watershed assessments, ODEQ 303 (d) reaches, and others. 1.1. map existing intact areas for protection 1.2. map degraded priority areas for restoration/enhancement 1.3. update and implement the SSA WS Council's Work Plan to cross-walk priority projects with Recovery Plan 2. ID willing landowners and local governments to protect intact areas through BMPs, incentives, and other mechanisms. 3. Streamline incentive programs and process. 3.1. provide meaningful financial incentives (e.g. increase Oregon's tax credit) in priority locations to implement riparian protection and habitat improvement projects 3.2. advertise ODFW's Wildlife Habitat Conservation and Management Program (WHCMP) and Riparian Tax Incentive Program (RTIP) 3.3. explore other	0	within 15 yrs	ODEQ Rpt (2010 Table 4) For Ag DMA (fencing)	$6,308 / acre	TBD	---	NRCS, FSA, South Santiam WS Council, private landowners

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
				opportunities to acquire setbacks, easements, or acquisition.							

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A LFT: 8a Key Factor: CHS winter parr STW winter parr Secondary Factor: CHS fry-summer parr	Strategy: 1, 2, 3, 4, 5, 6 , via, Land Use Management to address issue of - Physical Habitat Quality	197 - SUB - SSA Priority: 1	In priority moderate-gradient stream reaches in the South Santiam subbasin, increase habitat complexity to provide juvenile fish refugia during high flows, and to augment other channel forming processes and habitat/water quality actions in this Plan.	1. Implement priority projects. 1.1. initiate restoration by increasing instream habitat complexity, including use of large wood and other bank stabilization measures 1.2. provide for long-term restoration by planting, protecting, maintaining, and restoring native riparian vegetation Comments: Although focus in reaches below Foster Dam, some of the best remaining habitat is above Foster Dam, and in need of further enhancement. "high" priority (Sweet Home Ranger District)	Tributaries include Canyon Cr., Owl Cr., and Soda Fk. The SSA WS Council and USFS implemented a LWD project on Moose Cr. In 2008/2009.	within 15 yrs	ODEQ Rpt (2010 Table 4) For Ag DMA	$12,333 / acre	TBD	---	South Santiam WS Council, OWEB, USFS, private landowners
Listing Factor: A LFT: 8a	Strategy: 1, 2, 3, 4, 5, 6 , via, Land Use Management to address issue of - Physical Habitat Quality	198 - SUB - SSA Priority: 2	Work with landowner adjacent to Waterloo Park to reestablish a long abandoned side channel for rearing and spawning.	TBD	0	within 15 yrs	Calculated	$330,000 / mi	TBD	---	??

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A LFT: 8a	Strategy: 1, 2, 3, 4, 5, 6 , via, Land Use Management to address issue of - Physical Habitat Quality	199 - SUB - SSA Priority: 1	(WP BiOp WQ RPA's) Release flows from Foster/Green Peter dams to meet flow targets in the South Santiam River that protect spawning, incubation, rearing and migration of salmonids.	1. Operate facilities to minimize adverse effects of ramping on fish stranding, redd desiccation, and loss of habitat.	0	within 5 yrs	WP BiOP	---	---	N/A	WP BiOp Action Agencies, NMFS
Listing Factor: A LFT: 7a Key Factor: none Secondary Factor: CHS eggs-alevins STW eggs-alevins	Strategy: 1, 2, 3, 4, 5, 6 , via, Land Use Management to address issue of - Physical Habitat Quality	200 - SUB - SSB Priority: 2	(no specific actions for LFT 7a; see relevant riparian actions under LFT code 8a)	TBD	0	on-going	---	---	---	---	ODEQ, ODF, USFS, USBLM, Forest Industry

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A LFT: 10e Key Factor: STW eggs-alevin Secondary Factor: none	Strategy: 1, 5, 6, 7, 8 , via, Flood Control / Hydropower to address issue of - Water Quality / Quantity / Hydrograph	201 - SUB - SSA Priority: 1	(WP RPA's 5.1, 5.1.2, and potentially 5.1.3) Evaluate feasibility and effectiveness of interim operational temperature control at Foster and Green Peter dams.	1. Consider temperature control structure at most appropriate dam in next term of the WP BiOp, if not effective at restoring normative conditions or reducing the LFT. 1.1. resolve potential conflicts between meeting TMDL temperature targets downstream of dams and operating dams to maximize benefits to Chinook and steelhead	0	phased timeline in WP BiOp	WP BiOP	---	---	N/A	WP BiOp action agencies, ODEQ
Listing Factor: E.1 LFT: 3a Key Factor: CHS and STW adult Secondary Factor: none	Strategy: 4, 13 , via, Hatchery Management to address issue of - Population Traits	202 - SUB - SSA Priority: 1	Manage current CHS Harvest Mitigation Hatchery Program (HMP) facilities and broodstock to meet mitigation goals, but do so in a manner that the genetic and demographic impacts of program do not pose unacceptable risk to extant NOR fish populations or compromise long term productivity of a reintroduction stock that would preclude success of conservation reintroduction/supplementation program above Foster Dam.	1. In the long term the VSP CHS diversity target is to maintain an average total basin pHOS rate <30%, which is coupled with improvements in access and passage and other LFT's affecting capacity and productivity. 1.1. promote a short and long term conservation hatchery strategy that will lead to a viable naturally-produced population 2. In the short term, implement actions and associated RME below Foster facility that will reduce genetic and demographic risk to extant NOR population: 2.1. improving trap attraction, operation, and sorting at new Foster facility 2.2. minimize the recycling of HOR fish entering trap,	0	on-going	---	---	---	---	ODFW, NMFS, USACE

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
				maximize the recycling of "true" NOR fish 2.3. adjust juvenile rearing and release strategies as feasible 2.4. modifying other hatchery rearing practices 2.5. increase harvest of HOR fish while minimizing risk to NOR fish 2.6. maintain HOR tagging efforts and CHS spawning surveys to support above efforts 2.7 adopt new ODFW recommendations for level of integration of NOR broodstock and look for annual opportunities to "outplant" NOR fish to other locales in lower subbasin 3. Over long term, increase NOR production below Foster through WP BiOp RPA water quality/quantity improvements and other actions addressing LFT's. Further develop a conservation supplementation (reintroduction) program (CSP) or set of strategies to be implemented above Foster and Green Peter dams. 3.1. adopt as template the new ODFW recommendations for reintroduction and modify as needed based on results of scientific review of program type							

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
				4. After Recovery Plan is adopted, develop a new HGMP with conservation details.							
Listing Factor: A.2 LFT: 2h Key Factor: CHS adult Secondary Factor: STW adult	Strategy: 4 , via, Land Use Management to address issue of - Habitat access	203 - SUB -CA Priority: 1	Continue to work with agencies and private parties for a solution on the passage of adult CHS over Sodom and Shear dams that are associated with the Thompson's Mill State Park site.	1. OPRD to maintain timeline for developing a surrender application, including a draft EA and draft BA, to submit to FERC in Fall 2010 for FERC's approval. - as funds are currently available to help with Sodom Dam and Shear Dam removal, but expire after December 2011, OPRD needs to stay on the current timeline for submitting its application to FERC in order to ensure all permitting is completed for the 2011 in-water work period. - subsequently, FERC will have to complete its NEPA process, as well as ESA consultation with NMFS and USFWS prior to approving this action. 2. Also, OPRD will have to obtain an USACE 404 permit for these actions.	Lower-Middle Calapooia Construction complete: 2011	within 5 yrs	TBD	---	---	---	Calapooia Watershed Council, OPRD, ODFW, USACE, FERC and other permit agencies, local governments, OWEB

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A LFT: 8a	Strategy: 1, 2, 3, 4, 5, 6 , via, Land Use Management to address issue of - Physical Habitat Quality	204 - SUB -CA Priority: 1	In priority moderate-gradient stream reaches in the Calapooia subbasin, increase habitat complexity to provide juvenile fish refugia during high flows, and to augment other channel forming processes and habitat/water quality actions in this Plan.	1. Implement priority projects. 1.1. initiate restoration by increasing instream habitat complexity, including use of large wood and other bank stabilization strategies 1.2. provide for long-term restoration by planting, protecting, maintaining, and restoring native riparian vegetation - other priority issues in the lower subbasin are temperature and other WQ issues, related to water withdrawal and lack of riparian function (i.e. shading) from agricultural practices.	- Select cool streams with gradients <4% - focus first on streams with year-round flow. - Brush Creek is a good example	within 15 yrs	ODEQ Rpt (2010 Table 4) For Ag DMA	$12,333 / acre	TBD	---	NRCS, FSA, OWEB, Calapooia Watershed Council, private landowners
Listing Factor: A LFT: 8a	Strategy: 1, 2, 3, 4, 5, 6 , via, Land Use Management to address issue of - Physical Habitat Quality	205 - SUB -CA Priority: 1	Identify for protection and restoration, reaches in upper Calapooia River where deep pools can be maintained or created, for target summer water temperature < 70°F.	1. Reduce water temperature further through channel modification and increased riparian shading. 2. Add multiple large logs with root wads and engineer for log stability during flood flows.	upstream of Hands Creek (on-going)	within 15 yrs	ODEQ Rpt (2010 Table 4) For Private Forest DMA	$4,700 / acre (riparian shading) $13,333 / acre (instream improvement)	TBD	---	Calapooia Watershed Council, private landowners, namely Weyerhauser

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A LFT: 8a	Strategy: 1, 2, 3, 4, 5, 6 , via, Land Use Management to address issue of - Physical Habitat Quality	206 - SUB -CA Priority: 1	Eliminate parking areas along main line roads, and decrease harassment near those pools where investments in spring Chinook holding pools have been made to minimize disturbance to the fish.	1. Maintain new Weyerhauser restricted access to upper subbasin. 2. Promote creation of dispersed additional resting/holding pools with specific stream habitat actions. 3. Increase OSP presence and protocols.	0	on-going	---	---	---	---	Weyerhauser, Calapooia Watershed Council, local governments
Listing Factor: A LFT: 8a	Strategy: 1, 2, 3, 4, 5, 6 , via, Land Use Management to address issue of - Physical Habitat Quality	207 - SUB -CA Priority: 1	Identify priority reaches in Calapooia subbasin where habitat restoration projects can be implemented and monitored.	1. Develop a prioritization framework and ID strategic reaches specific to UWR salmonids by collating work from several sources, including the Willamette Subbasin Plan (WRI 2004), WS Council Action Plans, watershed assessments, ODEQ 303 (d) reaches, and others. 1.1. map existing intact areas for protection 1.2. map degraded priority areas for restoration/enhancement 1.3. update and implement the Calapooia WS Council's Work Plan to cross-walk priority projects with Recovery Plan - ID the width of buffer feasible in priority reaches - increase shade along stream sections that have maximum temperatures close to 70°F for purposes of expanding the amount of cool water habitat for juvenile fish	Calapooia WS Council focus areas are the middle reaches of the mainstem, Brush Creek and Courtney Creek sub-basins	within 15 yrs	ODEQ Rpt (2010 Table 4) For Ag DMA ODEQ Rpt (2010 Table 4) For Ag DMA (fencing)	$6,308 / acre $4700 / acre (w/o fence) $1100 / (w fence)	TBD	---	NRCS, FSA, Calapooia Watershed Council, private landowners

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
				- suggestion to plant trees and buffers that are 50' wide, at least on the south banks 2. ID willing landowners and local governments to protect intact areas through BMPs, incentives, and other mechanisms. 3. Streamline incentive programs and process. 3.1. provide meaningful financial incentives (e.g. increase Oregon's tax credit) in priority locations to implement riparian protection and habitat improvement projects 3.2. advertise ODFW's Wildlife Habitat Conservation and Management Program (WHCMP) and Riparian Tax Incentive Program (RTIP) 3.3. explore other opportunities to acquire setbacks, easements, or acquisition							
Listing Factor: A LFT: 8a	Strategy: 1, 2, 3, 4, 5, 6 , via, Land Use Management to address issue of - Physical Habitat Quality	208 - SUB -CA Priority: 1	Work in a priority up or downstream direction, eliminating even small breaks in shading to increase and expand cool water zones and fish bearing habitat.	Comments: ID'd "medium" priority (Calapooia WS Council). Because water takes on heat it loses it very slowly, therefore temperature reduction actions should proceed from the upstream direction down. The valley and headwaters could be separated to take different restoration approaches.	Calapooia WS Council focus areas are the middle reaches of the mainstem, Brush Creek and Courtney Creek sub-basins	within 15 yrs	ODEQ Rpt (2010 Table 4) For Ag DMA	$4700 / acre (w/o fence) $1100 / (w fence)	TBD	---	NRCS, FSA, local governments, Calapooia Watershed Council, private landowners

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A LFT: 8a	Strategy: 1, 2, 3, 4, 5, 6 , via, Land Use Management to address issue of - Physical Habitat Quality	209 - SUB -CA Priority: 1	Use fencing, weed control, and planting of native conifers at appropriate sites.	TBD	Focus most of the conifer restoration efforts on the middle portion of the watershed	within 15 yrs	ODEQ Rpt (2010 Table 4) For Ag DMA (fencing)	$6,308 / acre	TBD	---	NRCS, FSA, OWEB, Calapooia Watershed Council, private landowners
Listing Factor: A LFT: 9c	Strategy: 8 , via, Land Use Management to address issue of - Water Quality / Quantity / Hydrograph	210 - SUB -CA Priority: 1	Improve summer water quality of headwater areas for oversummering Chinook by implementing sufficient riparian buffers.	1. ID strategic areas in coordination with actions for LFT 9a, but focus on problem areas in upper subbasin.	upper subbasin	within 15 yrs	TBD	---	---	---	ODEQ, OWEB, ODF, private landowners, Weyerhauser
Listing Factor: E.1 LFT: 3a Key Factor: CHS and STW adult Secondary Factor: none	Strategy: 4, 13 , via, Hatchery Management to address issue of - Population Traits	211 - SUB -CA Priority: 1	Modify hatchery CHS program practices in other subbasins of the ESU to minimize pHOS in the Calapooia subbasin.	1. As this population is likely extirpated, correct the LFT's and make a decision whether to allow natural seeding to occur from strays from other UWR populations, or to initiate a demographic boost with an appropriate conservation hatchery stock.	0	on-going	Baseline	---	---	N/A	ODFW, USACE

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A.2 LFT: 2d Key Factor: none Secondary Factor: CHS adults	Strategy: 4 , via, Flood Control / Hydropower to address issue of - Habitat Access	212 - SUB -MK Priority: 1	Restore adult access of natural origin fish to historic habitat blocked by large dams.	Cougar Dam 1. Finish construction, evaluate, and maintain the new adult trap below Cougar Dam. 2. Once downstream passage issues are resolved through WP-RPA 4.12.1, and agreement is made on reintroduction strategy (number and composition of adults), decrease or eliminate HOR outplants and reintroduce NOR fish collected at Cougar Dam adult trap. 3. Implement WP-RPA's 4.3, 4.4, and 4.5 to improve handling and transport protocols. 4. Implement WP-RPA 4.7 to improve and increase the number of suitable "outplanting=release" sites above Cougar Dam. 5. Continue to provide appropriate temperatures to attract adults into the SF Mckenzie River. Trail Bridge Dam 6. Specify protocols for handling and transporting adult fish above EWEB facilities prior to use of new fish ladder at Trail Bridge Dam. 7. Build a ladder and tailrace	0	Cougar adult trap ~2010 Trail Bridge adult ladder Completion date: within 6 years of license issuance (likely 2016 or 2017)	WP BiOP	---	---	N/A	WP BiOp action agencies, ODFW

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quanti ty	Total Cost	Key Entities / Potential Implement ers
				barrier that meets NMFS hydraulic design criteria.							

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A.2 LFT: 2d Key Factor: none Secondary Factor: CHS adults	Strategy: 4 , via, Flood Control / Hydropower to address issue of - Habitat Access	213 - SUB -MK Priority: 2	(see related Leaburg action for LFT 3a to improve facility sorting) Provide safe and effective upstream passage of adult salmon migration at the Leaburg Dam left and right bank fish ladders.	1. Update recommendations on how to achieve this based on recent attraction studies and other information, and develop and implement appropriate operational and/or facility improvements.	0	within 10 yrs	TBD	---	---	---	EWEB
Listing Factor: A.2 LFT: 2d Key Factor: none Secondary Factor: CHS adults	Strategy: 4 , via, Flood Control / Hydropower to address issue of - Habitat Access	214 - SUB -MK Priority: 2	Provide safe and effective upstream passage of adult salmon at Walterville tailrace.	1. Study in 2008 to quantify (attraction) and delay of adult salmon at the tailrace and assess impact on spawning distribution. 1.1. based on study results, develop and implement appropriate operational and/or facility improvements	0	See FERC	---	---	---	---	EWEB

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A.2 LFT: 1b Key Factor: none Secondary Factor: CHS smolts	Strategy: 4 , via, Flood Control / Hydropower to address issue of - Habitat Access	215 - SUB -MK Priority: 1	Provide safe and effective downstream passage through Cougar reservoir and dam.	1. Implement WP-RPA 4.12.1 that studies and reports on conceptual alternatives for downstream passage through dam complex and fish distribution in Cougar Reservoir. 1.1. based on studies and design alternatives, construct and operate a new downstream fish passage facility	0	Major Milestone go/no go decision: 2010 Complete construction: Dec 2014 Operation: 2015	WP BiOP	---	---	N/A	WP BiOp action agencies
Listing Factor: A.2 LFT: 1b Key Factor: none Secondary Factor: CHS smolts	Strategy: 4 , via, Flood Control / Hydropower to address issue of - Habitat Access	216 - SUB -MK Priority: 2	Continue to operate and maintain the Walterville fish screen to provide safe and effective fish passage.	TBD	0	on-going	---	---	---	---	EWEB
Listing Factor: A.2 LFT: 1b Key Factor: none Secondary Factor:	Strategy: 4 , via, Flood Control / Hydropower to address issue of - Habitat Access	217 - SUB -MK Priority: 1	Provide safe and effective downstream passage through Trail Bridge reservoir and dam.	1. Study conceptual alternatives for downstream passage through dam complex and fish distribution in reservoir(s). 1.1. based on studies and design alternatives, construct and operate new downstream fish passage facility at appropriate dam as agreed to in FERC agreement	0	on-going	---	---	---	---	EWEB

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
CHS smolts											
Listing Factor: A.2 LFT: 1b Key Factor: none Secondary Factor: CHS smolts	Strategy: 4 , via, Flood Control / Hydropower to address issue of - Habitat Access	218 - SUB -MK Priority: 1	Ensure new fish screen functions appropriately for Chinook salmon at the Leaburg Diversion	1. Assure that O&M funding is maintained to meet desired functionality.	0	on-going	---	---	---	---	EWEB

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quanti ty	Total Cost	Key Entities / Potential Implement ers
Listing Factor: A LFT: 7e Key Factor: none Second ary Factor: CHS egg-alevin	Strategy: 1, 2, 5, 6 , via, Flood Control / Hydropower to address issue of - Physical Habitat Quality	219 - SUB -MK Priority: 1	(same as for LFT 7c [NS] and 7f [MF]) Increase retention and sourcing of gravels and other materials below USACE facilities with a combination of habitat improvements, targeted flows, and augmentation.	1. (WP RPA 7.2) Improve channel complexity below dams with existing habitat restoration and enhancement program on USACE lands. 2. Augment depleted areas below dams with most appropriate source and size composition. 2.1. provide appropriate channel complexity to retain material. 3. (WP RPA 7.1.2) Prioritize some projects within the comprehensive habitat restoration program to include projects that improve incubation habitat. 4. (WP RPA 7.3) Implement to collect large wood in USACE reservoirs, and strategically promote placement of this wood in areas below dams that promote sourcing of incubation gravels. 5. To the extent that restoration at revetment sites implemented through WP RPA 7.4 leads to greater interaction and movement of floodplain substrates, fund as high priority projects those that produce incubation gravels. 6. Couple these improvements with	0	within 25 yrs	WP BiOP	---	---	N/A	WP BiOp action agencies

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
				Environmental Flow opportunities as described in RPA 2.7. to distribute gravel and other materials.							

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A LFT: 8a Key Factor: CHS winter parr Secondary Factor: CHS fry-summer parr	Strategy: 1, 2, 3, 4, 5, 6 , via, Land Use Management to address issue of - Physical Habitat Quality	220 - SUB -MK Priority: 1	Continue to support implementation of Goal 1 restoration actions described in "The McKenzie Watershed Conservation Strategy" (2002), stated as to protect and restore key fish and wildlife habitats.	1. Support Implementation of Strategy 2 that protects and restores aquatic habitats 2. Implement Strategy 3 that protects and restores floodplain and riparian vegetation 2.1. use EDT watershed assessment results to prioritize and implement best restoration actions in lower subbasin - the McKenzie River strategy specifies the goals and actions for protection and restoration of the subbasin. Where appropriate, each goal identifies priority actions and river reaches.	Lower McKenzie basin; see detailed locations in document	within 15 yrs	TBD	---	---	---	McKenzie Watershed Council
Listing Factor: A LFT: 8a Key Factor: CHS winter parr Secondary Factor: CHS fry-summer parr	Strategy: 1, 2, 3, 4, 5, 6 , via, Land Use Management to address issue of - Physical Habitat Quality	221 - SUB -MK Priority: 1	Identify priority sites in the lower McKenzie River subbasin where habitat protection is needed and restoration is desirable, design restoration projects, implement work, and monitor.	1. Use the McKenzie WS Council Conservation Strategy (2002) and the Subbasin Assessment (2000), and maps therein, to identify high priority reaches for conservation and restoration actions. - restoration projects include: reconnect side channels and wetlands to increase channel complexity, place large wood, boulders or other structures, restore riparian habitat, add gravels to restore spawning habitat. - restore ecological function to the extent possible - modify revetments to	0	within 15 yrs	Depends on Project type	---	---	---	USACE, EWEB, Watershed council, private landowners

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
				replace hardened bank structures with more natural bank treatments.							
Listing Factor: A LFT: 8a Key Factor: CHS winter parr Secondary Factor: CHS fry-summer parr	Strategy: 1, 2, 3, 4, 5, 6 , via, Land Use Management to address issue of - Physical Habitat Quality	222 - SUB -MK Priority: 1	Protect and enhance the McKenzie/Willamette Confluence Area and lower river.	1. Implement the "Land use, Flood Control, and Habitat Enhancement Guidelines for the confluence area of the McKenzie and Willamette rivers" (2001).	Lower McKenzie and mainstem Willamette.	within 15 yrs	TBD	---	---	---	Lane County, ODFW, EWEB, McKenzie Watershed Council, aggregate industry

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A LFT: 8a Key Factor: CHS winter parr Secondary Factor: CHS fry-summer parr	Strategy: 1, 2, 3, 4, 5, 6 , via, Land Use Management to address issue of - Physical Habitat Quality	223 - SUB -MK Priority: 1	Continue to implement the McKenzie WS Council's "Action Plan for Recreation and Human Habitat".	1. Support "possible actions" in Chapter 5, Goals 1 and 3 of the plan. 1.1. ID planning or zoning actions that would minimize future urbanization impacts in lower subbasin	0	within 15 yrs	TBD	---	---	---	McKenzie Watershed Council, local governments, private landowners
Listing Factor: A LFT: 8a Key Factor: CHS winter parr Secondary Factor: CHS fry-summer parr	Strategy: 1, 2, 3, 4, 5, 6 , via, Land Use Management to address issue of - Physical Habitat Quality	224 - SUB -MK Priority: 2	Implement the "Lane County Riparian Development Ordinance."	1. Evaluate and correct barriers to implementation. 2. Evaluate sufficiency of existing Ordinance for future urbanization and climate change impacts.		within 15 yrs	TBD	---	---	---	Lane County, USBLM

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A LFT: 8a Key Factor: CHS winter parr Secondary Factor: CHS fry-summer parr	Strategy: 1, 2, 3, 4, 5, 6 , via, Land Use Management to address issue of - Physical Habitat Quality	225 - SUB -MK Priority: 2	Coordinate projects of the McKenzie River Trust to implement priority habitat restoration projects.	1. Align/crosswalk MRT projects with Recovery Plan priorities.	Lower McKenzie and mainstem Willamette.	within 15 yrs	TBD	---	---	---	McKenzie River Trust, Watershed Council, ODFW, USBLM
Listing Factor: A LFT: 8a Key Factor: CHS winter parr Secondary Factor: CHS fry-summer parr	Strategy: 1, 2, 3, 4, 5, 6 , via, Land Use Management to address issue of - Physical Habitat Quality	226 - SUB -MK Priority: 3	Coordinate projects with the "Friends of the Mohawk" to implement priority habitat restoration projects.	1. Align/crosswalk FOM projects with Recovery Plan priorities.	Mohawk subbasin	within 15 yrs	TBD	---	---	---	ODFW

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A LFT: 10d Key Factor: CHS fry-winter parr Secondary Factor: none	Strategy: 1, 5, 6, 7, 8 , via, Flood Control / Hydropower to address issue of - Water Quality / Quantity / Hydrograph	227 - SUB -MK Priority: 1	Operate Trail Bridge Dam to minimize adverse effects of ramping on fish stranding, redd desiccation, and loss of habitat in the McKenzie River downstream of Trail Bridge.	1. Identify appropriate ramping rates at various flows below Trail Bridge. 1.1. OWEB to implement FERC agreement and operate Trail Bridge dam to meet downstream ramping rate limits	0	See FERC	---	---	---	---	EWEB
Listing Factor: A LFT: 9g Key Factor: none Secondary Factor: CHS egg-alevin	Strategy: 1, 5, 6, 7, 8 , via, Flood Control / Hydropower to address issue of - Water Quality / Quantity / Hydrograph	228 - SUB -MK Priority: 1	Operate McKenzie subbasin WP flood control/hydropower projects to mimic natural temperature regime, while at the same time complementing the downstream passage benefits of spilling, and minimizing exceedence of TDG (total dissolve gas) below projects, and managing ramping rates to minimize stranding of early Chinook life stages.	1. Temperature control is now possible at Cougar Dam with the Selective Withdrawal Tower installed in 2005 1.1. use RME under WP RPA 5.4 to evaluate the effects of the Cougar temperature structure operation on TDG 1.2. resolve remaining issues with ODEQ regarding TMDL temperature targets 1.3. evaluate whether temperature control at other WP facilities in the subbasin are needed in the future 2: Monitor TDG below each large dam to identify the operating and background conditions causing high TDG. 2.1. based on monitoring TDG, design structural and/or operational	0	on-going	---	---	---	---	USACE, EWEB, ODEQ

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
				modifications to dams to reduce project-related TDG exceedences							

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: E.1 LFT: 3a Key Factor: CHS adult Secondary Factor: none	Strategy: 4, 13 , via, Hatchery Management to address issue of - Population Traits	229 - SUB -MK Priority: 1	Until the Cougar downstream passage facility is completed and has demonstrated safe and timely passage, continue to supplement natural production in the subbasin by implementing the interim trap-and- haul measures described in the 2008 BiOp to outplant adult fish into historical habitat above the USACE Cougar flood control/hydropower complex.	1. Continue to implement and evaluate the experimental Outplant Program (as described in RPA 4.1), using hatchery fish to seed habitat above Cougar Dam, and evaluate outplant strategies and levels relative to best way to transition to a more formal reintroduction program using only natural-origin fish. 2. Based on Outplant evaluation studies, develop timelines and measurable criteria within the COP for eventual transition to a reintroduction program whereby above-dam natural fish production makes a significant contribution to overall population abundance and productivity to meet recovery goals. 3: Once above conditions are met, discontinue hatchery outplants and implement reintroduction of natural-origin fish to meet TRT diversity criteria and Recovery Plan D and SS criteria.	0	on-going	---	---	---	---	USACE, NMFS, ODFW

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: E.1 LFT: 3a Key Factor: CHS adult Secondary Factor: none	Strategy: 4, 13 , via, Hatchery Management to address issue of - Population Traits	230 - SUB -MK Priority: 1	Manage current CHS Harvest Mitigation Hatchery Program (HMP) facilities and broodstock to meet mitigation goals, but do so in a manner that the genetic and demographic impacts of program do not pose unacceptable risks to the remaining wild fish population or impede long term recovery goals of the McKenzie CHS population.	1. In the long term the VSP diversity target is to maintain an average total basin pHOS rate <10%, which is coupled with improvements in access and passage and other LFT's affecting capacity and productivity. To achieve this, promote a wild fish management zone for the subbasin above Leaburg Dam that has a feasible pHOS target of <5%. 2. In the short term, implement actions and associated RME at and below Leaburg Dam that will reduce the number of HOR fish that need to be sorted at Leaburg, and reduce the pHOS in the spawning areas below Leaburg Dam. 2.1. adopt new ODFW recommendations for lower level of integration of NOR broodstock, and pass only NOR fish above Leaburg Dam. 2.2. improve attraction flows and entry to McKenzie Hatchery 2.3. modify Leaburg Hatchery ladder facility to assist in removing HOR CHS and collecting NOR CHS for passage above Leaburg 2.4. minimize the recycling of HOR adults entering traps at Leaburg ladder and the hatcheries 2.5. increase harvest of	0	on-going	---	---	---	---	ODFW, NMFS, USACE

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
				HOR fish below Leaburg dam while minimizing risk to NOR fish 2.6. evaluate pHOS reduction effectiveness of the on-going partial program relocation (SAFE) 2.7. explore opportunities/feasibility of acclimating and releasing juvenile CHS at sites in lower McKenzie subbasin; modify harvest regulation zones as needed to shift fishery effort to those areas. 2.8. resolve technical/feasibility issues of upgrading Leaburg Dam EWEB facility with engineering subgroup to achieve better sorting and handling of wild fish, resolve any funding uncertainties with BPA 2.9. maintain HOR tagging efforts and CHS spawning surveys to support above efforts 3. Over long term, increase NOR fish production below and above Leaburg through WP BiOp RPA water quality/quantity improvements and other actions addressing LFT's. 3.1. once adult and juvenile passage issues are resolved at Cougar Dam through WP BiOP RPA's, develop a conservation strategy and allocation schedule where it is defined under what							

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quanti ty	Total Cost	Key Entities / Potential Implement ers
				demographic conditions and passage improvement conditions the HOR outplants above Cougar Dam could be phase out and replaced with reintroduction of NOR fish that enter the South Fork Mckenzie River. 4. Further program relocation or reduction will be considered if above measures do not meet long term pHOS goal.							

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: C.1 LFT: 6c Key Factor: none Secondary Factor: CHS fry-winter parr	Strategy: 10, 11, 13 , via, Hatchery Management to address issue of - Predation	231 - SUB -MK Priority: 1	Reduce number of hatchery STS released.	TBD	0	within 10 yrs	Baseline	---	---	N/A	ODFW
Listing Factor: C.1 LFT: 6d Key Factor: none Secondary Factor: CHS fry-winter parr	Strategy: 10, 11, 13 , via, Hatchery Management to address issue of - Predation	232 - SUB -MK Priority: 1	Evaluate the potential for reduction of predation on juvenile Chinook by reducing or discontinuing releases of hatchery trout in the McKenzie River upstream of Leaburg Dam.	TBD	0	within 10 yrs	Baseline	---	---	N/A	ODFW
Listing Factor: C.1 LFT: 6d Key Factor: none	Strategy: 10, 11, 13 , via, Hatchery Management to address issue of -	233 - SUB -MK Priority: 1	Release hatchery trout in areas and during periods when Chinook are not as susceptible to predation.	TBD	0	within 10 yrs	Baseline	---	---	N/A	ODFW

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Secondary Factor: CHS fry-winter parr	Predation										
Listing Factor: C.1 LFT: 6d Key Factor: none Secondary Factor: CHS fry-winter parr	Strategy: 10, 11, 13 , via, Hatchery Management to address issue of - Predation	234 - SUB -MK Priority: 1	Evaluate predation by hatchery trout and conduct a net benefit analysis on the effects of hatchery trout releases on bull trout population size in Trail Bridge Reservoir.	TBD	0	within 10 yrs	Baseline	---	---	N/A	ODFW

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A.2 LFT: 2e Key Factor: CHS adult Secondary Factor: none	Strategy: 4 , via, Flood Control / Hydropower to address issue of - Habitat Access	235 - SUB -MF Priority: 2	Within the 2008 BiOp COP process and BRT activities, evaluate further whether eventual reintroduction and production above Hills Creek Dam is a viable alternative to other remedies for improving VSP criteria to meet desired status risk level (Chinook-Low).	- Current WP BiOp does not formalize specific passage improvements for Hills Creek Dam, but indicates outplant sites may be established above dam, presumably from collections at new Dexter facility. In support of determining future passage needs in next term of BiOp, implement actions in current WP BiOp: 1. As other LFT's improve and NOR abundance increases above Lookout Pt., monitor adult fish movement below Hills Creek dam to determine if large numbers of Chinook congregate below Hills Creek. 1.1. if so, evaluate within COP studies the feasibility of a future adult fish facility below the dam, relative to the benefits of continued trap-and-haul from the new Dexter facility 1.2. in support of this effort, implement the juvenile downstream passage assessments described in WP-RPA's 4.10 and 4.11 2. Use these data and results within language of WP-RPA 4.12 to support BRT SLAM modeling to reduce uncertainty regarding need to improve downstream survival at Hills		within 25 yrs	TBD	---	---	---	USACE

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
				Creek - needed to support decisions regarding need to construct and operate new downstream fish passage facility at Hills Creek Dam in next term of the WP BiOp							
Listing Factor: A.2 LFT: 1f Key Factor: CHS smolt	Strategy: 4 , via, Flood Control / Hydropower to address issue of - Habitat	236 - SUB -MF Priority: 1	Provide safe and effective downstream passage through the Dexter/Lookout Point flood Control/hydropower complex to benefit all size classes of juvenile migrants produced above Lookout Pt. Dam.	1. Manage reservoir levels for more normative flows (pre-dam flows) to pass inflow year round, except during flood control operations. Alternatives to be considered in the WP BiOp 2008 are: 1.1. WP-RPA 4.8: Evaluates interim measures to improve	0	RPA 4.8: Interim downstream measures within COP process, including full reservoir drawdown (but not specific to	WP BiOp	---	---	---	USACE

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Secondary Factor: none	Access			downstream passage within Project constraints, within COP process. Measures could include partial or full reservoir drawdown, and use of spillway. Includes evaluating dam & facility constraints on how far down the reservoirs could be dropped. Need to assess cost/benefits of this action, relative to authorizations, storage loss for flow augmentation, and pollution abatement. Therefore it is unclear that a drawdown alternative will be chosen method to aid downstream migrants and that WP-RPA 4.8 will result in meaningful improvements. 2. WP-RPA 4.9: Build, evaluate, and report on effectiveness of Head of Reservoir (HOR) prototype above Lookout Pt. Dam. Permanent HOR does not occur if not effective at increasing overall productivity above Lookout Point. 3. WP-RPA's 4.10 and 4.11: Supporting studies to evaluate passage improvement alternatives through Lookout Pt/Dexter reservoirs and dams 4. WP-RPA 4.12.2: Investigate feasibility of fish passage at Lookout Pt.		this dam complex). Implement chosen interim measures by 5-2011 RPA 4.9: HOR prototype report by 12-2016 (See BiOp 2008 timelines for assessing/reporting options)					

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
				Dam. Based on studies and design alternatives, construct new downstream fish passage facility by 2021. - does not secure guarantee structural downstream passage improvements at Lookout Pt. Dam							
Listing Factor: A.2 LFT: 1f Key Factor: CHS smolt Secondary Factor: none	Strategy: 4 , via, Flood Control / Hydropower to address issue of - Habitat Access	237 - SUB -MF Priority: 1	Provide safe and effective downstream passage through Fall Creek reservoir and dam.	1. Implement WP-RPA 4.8.1 to drawdown in autumn as an operational measure to reduce smolt injury, supported by effectiveness RME. 1.1. WP BiOp entities clarify timeline and standard for evaluating this drawdown option. 2. If drawdown is deemed insufficient to provide safe and effective passage, evaluate other operational measures through WP-RPA 4.8 and WP-RPA 4.13 (COP process). 2.1. study conceptual alternatives for downstream passage through dam complex based on fish distribution in the reservoir. 2.2. based on COP studies and design alternatives, consider construction and operation of structural protections and/or fish bypass facilities	0	on-going start fall flow modifications in 2008	Baseline	---	---	N/A	USACE

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A.2 LFT: 1f Key Factor: CHS smolt Secondary Factor: none	Strategy: 4 , via, Flood Control / Hydropower to address issue of - Habitat Access	238 - SUB -MF Priority: 1	Provide safe and effective downstream passage through Hills Creek reservoir and dam.	1. Within WP-RPA's 4.10 and 4.11, assess passage through Hills Creek reservoir and dam. 2. Use these data and results within language of WP-RPA 4.12 to support SLAM modeling to reduce uncertainty regarding need to improve downstream survival in the future - needed to support decisions regarding need to construct and operate new downstream fish passage facility at Hills Creek Dam in next term of the WP BiOp	0	within 25 yrs	Baseline	---	---	N/A	USACE
Listing Factor: A.2 LFT: 2e Key Factor: CHS adult Secondary Factor: none	Strategy: 4 , via, Flood Control / Hydropower to address issue of - Habitat Access	239 - SUB -MF Priority: 1	(see relation to LFT 2m) Reduce pre-spawn mortality by reducing injury and stress related to fish handling at and above USACE facilities.	1. WP-RPA 4.6 to rebuild, operate, and maintain the Adult Fish Collection and handling facilities below Dexter and Fall Creek dams for expanded and improved sorting and handling of wild and hatchery fish. 2. Support objective of WP-RPA 4.6 by implementing WP-RPA's 4.3, 4.4, and 4.5 to improve and standardize handling and transport protocols, and by implementing WP- RPA 4.7 to improve and increase the number of suitable outplanting sites above Lookout Pt. Dam, Hills Creek Dam, and Fall Creek dams. 2.1. assess through RME whether these show demonstrable improvement	0	RPA 4.6 Dexter facility operational by March 2015 Falls Creek facility operational by March 2016	Baseline	---	---	N/A	USACE

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A.2 LFT: 2e Key Factor: CHS adult Secondary Factor: none	Strategy: 4 , via, Flood Control / Hydropower to address issue of - Habitat Access	240 - SUB -MF Priority: 1	Until downstream passage facilities are completed and have demonstrated safe and timely passage, supplement natural production in the subbasin by implementing the interim trap-and-haul measures described in the 2008 WP BiOp to outplant adult fish into historical habitat above Fall Creek, Dexter/Lookout Pt, and Hills Creek Dams	1. Continue to implement and evaluate the experimental Outplant Program (described in WP-RPA 4.1), using hatchery fish to seed habitat above Foster Dam, and evaluate outplant strategies and levels relative to best way to transition to a more formal reintroduction program using only NOR fish. 2. Based on Outplant evaluation studies, develop timelines and measurable criteria within the COP for eventual transition to a reintroduction program whereby above-dam natural fish production makes a significant contribution to overall population abundance and productivity to meet recovery goals. 3. Once the above conditions have been met, discontinue hatchery outplants and implement reintroduction of NOR fish to meet TRT diversity criteria and Recovery Plan diversity and spatial structure criteria.	0	on-going	---	---	---	---	USACE

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A.1 and A.2 LFT: 2m Key Factor: CHS adult Secondary Factor: none	Strategy: 4, 8 , via, Flood Control / Hydropower to address issue of - Habitat access & Water Quality	241 - SUB -MF Priority: 1	(see LFT 2e for handling actions) Resolve uncertainty of any remaining pre-spawn mortality not associated with injury and stress associated with Middle Fork Willamette Collection facilities.	1. Improve water quality in subbasin below MF Willamette dams by implementing WP RPA's 5.1 and 5.2 for water quality to meet adult fish needs by resolving inadequacies of temperature and TDG profiles. 2. Monitor metrics of fish health at different times and locations above Willamette Falls to further delineate whether the problem is solely related to Flood Control/hydropower effects, or is exacerbated by other issues that impact fish condition and maturity (i. e. disease, toxins). - this is not a current WP BiOp RPA)	0	within 25 yrs	TBD	---	---	---	USACE

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A LFT: 7f Key Factor: CHS egg-alevin Secondary Factor: none	Strategy: 1, 2, 5, 6 , via, Flood Control / Hydropower to address issue of - Physical Habitat Quality	242 - SUB -MF Priority: 1	(same as for LFT 7c [NS] and 7e [MK]) Increase retention and sourcing of gravels and other materials below USACE facilities with a combination of habitat improvements, targeted flows, and augmentation.	1. (WP RPA 7.2) Improve channel complexity below dams with existing habitat restoration and enhancement program on USACE lands. 2. Augment depleted areas below dams with most appropriate source and size composition. 2.1. provide appropriate channel complexity to retain material. 3. (WP RPA 7.1.2) Prioritize some projects within the comprehensive habitat restoration program to include projects that improve incubation habitat. 4. (WP RPA 7.3) Implement to collect large wood in USACE reservoirs, and strategically promote placement of this wood in areas below dams that promote sourcing of incubation gravels. 5. To the extent that restoration at revetment sites implemented through WP RPA 7.4 leads to greater interaction and movement of floodplain substrates, fund as high priority projects those that produce incubation gravels. 6. Couple these improvements with	0	within 25 yrs	WP BiOP	---	---	N/A	WP BiOp action agencies

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
				Environmental Flow opportunities as described in RPA 2.7. to distribute gravel and other materials.							

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A LFT: 7g Key Factor: none Secondary Factor: CHS egg-alevin	Strategy: 1, 2, 5, 6 , via, Flood Control / Hydropower to address issue of - Physical Habitat Quality	243 - SUB -MF Priority: 2	(see actions associated with LFT 7f) Restore substrate recruitment and reduce streambed coarsening below dam projects.	TBD	0	within 25 yrs	WP BiOP	---	---	N/A	WP BiOp action agencies
Listing Factor: A LFT: 8a Key Factor: CHS winter parr Secondary Factor: CHS fry-summer parr	Strategy: 1, 2, 3, 4, 5, 6 , via, Land Use Management to address issue of - Physical Habitat Quality	244 - SUB -MF Priority: 1	If it does not exist, develop proactive framework to minimize future urbanization impacts in Lower Middle Fork Willamette Basin	1. Evaluate and synthesize existing regulatory urbanization provisions and projections relative to salmonid needs.	Eugene/Springfield urban interface	within 15 yrs	TBD	---	---	---	Lane County Council of Governments

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A LFT: 8a Key Factor: CHS winter parr Secondary Factor: CHS fry-summer parr	Strategy: 1, 2, 3, 4, 5, 6 , via, Land Use Management to address issue of - Physical Habitat Quality	245 - SUB -MF Priority: 1	Evaluate the restoration opportunities identified in the Lower MF Willamette Watershed Assessment (2002) for riparian and aquatic habitat, with emphasis on CHS.	TBD	0	within 15 yrs	TBD	---	---	---	SWCD, NRCS, MF Watershed Council
Listing Factor: A LFT: 8a Key Factor: CHS winter parr Secondary Factor: CHS fry-summer parr	Strategy: 1, 2, 3, 4, 5, 6 , via, Land Use Management to address issue of - Physical Habitat Quality	246 - SUB -MF Priority: 1	Implement the "high priority actions" that benefit CHS identified under each of the six Goals in MF Willamette Watershed Council's Action Plan.	TBD	0	within 15 yrs	TBD	---	---	---	MF Watershed Council

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: A LFT: 8a Key Factor: CHS winter parr Secondary Factor: CHS fry-summer parr	Strategy: 1, 2, 3, 4, 5, 6 , via, Land Use Management to address issue of - Physical Habitat Quality	247 - SUB -MF Priority: 2	Identify priority sites in the Lower Middle Fork Willamette subbasin where habitat protection is needed and restoration is desirable, design restoration projects, implement work, and monitor.	1. Use the Middle Fork Willamette WS Council Action Plan to identify high priority reaches for conservation and restoration actions. - Restoration projects include: reconnect side channels and wetlands to increase channel complexity, place large wood, boulders or other structures, restore riparian habitat, add gravels to restore spawning habitat. - Modify revetments to replace hardened bank structures with more natural bank treatments.	TBD	within 15 yrs	TBD	---	---	---	USACE, MFW WS Council, landowners, Cities of Eugene and Springfield
Listing Factor: A LFT: 9f Key Factor: CHS egg-alevin Secondary Factor: none	Strategy: 1, 5, 6, 7, 8 , via, Flood Control / Hydropower to address issue of - Water Quality / Quantity / Hydrograph	248 - SUB -MF Priority: 1	Operate WP flows in MF subbasin to mimic the natural temperature regime in the fall	- A water Temperature Control Facility would presumably need to be constructed, which is not a certainty in current term of the WP BiOp	0	within 25 yrs	WP BiOP	---	---	N/A	WP BiOp Action agencies, NMFS

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
Listing Factor: E.1 LFT: 3a Key Factor: CHS adult Secondary Factor: none	Strategy: 4, 13 , via, Hatchery Management to address issue of - Population Traits	249 - SUB -MF Priority: 1	Manage current CHS Harvest Mitigation Hatchery Program (HMP) facilities and broodstock to meet mitigation goals, but do so in a manner that the genetic and demographic impacts of program do not pose unacceptable risk to extant NOR fish populations or compromise long term productivity of a reintroduction stock that would preclude success of conservation reintroduction/supplementation program above MF Willamette dams.	1. In the long term the VSP CHS diversity target is to maintain an average total basin pHOS rate <10%, which is coupled with improvements in access and passage and other LFT's affecting capacity and productivity. Promote a short and long term conservation hatchery strategy that will lead to a viable naturally-produced population, focused in the area above MF Willamette dams. 2. Actions and goals to control pHOS are modest below Dexter and Falls Creek dams (unless pseudo-isolation becomes an issue) but to minimize further genetic risk impacts for a future reintroduction effort using MF Willamette HMP stock, actions in the short term could include: 2.1. improve trap attraction, operation, and sorting at new Dexter facility 2.2. adjust juvenile rearing and release strategies as feasible 2.3. evaluate and Implement HGTG guidelines for reducing genetic impacts 2.4. maintain HOR tagging efforts and CHS spawning surveys to support above efforts 2.5 adopt new ODFW recommendations for level	0	on-going	---	---	---	---	ODFW, NMFS, USACE

CH 3 Listing Factor and CH 5 LFT	CH 7 Strategy or CH 6 VSP objective	Action ID and Priority	Recovery Action	Sub Action or Task	Focal Locations or Program	Schedule	Cost Basis	Unit Cost	Quantity	Total Cost	Key Entities / Potential Implementers
				of integration of NOR broodstock 3. Over long term, further develop a conservation supplementation (reintroduction) program (CSP) or set of strategies to be implemented above Fall Creek, Lookout Pt., and Hills Creek dams. 3.1. improve other LFT's associated with passage and pre-spawn mortality, then commence reintroduction 3.2. adopt as template the new ODFW recommendations for reintroduction and modify as needed based on results of scientific review of program type 4: After Recovery Plan is adopted, develop a new HGMP with conservation details.							
								Sub Total		$105,106,114	
								Total		$265,934,439	

9.2 Action Implementation

ODFW and NMFS acknowledge the many organizations that have been active in supporting habitat protection and restoration in the Willamette Basin, including local, State, tribal and Federal government and numerous non-governmental entities. Some have resources to contribute, some need additional resources. We also understand that implementing the ESA is not the only priority in the Basin, so the Plan will be most successful if it partners with and supports ongoing efforts that contribute to a functioning ecosystem that will support native species and human society, together, for the long term

The Plan used a comprehensive approach to identify the most important recovery strategies and actions that would reduce the LFTs that inhibit the recovery of UWR Chinook and steelhead. Section 9.1.1 describes a number of criteria for establishing priorities that an guide ODFW, NMFS and the numerous recovery implementation partners. This Plan relies on existing legal mandates to fund and implement many of the actions, but also relies on voluntary implementation of other proposed recovery actions. Within existing laws, regulations and agreements, ODFW and NMFS assume that that regulatory agencies will use this Plan to guide their decisions. This Plan is not a regulatory document, in that it does not require other agencies to implement actions. However, we assume that existing regulatory programs will continue to be funded and implemented and that regulatory agencies will use the Plan as a resource as they implement existing laws, regulations and agreements. If assessments and monitoring indicate that the status of the fish and the threats is not improving, more restrictive management, and possibly new or enhanced regulatory programs, may be necessary.

Given the numerous years that UWR Chinook salmon and steelhead have been listed under the federal ESA (Table 1-1), many entities have already implemented and continue to implement recovery actions based on: 1) draft versions of this Plan, and 2) the known conservation and recovery need of these ESUs. This Plan helps guide and prioritize the actions already being implemented at the population and ESU/DPS scales, and identifies other necessary actions at those scales to meet the recovery goals identified in Chapters 6 and 10.

Implementation Challenges

Despite the projection that desired status objectives for most, if not all, UWR Chinook and steelhead populations are achievable, there are significant challenges with respect to implementing enough actions and with enough intensity, to reach recovery goals. In addition, the developers of this Plan acknowledge that there may be alternative recovery actions to those proposed in this Plan, and it is anticipated that actions designed to meet a specific recovery objective may vary due to logistics, funding constraints, or an organization's authorities and administrative processes. Due to the voluntary nature of many of the actions in this Plan, there is uncertainty how long it will take to meet full implementation.. Factors beyond the control of this Plan include: 1) the funding obstacles and actual costs associated with recovery actions as they compete with other societal objectives in times of economic hardship at the local, State, and Federal level for both private and public entities, 2) the associated timeliness necessary to improve the status of certain populations, 3) the social feasibility of some actions where there is conflict with other societal goals and uncooperative or uninterested potential partners, and 4) initial uncertainty of technological feasibility and evaluation of some actions. In addition, as highlighted elsewhere in this Plan, there are projections of significant emerging threats to the listed ESU/DPS, manifested through climate change and human population growth.

Funding Strategies

Given the challenges of Plan implementation, and the large price tag associated with this and other recovery plans, and the limited funding available to address conservation and recovery actions within and across populations, and the region, ODFW and NMFS recommend that agencies take an integrated, strategic approach to funding to the extent possible. Project solicitations and selection for funds from the NPCC Fish and Wildlife Program/BPA, OWEB, NMFS Mitchell Act program, and others should take Plan priorities into consideration to address limiting factors and threats identified in the Plan to the extent possible. In addition, these funding entities should adopt overarching strategies consistent with the following:

- within the ESU and DPS, place a majority of funds in high priority actions and locations
- within the ESU and DPS, reserve some proportion of funds for lower priority actions and locations to encourage and engage ESU/DPS-wide conservation and recovery participation and achieve local Plan goals
- report funding activities in order to measure progress toward Plan objectives
- coordinate and standardize reporting metrics to assure they are appropriate for tracking purposes
- encourage innovative funding approaches such as targeted Requests for Proposals (RFPs) and Strategic Investment Partnerships (SIPs).

Decision Making and Implementation Structure

As discussed earlier, ODFW and NMFS acknowledge the numerous forums, groups, formal and informal partnerships, and involved citizens involved in some aspect of land and fish/wildlife conservation efforts. However, it is unclear how well these entities are functioning, coordinated, or governed within a conservation network, and there is some uncertainty on best approach for integrating UWR ESU/DPS actions, monitoring standards, and feedback mechanisms into such a network. To address these uncertainties, subsequent to completion of the Plan, ODFW and NMFS intend to publish an Implementation Schedule that will provide details of strategies, actions and timelines for implementation. Our goals for implementing the Plan and Implementation Schedule include establishing efficient and effective communication and coordination between and within numerous entities. On the one hand, we want to provide a structure for meeting and tracking progress towards recovery goals, linking with ongoing efforts and communicating clear policy and management messages. On the other hand, we want to avoid the formation of unnecessary standing committees and a ‘recovery bureaucracy’ in the Willamette.

We therefore propose the establishment of a Willamette Recovery Coordination Team (WRCT) to link:1) the many implementers of “on-the-ground” actions (including the Willamette Project BiOp WATER steering committee, State and Federal agencies, tribes, local governments, watershed councils and, non-governmental organizations (referred to here as action teams) and 2) RME programs that track results of such actions. The WRCT will be responsible for ESU/DPS-level reporting and coordinating (Figure 9-1).

The WRCT would o facilitate information exchange regarding: 1) Plan action priorities at local scales, 2) how to effectively implement those local priorities within other regional conservation efforts and coordinated funding strategies, 3) technical issues and resources, and 4) linkages to State, ESU/DPS, and regional forums. The WRCT will adapt and change the implementation schedule and coordination efforts as necessary to adjust to funding, available resources, and implementation needs.

Functionally, those involved in the plan implementation serve in two broad roles: coordination/facilitation (WRCT) and the several *Action Teams.* The WRCT will include

- ODFW Conservation and Recovery Program
- ODFW NW Region
- NMFS Salmon Recovery Branch
- NMFS Production and Inland Fisheries Branch

- OWEB
- GNRO

The WRCT provides oversight and vision to Recovery Plan implementation, serves as the sounding board for input from stakeholders on plan progress and direction, and convenes regional workgroups as needed. This team is the responsible entity for reporting ESU/DPS assessments to NMFS and shares accountability for species recovery in this Management Unit.

The following is an outline of the letter-coded functions in Figure 9-1, with a general description of the *Coordination Team* function.

A. ESU Coordination: WRCT coordinate with WATER BiOp Steering and Management teams for WP BiOp priority strategies, actions, and schedules.

   - *WP BiOp Action Teams* implement VSP and Listing Factor priority actions in WP BiOp implementation schedule

B. Priorities & Schedules: WRCT members help define priorities and coordinate 3-year implementation schedules with actions in other programs (WP BiOp habitat RPAs, TMDL WQMPlans, other) and watershed action plans. These schedules outline priorities for implementing the Plan in the upcoming years, and will be shared with habitat action teams and other entities involved in Recovery Plan implementation, including watershed councils, SWCDs, government agencies, other implementers, and the general public. First priority may be to complete a watershed assessment or a subbasin specific action Plans to determine specific locations for priority actions (if this has not already been done).

C. Funding: WRCT members (OWEB) coordinate with other funders (WATER-HTT, BPA/ODFW Wildlife mitigation, others) to package and fund acquisitions and restoration actions. The funding sources identified in the Plan or in the 3-year implementation schedule will be made aware of the schedule priorities and asked to adopt or support those priorities (Note: Many of the large WP BiOp actions are on fixed schedules within the terms of that document, but the WRCT will coordinate these schedules with non-BiOp actions).

D. Action Teams: WRCT member facilitate action implementation by managing database of potential implementers and connecting them for funding opportunities and priorities. Outreach and education is subcomponent.

   - *Habitat Action Teams* implement priority VSP and Listing Factor actions in 3-year implementation schedule. It will be up to the action teams coordinate internally to seek implementation commitment from local stakeholders and volunteers, and to regularly communicate with other implementing organizations to keep them informed on Plan implementation issues. Watershed Councils, SWCDs, cities, counties, land managers and other implementers will use the action priorities outlined in the three-year Implementation Schedules to identify projects to implement and seek funding.

E. RME Coordination: WRCT members coordinate with those implementing the Willamette Project BiOP RME and other ESA RME for program funding/development.

   - *RME Action Teams* implement WP BiOp RME program; integrate supplemental monitoring where there are gaps in other subbasins and Willamette mainstem

F. Reporting System: WRCT members coordinate development and maintenance of tracking and reporting system that is fed by four RME subcomponents. The Team will develop a reporting/tracking system for gathering information from implementers (including public agencies), and their funding entities, and develop annual reports on implementation accomplishment. These reports will be shared with implementers, funding entities, Oregon Plan Teams, and the general public. Annual reports will be used to assess the what was accomplished during the implementation period at the population and ESU level. The ESU Coordination Team will use the tracking system to periodically (quarterly or annually) review progress towards implementation of priority actions and to summarize local implementation needs for more effective progress in implementation (i.e., Watershed Council support, garnering support from key landowners or entities, resolve uncertainties in applying best approach for implementing priority actions, funding initiatives and facilitation, etc.)

G. Status Reports/Assessments: WRCT members coordinate generation of 1- and 5-year status reports and 12-year ESU assessment reports. Reports on RME results will be reported to the ESU Coordination Team to facilitate adaptive management. These results and any modifications to Plan implementation arising from the results will be conveyed to the action teams.

H. Adaptive Management: WRCT team coordinate alternative management direction, based on population performance during reporting and assessment cycles

I. Other Planning Forums: ESU-CT team coordinate with strategy and direction in other regional conservation planning efforts that have bearing on VSP and Listing Factor actions.

J. Policy Interface: WRCT team interact in policy venues in other natural resource regimes (example: Oregon Plan Core team, others)

The *Action Teams* will be comprised of various groups depending upon action type, location, or internal function. *Habitat Action Teams* will integrate their efforts with the various State agency teams associated with the Oregon Plan for Salmon and Watersheds, but priorities for UWR Chinook and steelhead projects will be guided by this implementation plan.

Habitat Action Team members will likely include members of the UWR Stakeholder Team (cities, utilities, private forest and agriculture representatives, conservation groups, Federal representatives, watershed councils, SWCD’s) and other local stakeholders, interest groups, tribes and governments that are involved in land and aquatic resource management. This diverse group represents differing perspectives, missions, and geographic areas, but will function with the overall objective of collectively working together to achieve and advance Recovery Plan habitat objectives. These teams are comprised of the various local entities implementing local restoration and conservation actions via their respective authorities, mandates, missions, and work plans, and include watershed councils, SWCD’s, Federal and State agencies, local governments, tribes, conservation groups, and utilities. Habitat teams will be encouraged to form informal and formal partnerships within subbasins and major reaches of the mainstem Willamette to achieve fish recovery and watershed goals. Many of these collaborative partnerships already exist. For example, many watershed councils currently function in this capacity with representation from a diverse set of interest and action groups. As appropriate, teams can form leadership roles for some members to facilitate coordination with the WRCT to support development of three-year implementation schedules, plans, and reports, and other project information. Team membership will be voluntary and the teams can determine any internal governance structure. These habitat Teams will lead the promotion of public involvement through outreach, education, and volunteer opportunities.

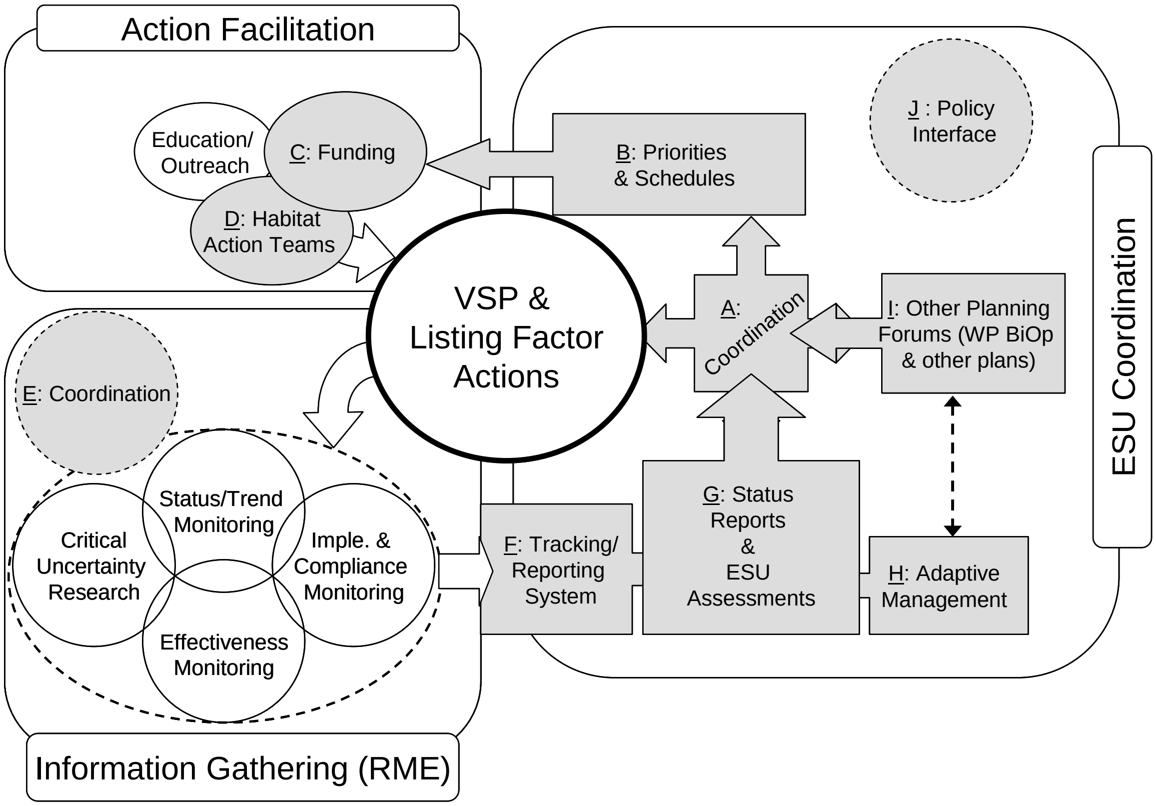

Figure 9-1. General structure and function of the implementation and adaptive management processes for the UWR Plan. See text for details.

9.3 Adaptive Management

Implementation of the Plan will be guided with an adaptive management process. UWR salmon and steelhead have complex life cycles which traverse habitats from high elevation tributaries to the open ocean. Life history strategies are diverse and life stage specific habitat requirements are complex. As described earlier in this Plan, there are many LFTs that influence the viability of UWR Chinook and steelhead at all life stages. The suite of proposed management actions to address primary limiting factors and threats across the entire life cycle is equally broad and diverse. Although the limiting factors and threats, as well as the management actions, have been developed based on best available science, there remains considerable uncertainty regarding the outcomes and effectiveness of the proposed management actions and the status of populations. It is this uncertainty which generates the essential need for an effective adaptive management process.

A successful adaptive management process requires an understanding of how and why salmon and steelhead and their associated habitats respond to the management actions taken to improve their status. In addition, success requires a decision framework and process which considers new information in the development of future management actions. This Plan does not preclude the development of future, more detailed comprehensive actions at a later date through regulatory processes (e.g., BiOp, NEPA and ESA; HGMP development), assuming they be advised by the overarching strategies identified in this Plan.

A detailed RME Plan is presented in Chapter 8 which provides the foundation for gathering and synthesizing the essential information needed for adaptive management of this salmon and steelhead recovery effort. Information needs fall into four categories: 1) status and trends monitoring; 2) implementation and compliance monitoring; 3) action effectiveness monitoring; and 4) critical uncertainty research. The RME Plan links the biological and physical responses to the management actions.

Adaptive Management Plan

The Plan is intended to describe key elements for immediate implementation and also provide a strategic means of improving management decisions in the future – in essence, to be a living document. This will be done through an adaptive management process that will allow for the continual assessment of the effectiveness of management strategies and actions to improve the status of UWR Chinook and steelhead. Through the analyses of RME data, the Oregon Plan Core Team, Regional Management Team, and other advisory groups will be able to determine if the premise of the Plan – that the management strategies will be able to help the ESU and DPS achieve desired status – is accurate. If not, the adaptive management process will allow for the State of Oregon to consider a different premise.

The adaptive management process for the Plan will utilize the information gathered from the RME Plan to evaluate the effectiveness of the Plan in achieving its goals. This information will be considered at regular intervals to assess the progress in population and ESU/DPS health, along with the success of implementing actions and the effectiveness of those actions. These regular assessments will occur at three levels and within an implementation governance framework described above.

1. Annual status reports. The WRCT will direct production of a brief annual report that reviews the most recent data available for the ESU/DPS. This annual report will serve as an *early warning system, meaning reductions in abundance could* alert us to unexpectedly adverse marine conditions; management conditions; biological characteristics of the UWR fish populations; or the habitat that supports the ESU/DPS. The annual report will also formally document adaptive management decisions and actions, as well as how they relate to actions, desired statuses, and delisting threat reduction scenarios in this Plan.

2. Five-year status report. Oregon will provide RME information to NMFS for their five-year status reports, including a succinct status report regarding implementation of commitments by agencies, restoration work accomplished, and summarizing salmon, steelhead and habitat data available by population.

3. Twelve-year ESU/DPS assessment. Produce a comprehensive assessment of the status of the ESU and DPS, conducted by an appropriate team of scientists from different agencies. The assessment will include viability metrics, trends in habitat, and implementation and effectiveness of restoration and management commitments. This assessment would be similar in scope to the 2005 Oregon Coastal Coho Assessment (ODFW 2005b). Depending on the outcome of this thorough 12-year assessment, the periodicity of future detailed assessments may be adjusted.

The adaptive management process will play out on different levels as the Plan is implemented. Annual RME information collected will be reviewed to determine the effectiveness of large-scale strategies and actions, and in some cases, site-specific actions. Those actions found to be ineffective will be discouraged. New actions based on the results of research may be proposed to more effectively implement a strategy. The State will make these responsive adjustments as more information is collected. Considering changes to strategies will be a more deliberative process.

Assessing the effectiveness of the Plan, including its strategies, will be conducted in 2023, and periodically thereafter. An assessment will also be considered if information suggests there has been a significant decline in the health of any of the ESU/DPS (i.e., the annual report will serve as an early warning system). Assessments of the Plan will be coordinated by the WRCT, with involvement of Oregon Plan teams, and will include public participation.

The adaptive management process can lead to changes in all aspects of the Plan. The review of information may suggest revision of one or more of the RME's measurable criteria, their metrics, or thresholds for passing. Any such revisions would involve NMFS and other co-managers. If the periodic assessment of this Plan's effectiveness shows that progress is not being made toward achieving the desired status of the ESU or DPS, it may be necessary to consider other approaches to obtain the improvements in survival needed. In this situation Oregon will convene the Planning Team and consider alternate approaches. The first alternative to consider would be whether the timeline identified for delisting is appropriate. If it is determined that the timeline is still appropriate, alternative actions should be considered. It is impossible to outline all of the potential alternatives to consider without knowing what the results of RME that may have been conducted have concluded. Some alternatives that may be considered include: implementing additional actions that have immediate benefits, such as those related to harvest and hatcheries; identifying actions that seek to increase the level of protective and restorative practices for tributary habitat, potentially shifting from mostly voluntary to more regulatory approaches; or developing new actions for threats that were not initially identified as limiting. This list of potential alternatives is not complete and these additional actions are not suggested at this time. They are only being provided as examples of what might be considered in the future.

Population Status Assessments

The effectiveness of this Recovery Plan to recover Chinook and steelhead in the Willamette basin will be determined by regularly assessing the status of each population over time. To determine the status of each population, an assessment will be made of each population's current status utilizing the interim measurable criteria identified in Chapter 8. A comparison of that current status to the population's status at the time the Plan was implemented, or the population's status at the time of the prior assessment, will be used to determine whether status has improved, remained the same, or declined. Status cannot be evaluated over a short period of time, but may be discernable prior to the full assessment period called for within each interim criterion (e.g., six straight years of lower than expected abundance and productivity would cause the abundance criterion to be considered unmet before the full 12 years had expired).
A decline in the status of any population would require Oregon to evaluate whether the decline is the result of ineffective actions, or unforeseen limiting factors and threats. If a population decline is indicated, the WRCT will convene appropriate entities and groups to consider the cause for the decline and the strategies and actions necessary to reverse the decline and set a trend towards recovery. The results of this assessment and proposed strategies and actions will be shared with the public and the legislature.
Assessments showing no change in population status, or improvement, will be utilized to determine if the strategies and actions implemented are as effective as anticipated. Action effectiveness will be considered during the 12-year review process.

Future NMFS Status Reviews and Plan Modifications

The future implementation of this Plan relies heavily on incorporating knowledge gained from research, monitoring, and evaluation of populations, limiting factors and threats, and the actions designed to achieve the desired statuses. As part of this adaptive management process, the ESA requires a review of all listed species at least once every five years. The NMFS interim recovery guidance (NMFS 2007b) requires that immediately following this five-year review, approved recovery plans will be reviewed, in conjunction with implementation monitoring, to determine whether or not the Plan needs to be brought up to date.

The NMFS Interim Recovery Guidance describes three types of Plan modifications: (1) an update; (2) a revision; or (3) an addendum. An update involves relatively minor changes. An update may identify specific actions that have been initiated since the Plan was completed, as well as changes in species status or background information that do not alter the overall direction of the recovery effort. An update does not suffice if substantive changes are being made in the recovery criteria or if any changes in the recovery strategy, criteria, or actions indicate a shift in the overall direction of recovery; in this case, a revision would be required. Updates can be made by NMFS and would be forwarded to stakeholders and cooperators, and posted on the NMFS website. An update would not require a public review and comment period. NMFS expects that updates will result from implementation of the adaptive management program for this Plan. Minor addenda such as information updates to implementation strategies also can be added to a Plan after it has been approved. A revision is a substantial rewrite and is required if major changes are needed in the recovery strategy, objectives, criteria, or actions. A revision may also be required if new threats to the species are identified, when research identifies new life history traits or threats that have significant recovery ramifications, or when the current Plan is not achieving its objectives. Revisions must include a public review and comment period.

Chapter 10: Broad Sense Recovery

This Chapter describes Oregon's goal of broad sense recovery. The earlier chapters in this Plan defined what NMFS considers will be necessary for the UWR ESU and DPS to be viable and delisted. Along with this definition, the chapters have described the 1) current status of the ESU and DPS and respective populations, 2) criteria and desired population statuses for delisting the ESU and DPS, 3) factors limiting the populations, and 4) the threat reduction actions needed to close the population conservation gaps from current statuses to desired statuses. If the actions identified in this Plan are adopted, we think the ESU/DPS delisting recovery goals will be achieved. Achieving the level of recovery defined in the threat reduction scenarios (Chapter 6) will result in a majority of the populations in the ESU and DPS remaining or becoming viable (low or very low risk) and the other populations remaining at current levels of risk or achieving less degree of extinction risk. Within this delisting scenario framework, some UWR Chinook and steelhead populations are not targeted for viable status, and these populations may provide lesser benefits to Oregonians than those with higher recovery goals. Under delisting criteria, these populations will provide insurance against an ESA listing, but they would only retain remnants of what they historically represented. Even for populations that are targeted to achieve viability, it is expected they will be able to withstand some level of incidental impact from fisheries targeting hatchery fish, but may not be healthy enough to accept additional risks such as direct harvest. Although returns of wild spawners will number in the several thousands in some populations in the ESU and DPS, they may not be numerous enough to seed the full capacity of a population area. As such, many stream reaches may remain unoccupied by wild Chinook salmon and steelhead, and many people will not be aware that they are living in ecosystems that are natural nurseries for anadromous salmonids, and that could support greater natural production and healthier linkages between salmonid life stages.

10.1 Goal for Broad Sense Recovery

For many Oregonians, maintaining salmon and steelhead populations as something close to museum pieces is not enough. The public advisory group that helped develop Oregon's Native Fish Conservation Policy (NFCP) recognized this and supported the objective of conserving Oregon's native fish at levels that can "provide recreational, commercial, cultural and aesthetic benefits … to present and future citizens" (ODFW 2003). The NFCP uses this statement as the basis for a desired status within each native fish conservation Plan. This objective also fulfills the mission of the *Oregon Plan for Salmon and Watersheds*, which is to restore "Oregon's native fish populations and the aquatic systems that support them to productive and sustainable levels that will provide substantial environmental, cultural, and economic benefits". The *Oregon Plan for Salmon and Watersheds* is founded on the principle that citizens throughout the region value and enjoy the substantial ecological, cultural and economic benefits that derive from having healthy, diverse populations of salmon and steelhead. Such a desired status is also considered in ESA recovery plans and has been called "broad sense recovery." Since this Plan serves as a State of Oregon Conservation Plan and has two desired statuses, we use the term "broad sense recovery" to represent the long-term goal of this Plan. The UWR Stakeholder Team that helped develop this Conservation and Recovery Plan discussed the idea of broad sense recovery early in the planning process. Based on those discussions a general goal for wild populations of salmon and steelhead in the UWR ESU and DPSs was developed.

<u>Broad Sense Recovery Goal</u>

Oregon populations of naturally produced salmon and steelhead are sufficiently abundant, productive, and diverse (in terms of life histories and geographic distribution) that the ESU and DPS as a whole (a) will be self-sustaining, and (b) will provide significant ecological, cultural, and economic benefits.

10.1.1 Broad Sense Recovery Criteria

The following criteria have been developed to help measure attainment of the broad sense recovery goal.

1. All UWR Chinook and steelhead populations have a "very low" extinction risk and are "highly viable" over 100 years throughout their historic range, and
2. The majority of UWR salmon and steelhead populations are capable of contributing social, cultural, economic and aesthetic benefits on a regular and sustainable basis.

The first criterion can be measured based on the risk of extinction over 100 years being less than 1% – the same metric for a population at very low risk. It is uncertain whether the achievement of this criterion in itself will lead to the achievement of the broad sense recovery goal, or if greater improvement in status is needed to achieve the second criterion of broad sense recovery. It can also be measured based on the abundance monitoring and targets identified in Chapter 8. The second criterion is much more subjective and will be based on value judgments made during the regular 12-year Plan assessments. These judgments will likely include a review of the amount and types of fisheries being supported by each wild population, the public perception of how healthy the populations are, and whether any cultural or aesthetic uses of the populations are being limited.

Broad sense recovery is a long-term goal for the UWR ESU and DPS. There are no rules or laws that require that it be achieved within a stated period of time; rather it will be a goal to measure progress against. Because the broad sense recovery goal requires all of the populations to be highly viable, the UWR ESU and DPS will achieve the delisting recovery goal before they achieve broad sense recovery. It is likely that some populations can achieve the first broad sense recovery criterion (very low risk of extinction) well before other populations. For a few populations, it appears possible to go beyond very low extinction risk, and for those populations (with a VL+ risk class in Table 10-1) the broad sense desired status is to achieve that higher level of viability.

10.2 Broad Sense Scenarios

The effort needed to achieve broad sense recovery for all of the populations is uncertain, but believed to be substantial and well beyond what is necessary to achieve the delisting scenarios. Table 10-1 shows the current and broad sense abundances for each population and the gap between the two under their respective broad sense scenarios. The current impacts can be found in the scenario tables in Chapter 6.

The amount of effort needed to achieve the threat reductions called for in Table 10-1 is difficult to determine. For this reason, a focus of this Conservation and Recovery Plan is defining the details of the threat reduction scenarios to meet population-level desired statuses for ESU and DPS delisting, and what must be done to achieve these desired statuses. Population recovery targets within the ESU and DPS delisting context are the first priority for this Plan, but population broad sense recovery is the long-term goal.

10.3 Strategies and Actions to Achieve Broad Sense Recovery

As mentioned above, it is likely that populations will reach their desired status for the ESU and DPS delisting scenario before they achieve broad sense recovery. As progress is made in implementing the actions identified in Chapter 7, the effectiveness and status monitoring identified in Chapter 8 will help define how much effort will be needed to achieve not only desired delisting status recovery, but broad sense recovery as well. The factors outlined in Chapter 5 that currently limit UWR salmon and steelhead from achieving the desired statuses defined in Chapter 6 threat reduction scenarios are also the same factors limiting the achievement of the broad sense scenarios. It will require reducing the impacts of those factors to the levels indicated in Table 10-1, a greater extent than required for the delisting threat reduction scenarios, to achieve the broad sense scenarios. Just as the same limiting factors must be addressed for broad sense as for desired delisting status, the same strategies and actions identified to achieve those statuses (Chapter 7) will need to be implemented for broad sense – only to a greater level or on a broader scale. As a result, no additional actions are identified in this Plan to achieve broad sense recovery. The quantity of work identified that must get done to achieve the threat reductions outlined in the delisting scenarios can be used to gauge how much additional work will be needed to achieve the threat reductions needed to achieve very low risk throughout the ESU/DPS.

The threat reduction scenarios identified for each population to achieve broad sense recovery (Table 10-1) outline the amount each threat category must be reduced. For those populations that there is confidence that they can achieve the broad sense scenario, the threat impacts for all but the freshwater habitat impacts show the same threat impact rate as was defined for desired status. This results in the required reduction in threat impact coming only from additional improvements in freshwater habitat. For the North Santiam, South Santiam, and Middle Fork Willamette Chinook salmon populations, it is unlikely to achieve the broad sense status of very low risk of extinction or beyond very low risk, and they are not included in Table 10-1. These scenarios are considered unlikely to be achieved because they call for reductions beyond what the Planning Team believed to be possible. For these populations, it will be necessary to monitor their status improvement as actions are implemented to achieve their delisting desired status.

Additional actions may be needed in some population areas to obtain the hatchery threat reductions associated with achieving very low risk (hatchery spawners comprising 10% or less of the natural spawners). Some, or most, of these reductions may be achieved through actions already proposed to address this threat in other populations' delisting scenarios (addressing stray hatchery fish from out-of-ESU/DPS areas). The same actions identified to remove hatchery fish in some populations under the desired status scenario would need to be implemented for those populations needing still further reductions in spawning hatchery fish under the broad sense scenario.

Additional threat reductions in estuary habitat will need to be reevaluated as the effectiveness of actions taken in the estuary become known. The threat reduction used in all of the population scenarios came from the proposed NMFS Estuary Module (NMFS 2008b) and was a hypothetical value the scientists suggested could be achieved if all actions identified in the Module were implemented to their fullest. Effectiveness monitoring may determine that greater benefit is being achieved from implemented actions than NMFS scientists thought. Until such evidence is found, no additional estuary habitat actions are proposed to achieve the broad sense scenarios. While the same tributary actions identified for achieving delisting scenarios in Chapter 7 will be needed for broad sense recovery, additional site-specific locations beyond those identified and treated for delisting recovery will need to be identified and the actions implemented. The locations for additional actions will come from data gathered from implementing actions in Chapter 7 that call for documenting habitat conditions and prioritizing locations. The level of additional habitat actions needed to achieve the broad sense scenarios will become apparent as results of RME associated with determining which actions should be implemented and the effectiveness of actions become available.

10.4 Implementation and Adaptive Management for Broad Sense Recovery

The RME identified in Chapter 8 and adaptive management process outlined in Chapter 9 will inform the WRCT on progress towards achieving the broad sense recovery goal. The benchmarks under development in Chapter 8 to measure progress related to biological recovery and to address the five ESA listing factors can also be used to determine progress towards broad sense recovery. The results of effectiveness monitoring will help determine how long it may take to achieve broad sense recovery, or if it appears to even be possible. The results of RM&E will inform the quantity, types and locations of actions that need to be implemented to achieve broad sense recovery, or results may identify that additional strategies may be needed to address a newly discovered limiting factor.

The adaptive management process identified in Chapter 9 has already been identified as being a crucial part of this Recovery Plan being effective and successful at achieving the desired delisting status. It will be even more important to the achievement of broad sense recovery. The uncertainties around what broad sense recovery looks like, what effort it will take to achieve it, and how long it will take to achieve it, are greater than those surrounding desired delisting status. The annual and periodic review of information related to implementation of the actions identified in this Plan, the changing status of populations and the resolution of critical uncertainties will be necessary to begin to lessen the uncertainties surrounding broad sense recovery. Through the adaptive management process the Implementation and Recovery Teams will learn not only what is working and what is not, but also how responsive each population is to improvements made and how that influences the need for additional actions and progress towards delisting and broad sense recovery.

10.5 Conclusion

The development of an effective implementation framework coupled with a responsive adaptive management Plan provides the best assurance that the *UWR Conservation and Recovery Plan for Chinook Salmon and Steelhead* will be fully implemented and effective. The identification in this Plan of the gaps that must be closed to achieve both delisting and broad sense recovery, along with the highlighting of the key and secondary factors that have caused those gaps and the actions necessary to address those factors and reverse their impacts, will ensure that the goals for recovery will be achieved if fully implemented. Implementation and the success of this Plan, however, relies on more than just what is described and identified in this Plan. This Plan will only be successful if the citizens of Oregon living within the Willamette basin embrace this Plan and voluntarily take the actions that are described here. It is only through the involvement of all of those who live and work in this area that recovery will be achieved.

Table 10-1. Summary of Broad Sense recovery targets, and reductions in current mortality impacts to meet Broad Sense recovery goals for UWR Chinook and steelhead populations.

		Broad Threat Management Categories & Sub-Categories																
		Flood Control / Hydropower (subbasin)				FW Land Use Management	Estuary LFT's	Other Species	Harvest Management	Hatchery Management								
		Spawner Access	Juvenile Passage	Spawner Habitat Conditions	Juvenile Habitat Conditions	Adult and Juvenile Conditions	Land Use & Flood Control/Hydro	Competition / Predation	Adults	Juv Competition / Predation	Adults							
		Mortality Rates of Threats										Total Reduced Life Cycle Impact			VSP Extinction Risk Class			
Population	Status	SAM	JPM	SHM	JHM	FWHM	EHM	OSM	HM	JCM	HFM	Cumulative Mortality	% Mortality Reduction	Abundance	A&P	DV	SS	Overall Risk
Clackamas CHS	Current	0.27				0.83	0.10	0.12	0.25	---	0.33	95%	---	1,369	M	M	L	M
	Broad Sense	0.24				0.54	0.08	0.07	0.25	---	0.10	80%	16.2%	5,618	VL+	L	L	VL+
Molalla CHS	Current	0.00	0.00	0.00	0.00	1.00	0.10	0.16	0.25	5.0%	0.95	100%	---	0	VH	H	H	VH
	Broad Sense	0.00	0.00	0.00	0.00	0.65	0.08	0.08	0.25	5.0%	0.10	81%	19.1%	2,627	VL	L	L	VL
Calapooia CHS	Current	0.00	0.00	0.00	0.00	1.00	0.10	0.16	0.25	5.0%	0.95	100%	---	0	VH	H	VH	VH

	Broad Sense	0.00	0.00	0.00	0.00	0.65	0.08	0.08	0.25	5.0%	0.10	81%	19.1%	1,815	VL+	L	L	VL+
McKenzie CHS	Current	0.25	0.00	0.10	0.56	0.56	0.10	0.18	0.25	5.0%	0.35	96%	---	4,889	VL	M	M	L
	Broad Sense	0.15	---	0.10	0.53	0.36	0.08	0.09	0.25	5.0%	0.10	88%	8.3%	13,613	VL+	L	L	VL+
Molalla STW	Current	0.00	---	0.00	0.00	0.94	0.10	0.16	0.16	5.0%	0.19	97%	---	2,456	L	M	L	L
	Broad Sense	0.00	---	0.00	0.00	0.61	0.08	0.08	0.16	5.0%	0.05	75%	22.8%	19,470	VL+	L	L	VL+
N. Santiam STW	Current	0.48	---	0.00	0.57	0.57	0.10	0.17	0.16	5.0%	0.14	95%	---	3,668	L	M	H	L
	Broad Sense	0.37	---	0.00	0.48	0.37	0.08	0.08	0.16	5.0%	0.05	87%	8.9%	10,013	VL+	L	L	VL+
S. Santiam STW	Current	0.18	---	0.00	0.66	0.66	0.10	0.17	0.16	5.0%	0.04	95%	---	2,715	VL	M	M	L
	Broad Sense	0.14	---	0.00	0.66	0.43	0.08	0.08	0.16	5.0%	0.04	89%	5.6%	5,371	VL+	L	L	VL+
Calapooia STW	Current	0.00	---	0.00	0.00	0.96	0.10	0.16	0.16	5.0%	0.00	98%	---	416	M	M	H	M
	Broad Sense	0.00	---	0.00	0.00	0.62	0.08	0.08	0.16	5.0%	0.00	75%	23.6%	4,471	VL+	L	L	VL+

Chapter 11: References

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