DRAFT
Recovery Plan for the Rock Creek Population of the Middle Columbia River Steelhead Distinct Population Segment

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Prepared by
National Marine Fisheries Service
Northwest Region

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Recovery Planning Glossary

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

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.

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. The ICTRT considers extirpated steelhead populations to be those that are entirely cut off from anadromy, such as the Crooked River population. 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 manmade 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.

major population group (MPG): A group of salmonid populations that are geographically and genetically cohesive. The MPG is a level of organization between demographically independent populations and the ESU or DPS.

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.

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 plan supplement: A NMFS supplement to a locally developed recovery plan that describes how the plan addresses ESA requirements for recovery plans. The supplement also proposes ESA delisting criteria for the ESUs addressed by the plan, since a determination of these criteria is a NMFS decision.

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 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. TRTs are complemented by planning forums unique to specific states, tribes, or regions, which 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).

Acronyms and Abbreviations

A/P	abundance/productivity
BACI	Before-After-Control-Impact
BLM	Bureau of Land Management
CAO	Critical Areas Ordinance
CCRP	Continuous Conservation Reserve Program
CEO	County Environmental Ordinance
cfs	cubic feet per second
CREP	Conservation Reserve Enhancement Program
CRP	Conservation Reserve Program
CRITFC	Columbia River Inter-tribal Fish Commission
CRP	Conservation Reserve Program
CSMEP	Collaborative Systemwide Monitoring and Evaluation Project
CSP	Conservation Security Program
CUPs	Conditional Use Permits
CZO	County Zoning Ordinance
DPS	Distinct Population Segment
Ecology	Department of Ecology
EDT	Ecosystem Diagnostic and Treatment
EIS	environmental impact statement
EKCD	Eastern Klickitat Conservation District
EQIP	Environmental Quality Incentives Program
ESA	Endangered Species Act
ESU	Evolutionarily Significant Unit
FCRPS	Federal Columbia River Power System
FEIS	final environmental impact statement
FPO	Floodplain Management Ordinance
FREP	Forestry Riparian Easement Program
FY	fiscal year
GMA	Growth Management Act
GRP	Grassland Reserve Program
HFRP	Healthy Forest Reserve Program
ICTRT	Interior Columbia Technical Recovery Team
MaSA	major spawning area
MOA	Memorandum of Agreement
MiSA	minor spawning area
MPG	major population group
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration-Fisheries
NPCC	Northwest Power and Conservation Council
NRCS	Natural Resources Conservation Service
PCSRF	Pacific Coastal Salmon Recovery Fund
PNAMP	Pacific Northwest Aquatic Monitoring Partnership
RCW	Rock Creek Watershed
QAR	Quantitative Analytical Report
RM	River-mile
SDPs	Substantial Development Permits
SEPA	State Environmental Policy Act
SMP	Shorelines Master Plan
SRFB	Salmon Recovery Funding Board
SS/D	Spatial structure/diversity
SSB	Substitute Senate Bill
TNC	The Nature Conservancy
TRT	Technical Recovery Team
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
VARs	Variances
VSP	Viable Salmonid Population
WAC	Washington Administrative Code
WCC	Washington Conservation Commission
WDFW	Washington Department of Fish and Wildlife
WDNR	Washington Department of Natural Resources
WHIP	Wildlife Habitat Incentive Program
W/LC TRT	Willamette/Lower Columbia Technical Recovery Team
WRIA	Water Resources Inventory Area
WRP	Wetlands Reserve Program
WY	Water Years
YN	Yakama Nation

Executive Summary

This is a recovery plan (Plan) for the protection and restoration of the Rock Creek population of Middle Columbia River steelhead (*Oncorhynchus mykiss*), which spawn and rear in tributaries to the Columbia River in central and eastern Washington and Oregon (Figure 1-1). Rock Creek drains an area of 223.2 sq. miles (578.1 sq. km) in southeastern Washington State. It joins the Columbia River at RM 230, approximately 12 miles upstream of John Day Dam (Figure E-1).

"Steelhead" is the name commonly applied to the anadromous form of the biological species *Oncorhynchus mykiss*. The common name of the non-anadromous, or resident, form is rainbow trout. When NMFS originally listed the species as threatened on March 25, 1999 (64 FR 14517), it was classified as an "evolutionarily significant unit" (ESU) of salmonids that included both forms. Recently, NMFS revised its species determinations for West Coast steelhead under the ESA, delineating anadromous, steelhead-only "distinct population segments" (DPS). NMFS listed the Middle Columbia River steelhead DPS as threatened on January 5, 2006 (71 FR 834). Rainbow trout are under the jurisdiction of the U.S. Fish and Wildlife Service (USFWS).

Following direction identified under the ESA, the Plan discusses the process being used to remove threats to the long-term survival of the population and the broader DPS. It identifies recovery goals for the population and the criteria that provide the stepping stones for getting to recovery. It describes the current status of the Rock Creek population and its habitat in the Rock Creek drainage, and summarizes the results of the technical assessment examining the population's viability. It also identifies the major factors and threats affecting the population, and proposes strategies and actions designed to aid in its recovery. Finally, the Plan provides an implementation and adaptive management framework for making needed future adjustments on the road to recovery.

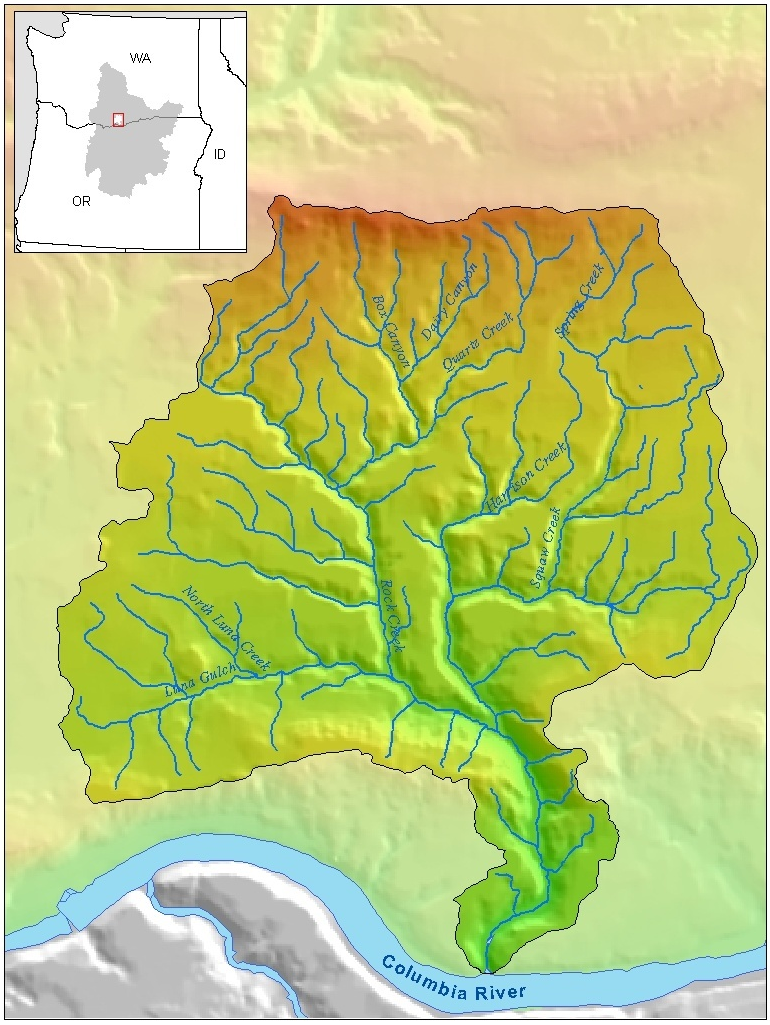

Figure E-1. Location of Rock Creek Subbasin in Middle Columbia River steelhead DPS.

The Plan builds upon past and current efforts by the many parties currently working to rebuild the population and improve its habitat. This approach reflects NMFS' belief that it is critically important to base ESA recovery plans on the many state, regional, tribal, local, and private conservation efforts that are already underway. The recovery plan for Rock Creek steelhead is the product of a process initiated by NMFS, and incorporates input from the Yakama Nation (YN), Washington Department of Fish and Wildlife (WDFW), Klickitat County, the Washington State Governor's Salmon Recovery Office, other Federal agencies, state agencies, local governments, and the public.

The Plan reflects direction for Rock Creek steelhead adopted by the Northwest Power and Conservation Council's (NPCC) Fish and Wildlife Program in the Lower Mid-Columbia Mainstem Subbasin Plan (NPCC 2004). The subbasin plan included information provided by Yakama Nation, Washington Department of Fish and Wildlife, and other Federal, state, and local entities. Scientific data in the Plan are also drawn from other more recent sources, including technical products for WRIA 31 and those

developed by the technical recovery team appointed by NMFS for the Interior Columbia recovery domain.

This plan is one of several recovery plans for independent steelhead populations in the Middle Columbia River steelhead DPS. Similar plans have been developed for steelhead populations in the White Salmon, Klickitat, and Yakima rivers, as well as in areas of southeast Washington and the State of Oregon. These separate plans are part of a DPS-level plan that integrates recovery actions across the DPS.

Biological Background

Chapter 3 of the Plan describes population and habitat characteristics for Middle Columbia River steelhead in the Rock Creek subbasin. It also discusses influences on this population from the hatchery production and releases, harvest, and the Columbia River hydrosystem.

Ecosystem Condition

Rock Creek begins in the Simcoe Mountains, which form the subbasin's northern border and the southern edge of the Yakama Indian Reservation. Major tributaries to Rock Creek include Badger Gulch, Harrison Creek, Luna Gulch, Quartz Creek and Squaw Creek. Lake Umatilla, the reservoir behind John Day Dam on the Columbia River, inundates the lower mile of Rock Creek.

The drainage displays a high basalt plateau and deeply incised canyons that reflect its underlying basalt geology. Headwater streams cross a relatively flat basalt plateau that is primarily forested and above known anadromous use, and then drop into steep-walled canyons where gradients increase to 2 to 4 percent or more. Flows in the subbasin's canyon and alluvial reaches are considered flashy, rising and falling rapidly in response to precipitation and snowmelt. Snowmelt runoff from higher elevations appears to help sustain flows into early spring. Numerous springs also exist in the subbasin and their releases provide important cool water refuges for juvenile salmonids during the summer and early fall (NPCC 2004) when stream flows are often insufficient. No flow regulation occurs in the drainage, although small amounts are diverted for stock watering.

Lands in the Rock Creek subbasin remain generally undeveloped, with nearly 47 percent rangeland, 26 percent forestland, and 4 percent dry land agriculture. Forests cover the upper elevations, and the middle and lower watershed supports range and agricultural uses. No irrigated land was estimated to exist as of 2001 (Flynn et al. 2004). Developed land accounts for less than one percent of the subbasin area (Aspect Consulting and WPN 2004).

Rock Creek Steelhead Population

Steelhead in Rock Creek are considered indigenous. Rock Creek is a natural production area, with no hatcheries located in the subbasin, although it is possible that some strays from outside hatchery sources enter Rock Creek. The stock is considered distinct from

other mid-Columbia stocks based on geographic isolation of the spawning population (WDF and WDW 1993).

Limited information exists on steelhead abundance in the Rock Creek drainage; however, some observations suggest that a significant number of steelhead may utilize the Rock Creek watershed in good water and ocean condition years. Surveys conducted by the Yakama Nation in lower Rock Creek in 2002, 2003 and 2004 show as many as 35 to 45 steelhead redds per mile in the lower five miles, and extensive distribution of redds throughout the watershed (NPCC 2004). More surveys are needed to determine steelhead abundance in the drainage. Efforts are underway to model the abundance and capacity within the watershed (Spencer, personal communication 2006).

Historically, steelhead likely utilized virtually all of the major streams and tributaries of Rock Creek for some part of their life history. In recent good water years, steelhead have been observed throughout the watershed (Spencer, personal communication 2006). Spawning distribution probably included all accessible portions of the Rock Creek watershed. As now, the highest spawning densities likely occurred in the more complex, braided reaches of the lower mainstem of Rock Creek, and in third- and fourth-order tributaries with moderate (1-4 percent) gradients (NPCC 2004). The headwaters of the mainstem and Box Canyon are generally above known anadromous fish use (NPCC 2004), however live steelhead, redds and *O. mykiss* fry have been observed up to the falls in Box Canyon (RM 0.3).

The Rock Creek subbasin lies within an ecotone/transition area that is capable of supporting summer and winter-run steelhead (Bambrick et al. 2004) and life history strategies suggest that both winter and summer steelhead may utilize the drainage (YN Fisheries 2004).

Recovery Goals and Criteria

Chapter 2 of the Plan describes the recovery goals for the Rock Creek steelhead population, and the process and criteria for measuring progress toward recovery. The ESA requires that recovery plans, to the maximum extent practicable, incorporate objective, measurable criteria which, when met, would result in a determination that the species be removed from the Federal List of Endangered and Threatened Wildlife and Plants (50 CFR 17.11 and 17.12). The recovery criteria comprise the core standards that NMFS believes will lead to conditions upon which the decision to delist a species will be based.

Biological Goals

The biological recovery goal for the Rock Creek steelhead population is to contribute to recovery for the Middle Columbia River Steelhead DPS by being maintained on a trajectory toward viable status. A viable population is defined as an independent population that has negligible risk of extinction due to threats from demographic variation, local environmental variation, and genetic changes over a 100-year timeframe (ICTRT 2007).

Broad Sense Goals

NMFS' approach to species recovery provides for inclusion of "broad-sense" recovery goals, which may incorporate many of the local and traditional uses, as well as rural and Native American values, deemed important in the Pacific Northwest. Broad sense recovery goals have been developed by several local and regional stakeholder groups in the Northwest, and have been proposed in recovery plans developed by other management units in this DPS. Defining broad sense goals for the Rock Creek subbasin and other areas within the Washington (WA) Gorge Management Unit would be one of the first steps taken by a Washington Gorge Area Regional Board, which could be supported by NMFS in the future to provide a collaborative process for implementation of the WA Gorge Management Unit plans.

Biological Criteria and Approach

NMFS appointed the Interior Columbia Technical Recovery Team (ICTRT) to provide a solid scientific foundation for recovery plans for Middle Columbia River steelhead and other listed species in the Interior Columbia domain. NMFS charged the ICTRT with defining ESU/DPS structure and developing biologically based viability criteria for ESA listed salmon and steelhead. The viability criteria identify future conditions that, when met, describe a viable population. The ICTRT viability criteria are organized around four major considerations: abundance, productivity, spatial structure and diversity.

The ICTRT's approach recognizes that salmonid population structure is hierarchical. Its recommended viability criteria are based on this structure, and describe distribution and characteristics of component populations needed to maintain an ESU, or a DPS, in the face of long-term ecological and evolutionary processes (ICTRT 2007). The approach recognizes that salmonid populations within an ESU or DPS share some genetic similarities because they move between different habitats during their life cycle. This distribution across the landscape ─ and the diverse genetic, life history and morphological characteristics that evolve ─ contribute significantly to a population's long-term persistence.

The ICTRT recognizes three levels in this salmonid population hierarchy:

- *Evolutionarily Significant Unit or Distinct Population Segment*: As defined under the ESA, a listed ESU or DPS must: 1) be substantially reproductively isolated from other conspecific units, and 2) represent an important component of the evolutionary legacy of the species (Waples 1991).

- *Independent Population*: As defined by McElhany et al. (2000), an independent population is "…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. Groups are considered to be independent populations if they are isolated to such an extent that exchanges of individuals among the populations do not substantially affect

the population dynamics or extinction risk of the independent populations over a 100-year time frame."

- *Major Population Groups:* Within the DPS, large population groupings exist that share similar genetic, geographic (hydrographic), and/or habitat characteristics (McClure et al. 2003). The ICTRT defined this level in the hierarchy as Major Population Groups (MPG). These MPGs are analogous to "strata" as defined by the Willamette/Lower Columbia TRT (W/LCTRT) and "geographic regions" described by the Puget Sound TRT.

The ICTRT has identified 17 extant and 3 extirpated independent steelhead populations in the Middle Columbia River steelhead DPS (McClure et al. 2003). These populations are discussed in Chapter 2. The ICTRT delineated the populations based on (1) genetic information, (2) geography, (3) life-history traits, (4) morphological traits, and (5) population dynamics. The ICTRT grouped these independent populations into four MPGs: the Cascades Eastern Slope Tributaries MPG, Yakima River MPG, John Day River MPG, and Walla Walla - Umatilla MPG (Figure E-2). The Rock Creek population is one of five extant populations (Klickitat River, Fifteenmile Creek, Rock Creek, Deschutes River Eastside, and Deschutes River Westside) and two extirpated populations [White Salmon River ('functionally extirpated' by Condit Dam) and Deschutes Crooked River (extirpated)] comprising the Cascades Eastern Slope Tributaries MPG. Populations in this MPG occupy Lower Columbia River tributaries in the DPS.

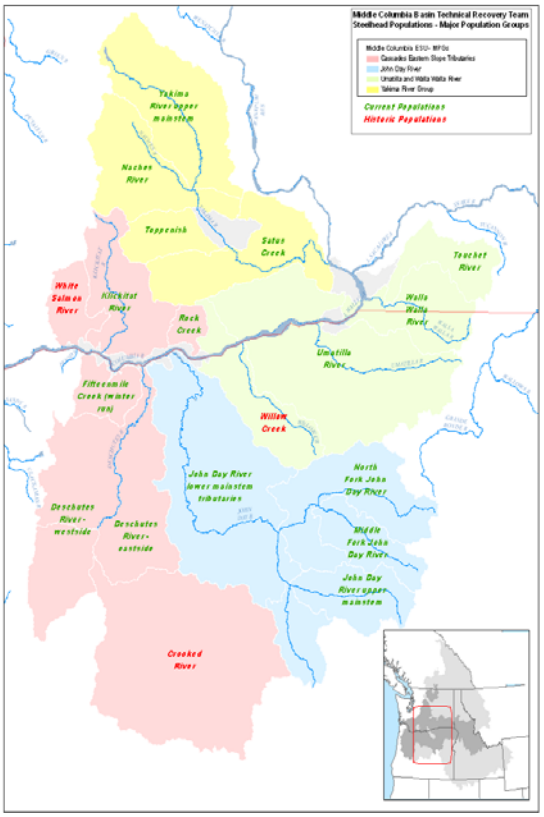

Figure E-2. Independent Populations in the Middle Columbia River Steelhead DPS

The ICTRT recognizes this hierarchical structure in its biological viability criteria. The criteria call for assessing viability at the independent population-level first. The population-level assessments provide the basis for evaluating viability at the next hierarchical level, the MPG. The MPGs then need to meet the defined criteria for the DPS to be rated as viable.

Biologically Based Viability Criteria

The ICTRT's biologically based viability criteria provided the stepping stones for assessing the status of populations in the DPS and identifying future conditions that, when met, would describe viable populations. The viability criteria are organized around four major considerations: abundance, productivity, spatial structure and diversity.

- *Abundance/Productivity:* Population abundance and productivity should be high enough that 1) in combination with intrinsic productivity, declines to critically low levels would be unlikely assuming recent historical patterns of environmental variability; 2) compensatory processes provide resilience to the effects of short term perturbations; and 3) subpopulation structure is maintained (e.g., multiple spawning tributaries, spawning patches, life history patterns). The ICTRT does not consider any population fewer than 500 individuals to be viable, regardless of its intrinsic productivity.

- *Spatial Structure/Diversity:* Spatial structure concerns a population's geographic distribution and the processes affecting that distribution. Diversity refers to the distribution of traits within and among populations of a DPS.

  The ICTRT defined two goals, or biological or ecological objectives, that spatial structure and diversity criteria should achieve: 1) maintaining natural rates and levels of spatially mediated processes, and 2) maintaining natural patterns of variation. The ICTRT also identified mechanisms, factors and metrics appropriate for assessing population status.

Section 3.2.1 identifies the ICTRT's biologically based viability criteria that address these abundance, productivity, spatial structure and diversity considerations. The ICTRT recommends that the criteria be met to remove the DPS from its listed status under the ESA.

To be viable, the ICTRT determined that the Rock Creek steelhead population needs to reach a minimum abundance threshold of 500 naturally produced spawners with a sufficient intrinsic productivity to achieve a 5 percent or less risk of extinction over a 100-year period as an acceptable risk level of a viable population.

Threats Criteria and Approach

Section 3.2.2 of the Plan describes the listing factors and listing/threats criteria that must also be addressed to de-list the DPS. These listing factors are the features that were

evaluated under section 4(a)(1) when the initial determination was made to list the species for protection under the ESA.

At the time of a delisting decision, NMFS will use the listing factors/threats criteria to review the status of the section 4(a)(1) listing factors and determine if the affected DPS is recovered to the point that it no longer requires protections of the ESA. NMFS expects that if the proposed actions described in this and other Middle Columbia River steelhead recovery plans are implemented, they will make substantial progress toward meeting the listing factor/threats criteria. These criteria are identified in Section 3.3 and address the five listing factors that were evaluated under section 4(a)(1): 1) the present or threatened destruction, modification, or curtailment of its habitat or range; 2) over-utilization for commercial, recreational, scientific or educational purposes; 3) disease or predation; 4) the inadequacy of existing regulatory mechanisms; and 5) other natural or manmade factors affecting its continued existence.

Current Status Assessment

Chapter 4 summarizes the ICTRT's viability assessment results for Rock Creek's Middle Columbia River steelhead population. The ICTRT identified the Rock Creek steelhead population as a summer-run within the Cascades Eastern Slope Tributaries MPG. It classified the population as a "basic" population based on historical habitat potential (ICTRT 2005). A steelhead population classified as basic has a mean minimum abundance threshold criteria of 500 naturally produced spawners with a sufficient intrinsic productivity to achieve a five percent or less risk of extinction over a 100-year timeframe.

- *Abundance/Productivity:* The ICTRT determined that, at present, no direct estimates of abundance and productivity are available for Rock Creek steelhead. There have been no systematic redd surveys in this population area; however, the general presence of steelhead has been documented. Because of the lack of direct information on current or indirect assessments of abundance and productivity, the ICTRT assigned the Rock Creek steelhead population **High** risk.

- *Spatial Structure and Diversity:* The ICTRT gave the Rock Creek population a combined integrated Spatial Structure/Diversity rating of **Moderate** risk. Based on the ICTRT historical potential analysis, the team found that the Rock Creek population was a relatively simple population structure, containing a single MaSA. It determined that although observations indicate that steelhead spawning may occur across much of the historical range, the relatively simple population structure results in a moderate rating for complexity. It noted that there have likely been minor reductions in life history diversity and phenotypic variation, but these changes are not severe enough to raise risk levels above low.

- *Overall Risk Rating*: The ICTRT concluded that the Rock Creek steelhead population does not currently meet viability criteria because the Abundance/Productivity risk rating is assigned a High risk rating. The overall Spatial Structure/Diversity rating is at Moderate risk. The lack of direct estimates

of abundance and productivity for this population was a factor in assigning a high risk rating (ICTRT 2006).

Limiting Factors and Threats Analysis

Chapter 6 identifies factors and threats that limit Middle Columbia River steelhead production in the Rock Creek subbasin.

Freshwater Habitat

Within the Rock Creek watershed, the population is primarily impacted by degraded habitat conditions. Habitat factors that limit steelhead production in the Rock Creek watershed are often the result of past and/or current land use practices that stress naturally occurring conditions. For example, anthropogenic changes in the subbasin have likely increased the intensity of low summer flows and high summer water temperatures that likely occur naturally in some parts of the watershed because of aspect, low precipitation and high width-to-depth ratios.

The major factors limiting steelhead viability within the Rock Creek watershed are reduced channel structure and complexity (lack of key habitat quantity and habitat diversity), loss of riparian function and condition, reduced floodplain function and channel migration processes, altered hydrology with lower summer flows, high water temperatures, increased fine sediment, altered food web, and predation and competition with exotic species. These freshwater habitat factors are discussed briefly below. Chapter 6 provides more detail on the factors, their effects on steelhead viability and different life stages, and their significance.

- *Altered natural hydrograph*: Seasonally low to intermittent and/or subsurface stream flows are a primary factor limiting steelhead production in the Rock Creek. The hydrograph in the Rock Creek system is naturally flashy, with high intensity, short duration flow. However, low and peak flows have likely become more pronounced due to anthropogenic changes in the watershed. Currently, low to nonexistent flows in all streams during late summer, fall and early winter limit juvenile steelhead production and mobility.

- *Degraded water quality, high stream temperatures:* Late summer water temperatures in the lower Rock Creek subbasin sometimes rise above 63.5°F, a level considered potentially lethal for steelhead and other salmonids. Rock Creek was listed twice on the Washington State Department of Ecology's 2002/2004 water quality assessment list as being impaired, but not requiring a TMDL (not on the 303(d) list). The lower Rock Creek reach was listed for impaired fish habitat (Flynn et al. 2004). The headwater reach has been listed as Category 5 for temperature, since Ecology was unable to ascertain that conditions of the 1996 Memorandum of Understanding had been met (WDOE 2002-2004).

- *Degraded riparian function and condition*: Rock Creek's rocky substrate and steep topography inhibit riparian forest stand development along many reaches. However, current riparian condition and function in many sections of Rock Creek

have been disturbed due to wildfires ("The Burn"), recent major flood events, past and current grazing, timber practices, road construction, and other land uses.

- *Reduced channel structure and complexity:* In-channel and riparian habitats in some stream reaches are degraded due to disturbance from grazing, timber harvest, road construction, and other anthropogenic changes, and from major flood events. These factors have contributed cumulatively to changes in the hydrograph, altering available perennial wet habitat and decreasing riparian and in-stream habitat and function (YN Fisheries 2006). Inundation of the one-mile reach above Rock Creek's mouth by the pool behind John Day Dam (Columbia River) has also led to a reduction in key habitat quantity and habitat complexity.

- *Reduced floodplain function and channel migration processes*: Cumulative impacts from several other limiting factors influence channel migration processes and morphology. Bridges on the Bickleton Highway (scheduled for replacement in 2008) and Old Highway 8 constrain flow and channel migration processes, but are considered necessary parts of the transportation network. A series of dikes in the middle mainstem Rock Creek reaches also limit the stream's ability to meander naturally. These and other impacts, such as from overgrazing, have altered hydrological regimes and influenced channel-forming processes in parts of the watershed.

- *Altered sediment routing:* Sediment loads (the percentage of fines in spawning gravel, embeddedness and turbidity) in the Rock Creek subbasin have likely increased over historic conditions, particularly limiting steelhead production during the egg incubation stage (entombment of eggs).

- *Competition for food sources:* Changes in the hydrologic regime and riparian conditions affect the food web. Macroinvertebrate species composition and quantity have been reduced.

- *Predation and competition:* The building of the John Day Dam and subsequent inundation of the bottom mile of Rock Creek not only introduced exotic piscivorous fish to the lower mile and reservoir, but also made it possible for these fish to travel up Rock Creek. Exotic piscivorous species have been observed in Rock Creek up to approximately one mile above the Old Hwy. 8 bridge (RM 3.5-4) (G. Morris, YN, pers. comm.).

Hatcheries

Steelhead are not stocked in Rock Creek, and very few fin-clipped steelhead have been seen in the subbasin. Hatchery strays of upriver origin may enter and spawn in Rock Creek, but the effects of out-of-subbasin hatchery programs on the Rock Creek steelhead population are unknown. Nevertheless straying, especially by non-indigenous hatchery steelhead, remains a concern.

Out-of-Subbasin Factors and Threats

Out-of-subbasin factors are discussed briefly in Section 5.3 and provide information on the influences from harvest, the Columbia River hydrosystem, and ocean conditions. The 2008 FCRPS Biological Opinion (NMFS 2008b) details the influences from the Columbia River hydrosystem on Middle Columbia steelhead populations. The Columbia River Estuary Module http://www.nwr.noaa.gov/Salmon-Recovery-Planning/ESA-Recovery -Plans/upload/Estuary-Module.pdf discusses factors that limit viability of Rock Creek steelhead in the Columbia River Estuary.

Recovery Strategies and Actions

Chapter 7 describes the recovery strategy for the Rock Creek steelhead population. The primary focus of the recovery strategy is to remove key threats to population viability in the Rock Creek watershed by improving freshwater habitat conditions and to gain information needed to better assess population status. The chapter also describes a framework for refining management strategies and prioritizing actions at all scales across the entire life cycle.

Prioritizing Recovery Actions

Section 7.1 provides direction for prioritizing recovery actions for Rock Creek steelhead. This direction recognizes that conservation of the existing quality habitat that supports core production and primary life history types, as well as quality migration habitats within populations and across the DPS, is the critical first step toward recovery. Protecting and restoring the normative natural ecological processes throughout the entire life cycle is essential for conserving the productive capacity of the habitat. In simplistic terms, the order of priority is to:

1. protect and conserve high quality habitats and natural processes that currently support productive capacity;
2. enhance habitat and restore natural processes that are impaired but are currently important to productive capacity; and,
3. restore habitat and natural processes that were historically important but do not currently contribute to productive capacity.

Section 7.1 provides more detail on considerations for prioritizing management strategies and actions for recovery of Rock Creek steelhead. The section also supports the creation of a Washington Gorge Area Regional Board. The Board could use the considerations identified by NMFS to prioritize recovery actions for salmon and steelhead in the Rock Creek subbasin, and other areas of the WA Gorge Management Unit.

Strategies and Actions

The strategies and actions identified in Section 7.4 provide an integrated approach to address factors and threats to steelhead in four categories: freshwater habitat, hatcheries, harvest, and hydrosystem (Table E-1).

- Freshwater habitat strategies and actions build on past and current efforts, and focus on protecting natural ecological functions, improving riparian areas, replacing culverts and other artificial structures that obstruct fish passage, reconnecting side channels, re-establishing or enhancing native vegetation, increasing channel roughness, and introducing large woody debris. They also focus research to gain the information needed to concentrate habitat restoration efforts in areas where they will be most effective.

- Hatchery strategies and actions aim to reduce straying of out-of-subbasin hatchery steelhead into the drainage.

- Harvest strategies and actions maintain current harvest regulations and call for education efforts to reduce steelhead harvest near the mouth of Rock Creek.

- Hydrosystem strategies and actions identify ways to improve hydropower operations and facilities for fish passage, and to reduce predation and competition.

Together, the proposed strategies and actions will increase abundance, productivity, spatial structure and diversity of Rock Creek steelhead to help regain DPS viability, as well as make progress toward meeting broad sense recovery goals. The strategies and actions build from past and current efforts to improve habitat conditions in the subbasin to address factors and threats limiting viability of the Rock Creek steelhead population throughout its lifecycle. While fundamentally intended to produce biological results, strategies and actions included in this plan also reflect economic, political, social, and cultural considerations.

Table E-1. Recovery Strategies and Actions for Listed Salmon and Steelhead Populations in the Rock Creek Subbasin.

Priority Strategies	Key Actions
Freshwater Habitat	
Protect and conserve natural ecological processes that support the viability of populations and their primary life history strategies throughout their life cycle.	• Protect highest quality habitats through acquisition and conservation. • Adopt and manage Cooperative Agreements. • Consistently apply Best Management Practices and existing laws to protect and conserve natural ecological processes. • Review existing land use planning documents and ordinances pertaining to riparian and floodplain management.
Gain information needed to identify and prioritize habitat actions that will provide the greatest opportunity to contribute to recovery.	• Conduct surveys to determine steelhead distribution. • Gather information to calculate abundance and productivity estimates and complete gap analyses. • Evaluate population phenotypic and genetic variations.
Restore floodplain function and channel migration processes.	• Reconnect side channels. • Remove dikes. • Reconnect floodplain to channel. • Relocate or improve floodplain infrastructure and roads. • Relocate beaver to suitable areas.
Restore riparian condition and function	• Restore/enhance natural riparian vegetative communities. • Develop grazing strategies that promote riparian recovery. • Eradicate invasive plants species from riparian areas.

Priority Strategies	Key Actions
Restore channel structure and complexity	• Place stable wood and other large organic debris in streambeds. • Stabilize streambanks. • Restore natural channel form. • Fertilize stream with fish carcasses.
Restore degraded upland processes	• Restore native upland plant communities. • Implement BMPs to forest, agriculture, and grazing practices that mimic natural runoff and sediment production. • Implement road management actions to reduce erosion and fine sediment inputs.
Restore natural hydrograph to enhance flows during critical periods.	• Employ BMPs to forest, agriculture and grazing practices and to road management. • Protect and/or rehabilitate springs. • Increase pool habitat. • Develop water and sediment control basins.
Improve degraded water quality, reduce summer water temperatures.	• Restore natural functions and processes through actions identified in strategies above. • Construct water and sediment control basins.
Hatcheries	
Reduce the uncertainty of origin of hatchery strays and increase ability to recognize hatchery-origin fish.	• Monitor the potential for hatchery strays entering Rock Creek. • Increase the proportion of Columbia River Basin hatchery steelhead marked with coded-wire tags, especially in programs shown to stray at high rates in the past, and require the mass marking of all hatchery steelhead releases with, at a minimum, an adipose fin-clip.
Harvest	
Improve quality of harvest and natural-origin fish	• Increase outreach efforts to reduce the number of steelhead caught in recreational fisheries near the mouth of Rock Creek.
Hydrosystem	
Improve hydropower operations and facilities to enhance steelhead survival and restore normative migration patterns.	• Adjust hydro operations on the Columbia River to restore normative migration patterns and improve the survival of steelhead smolt during outmigration.
Reduce predation on, and competition between, salmonids	• Reduce predation by pinnipeds. • Reduce predation by terns & cormorants. • Reduce predation by pikeminnows and other warm water game fish.

Implementation and Adaptive Management Framework

As part of implementing the Rock Creek recovery plan, a detailed monitoring and evaluation program will be designed and incorporated into an adaptive management framework based on the principles and concepts laid out in the NMFS guidance document, *Adaptive Management for Salmon Recovery: Evaluation Framework and Monitoring Guidance.* Chapter 8 describes research, monitoring and evaluation, and other elements of plan implementation that are crucial to achieving viability.

The Rock Creek subbasin monitoring and evaluation program will build on existing programs designed for monitoring tributary habitat in the Rock Creek subbasin, hydropower actions in the Mid-Columbia, Mid-Columbia hatchery programs, and other actions outside of the Mid-Columbia tributary subbasins (e.g., Columbia mainstem

hydropower, estuary and ocean conditions and salmon use, mainstem and ocean harvest). The Rock Creek monitoring and evaluation program will provide (1) a clear statement of the metrics and indicators by which progress toward achieving goals can be assessed, (2) a plan for tracking such metrics and indicators, and (3) a decision framework through which new information from monitoring and evaluation can be used to adjust strategies or actions aimed at achieving the Plan's goals.

NMFS supports the creation of Washington Gorge Area Regional Board to provide a *collaborative process* for 'further prioritizing recovery actions' and for 'implementation of' the WA Gorge Management Unit plans. The Board could be created in 2008-2009, subject to concurrence by state, tribal and local governments, and the Yakama Nation.

1. Introduction

The Endangered Species Act of 1973 (ESA) requires NOAA's National Marine Fisheries Service (NMFS) to develop recovery plans for species listed under the Act. The purpose of recovery plans is to identify actions needed to restore threatened and endangered species to the point where they are again self-sustaining elements of their ecosystems and no longer need the protections of the ESA.

This recovery plan focuses on the conservation and survival of Middle Columbia River steelhead (*Oncorhynchus mykiss*) in the Rock Creek subbasin, which encompasses an area of 223.2 sq. miles (578.1 sq. km) in southeastern Washington and joins the Columbia River at RM 230, about 12 miles upstream of John Day Dam (Figure 1-1). Lake Umatilla, the reservoir behind the dam, inundates the lower mile of Rock Creek.

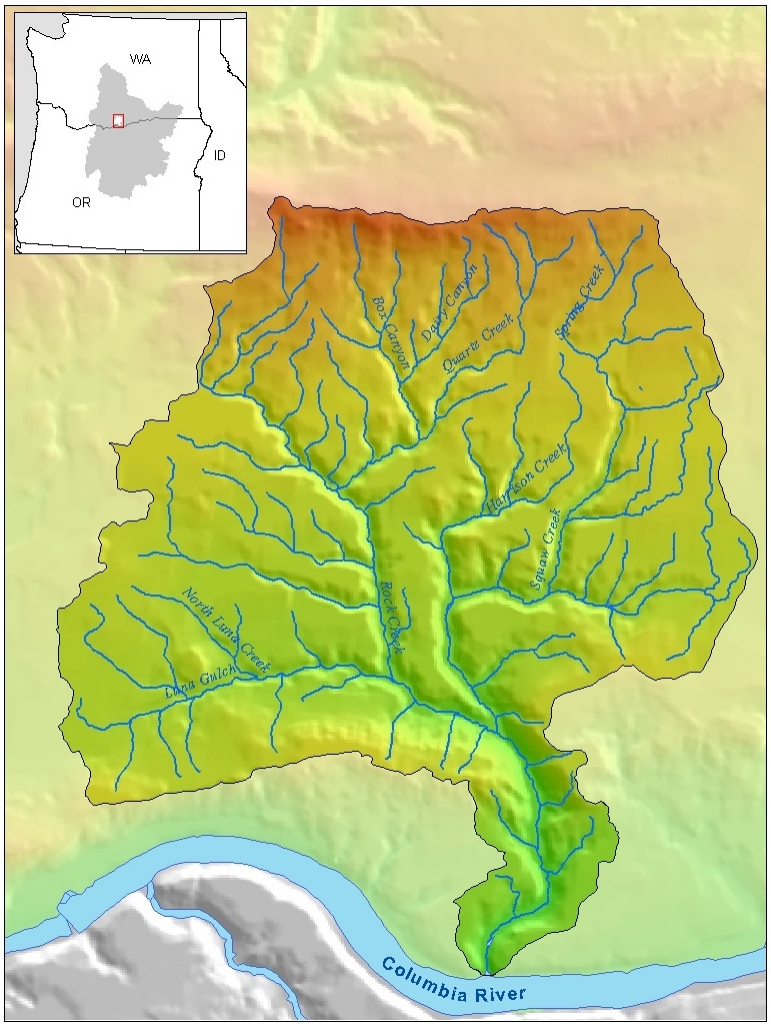

Figure 1-1 Location of Rock Creek Subbasin.

The Rock Creek steelhead population was originally listed as threatened as part of the Middle Columbia River steelhead evolutionarily significant unit (ESU) on March 25,

1999. After NMFS revised its species determinations for West Coast steelhead, Rock Creek steelhead were included in the Middle Columbia River steelhead distinct population segment (DPS), which NMFS listed as threatened on January 5, 2006 (71 FR 834). This DPS includes steelhead populations in Oregon and Washington tributaries of the Columbia River upstream of the Hood and Wind River systems, up to and including the Yakima River. The Snake River is not included in this DPS (Good et al. 2005).

The Rock Creek population is classified as summer-run in the recent ICTRT status assessment (ICTRT 2008) and the Lower Mid-Columbia Mainstem Subbasin Plan (NPCC 2004), although the latter source noted that some evidence suggests both summer and winter-run steelhead may spawn in the Rock Creek subbasin.

While NMFS is the agency responsible for recovery planning for salmon and steelhead under the ESA, the agency believes it is critically important to base ESA recovery plans for salmon and steelhead on the many state, regional, tribal, local, and private conservation efforts already underway throughout the region. Local support of recovery plans by those whose activities directly affect the listed species, and whose actions will be most affected by recovery requirements, is essential. This recovery plan for Rock Creek is the product of a process initiated by NMFS and involves technical input from the Yakama Nation (YN), Washington Department of Fish and Wildlife (WDFW), Klickitat County, the Washington State Governor's Salmon Recovery Office, other Federal agencies, state agencies, local governments, and the public.

This recovery plan for the Rock Creek steelhead population is one of several similar recovery plans for independent steelhead populations within the DPS. Together, this plan and other local and regional plans contribute to an overall, DPS-level plan. NMFS expects this plan to contribute to meeting the ESA section 4(f) recovery plan requirements as part of the DPS-level plan.

1.1 Purpose of Plan

A recovery plan provides a road map for the recovery of a threatened or endangered species and its habitats. It describes a process to remove the threats to the long-term survival and reverse the decline of a listed species. In the Plan, recovery is generally defined as the restoration of listed steelhead such that they become viable components of their ecosystem. A recovery plan is a guidance document, intended to provide information that NMFS has determined will lead to recovery of listed species and their associated habitats. The Plan describes the current status of the Rock Creek steelhead population, as well as ongoing and proposed actions designed to aid in its recovery.

The primary purpose of a recovery plan is to identify actions that will restore threatened and endangered species to levels where they no longer need ESA protection. However, in the case of listed salmon and steelhead, considerations in addition to the ESA are also important. Middle Columbia River steelhead and all of the other listed ESUs have historically been harvested, and there is a strong public interest in restoring them to harvestable status. Because listed fish often migrate with non-listed fish, the listings have become factors limiting the harvest of both. Recovery plans are also intended to address

these other considerations. Nevertheless, these harvest and other broader considerations exceed ESA requirements and will not be used for any regulatory or enforcement decisions or actions under the ESA, including delisting decisions and actions under sections 7, 9, 10, and 11 of the ESA. Delisting decisions will be made based on the ESA's listing factors. Other regulatory and enforcement actions will also be based solely on ESA requirements.

1.1.1 ESA Requirements

Section 4(f) of the ESA requires that a recovery plan be developed and implemented for species listed as endangered or threatened under the statute. These plans must, at a minimum, contain (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. Although the plans are guidance and not regulatory documents, authors of the ESA clearly envisioned recovery plans to be a central organizing tool for the recovery of listed species.

As a template for listed species recovery, a recovery plan describes a process to remove the threats to the long-term survival by reversing the decline of a listed species and its habitat. In this plan, recovery is generally defined as the restoration of listed species such that they initially become viable and eventually become harvestable components of their ecosystem. A recovery plan provides the necessary information that Federal agencies (National Marine Fisheries Service and the U.S. Fish and Wildlife Service) have determined will lead to recovery of listed species and their associated habitats. The Plan describes the current species status, the 'gap' that needs addressing to reach recovery, as well as ongoing or proposed actions designed to aid in the recovery of the species. The Plan will also provide an estimated timeframe and costs for the overall effort.

Once a species is deemed recovered and therefore removed from a listed status, section 4(g) of the ESA requires the monitoring of the species for 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.

1.1.2 Coordination with Others

The Plan aims to provide consistency between the Plan and related planning and management efforts.

Federal Treaty and Trust Responsibilities

Northwest Indian tribes have legally enforceable treaty rights reserving to them a share of the harvestable salmon and steelhead. Achieving the basic purposes of the ESA such that the species no longer needs the protection of the Act may not by itself fully meet these rights and expectations, although it will lead to major improvements in the current situation. Ensuring a sufficient abundance of salmon to sustain harvest can be an

important element in fulfilling trust and treaty rights as well as garnering public support for these plans.

It is NMFS policy that recovery of salmonid populations must achieve two goals: (1) the recovery and delisting of salmonids listed under the provisions of the ESA, and (2) the restoration of the meaningful exercise of tribal fishing rights. "It is the agency's view that there is no conflict between the statutory goals of the ESA and Federal trust responsibility to Indian tribes" (Letter from Terry Garcia, Assistant Secretary for Oceans and Atmosphere, to Ted Strong, Executive Director, Columbia Inter-Tribal Fish Commission, July 21, 1998). Additionally, NMFS "will continue to join with states and tribes to develop a comprehensive approach to the restoration of fish and wildlife resources in a manner that fulfills all obligations under Federal law, including trust obligations to Indian tribes" (ibid.).

Thus, it is appropriate for recovery plans to take these considerations into account and plan for a recovery strategy that includes harvest. In some cases, the desired abundances for harvest may come about through increases in the naturally spawning population. In others, the recovery strategy may include appropriate use of hatcheries to support a portion of the harvest. So long as the overall plan is likely to achieve the biological recovery of the listed ESU, it will be acceptable as a recovery plan.

Treaty Indian fishing rights in the Columbia basin are under the continuing jurisdiction of the U.S. District Court for the District of Oregon in the case of *United States v. Oregon*, No. 68-513 (filed in 1968). The parties to *U.S. v. Oregon* are the United States acting through the Department of Interior (USFWS and Bureau of Indian Affairs) and DOC (National Marine Fisheries Service), the Warm Springs, Umatilla, Nez Perce, Yakama, and Shoshone-Bannock Tribes, and the states of Oregon, Washington, and Idaho. In *U.S. v. Oregon*, the Court affirmed that the treaties reserved for the tribes 50 percent of the harvestable surplus of fish destined to pass through their usual and accustomed fishing areas.

The Rock Creek subbasin is part of the Yakama Nation's ceded area, and home to the Rock Creek Band of the Confederated Bands and Tribes of the Yakama Nation. Yakama Nation staff developed much of the data on the Rock Creek population. The Yakama Nation is voluntarily participating in recovery planning and implementation in the Rock Creek subbasin and throughout its ceded area as a sovereign with treaty-reserved rights on and off the reservation, and as a fish and wildlife co-manager. In so doing, Yakama Nation does not waive or in any way alter its treaty-reserved rights.

Other Federal, State and Local Responsibilities

To ensure consistency in goals, strategies, and actions and to eliminate needless duplication of effort, the process aims to provide consistency between planning for ESA recovery, the Northwest Power and Conservation Council (NPCC) fish and wildlife program, the State of Washington watershed management and salmon recovery programs, and local planning and regulatory efforts.

The Plan follows ESA guidelines and builds upon direction for Rock Creek in the Lower Mid-Columbia Mainstem Subbasin Plan (NPCC 2004), which included information provided by Yakama Nation, Washington Department of Fish and Wildlife, and other Federal, state, and local entities. The NPCC adopted the subbasin plan into its Fish and Wildlife Program. Additional scientific data are drawn from other more recent sources, including technical products for WRIA 31 and those developed by the technical recovery team appointed by NMFS for the Interior Columbia recovery domain.

1.2 Context of Plan Development

This plan for the Rock Creek steelhead population is not only one of several recovery plans for steelhead populations in the Mid-Columbia River steelhead DPS, rather it is part of a much larger recovery effort. Recovery of the Rock Creek steelhead population is one of many recovery plans within NMFS' larger framework of recovery planning efforts for listed salmon and steelhead populations across the Pacific Northwest.

Currently 12 ESUs and 6 DPSs 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. The Mid-Columbia River steelhead DPS falls within the Interior Columbia Recovery Domain (which is divided into three sub-domains: the Snake River, Mid-Columbia, and Upper Columbia). The other recovery domains are the Willamette/Lower Columbia, Puget Sound and Washington Coast, Oregon Coast, and the Southern Oregon/Northern California Coast. (http://www.nwr.noaa.gov/Salmon-Recovery-Planning/Recovery-Domains/Middle-Upper-Columbia/Index.cfm). Similar opportunities for technical and stakeholder involvement exist in each domain.

1.2.1 Technical Recovery Teams

NMFS appointed an independent Technical Recovery Team (TRT) for each recovery domain that has geographic and species expertise for the domain and can provide a solid scientific foundation for recovery plans. The charge of each TRT is to define ESU/DPS structure, develop biological viability criteria for ESUs and populations, to provide scientific support to local and regional recovery planning efforts, and to provide scientific evaluations of recovery plans. The TRTs includes biologists from NMFS, state, tribal and local entities, agencies, academic institutions, and private consulting groups. All the TRTs operate from a common scientific foundation. Each TRT uses the same biological principles for developing its recommended ESU/DPS and population viability criteria — criteria that will be used, along with threats criteria, to determine whether a species has recovered sufficiently to be downlisted to threatened (if endangered) or delisted — although they have developed regionally specific approaches to these criteria. Each TRT's recommendations are 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 Interior Columbia TRT provides technical support for the Mid-Columbia River steelhead DPS recovery planning effort. The ICTRT includes biologists from NMFS, the Oregon Department of Fish and Wildlife, Idaho Department of Fish and Game, U.S. Forest Service, Columbia River Inter-Tribal Fish Commission, U.S. Fish and Wildlife Services, University of Montana, and the University of Washington.

1.2.2 Planning Forums

NMFS works with state, tribal, local, and other Federal stakeholders to develop a planning forum that is appropriate for each recovery domain; one that builds to the extent possible on ongoing, locally led efforts. In this case, NMFS has worked independently with the Yakama Nation, Washington Department of Fish and Wildlife, Klickitat County and local entities to develop the recovery plan for the Rock Creek steelhead population.

In the future, NMFS would support a planning forum that could provide policy guidance for further development and implementation of the Plan. This forum, the Washington Gorge Area Regional Board, could provide a local policy forum for the WA Gorge Management Unit, one of four management units for the Mid-Columbia River steelhead DPS (Figure 1-2). A "management unit," as defined by NMFS, is a portion of a listed species (ESU/DPS) that might require different management due to different threats in certain geographic areas or management by different state, tribal, or local entities. The WA Gorge Management Unit covers the White Salmon, Klickitat and Rock Creek drainages. The other three management units are 1) Oregon, 2) Yakima, and 3) Southeast Washington. Similar planning forums exist for the latter three management units.

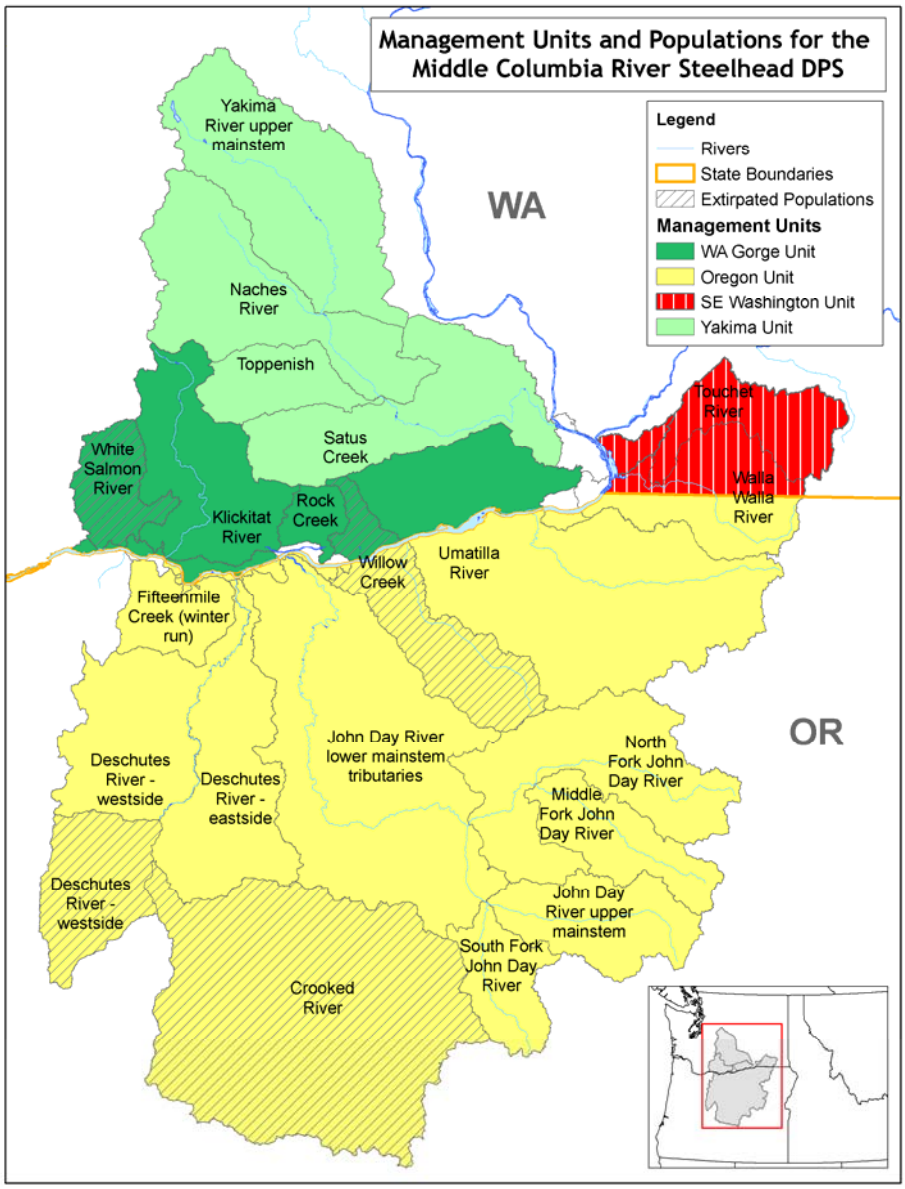

Figure 1-2 NMFS Management Units for the Middle Columbia Steelhead DPS

1.3 How NMFS Intends to Use this Plan

Although recovery plans are not regulatory and their implementation is voluntary, they are important tools that help to do the following:

- Provide context for regulatory decisions.
- Guide decision making by Federal, state, Tribal, and local jurisdictions.
- Provide criteria for status reporting and delisting decisions.
- Organize, prioritize, and sequence recovery actions.
- Organize research, monitoring, and evaluation efforts.

NMFS will encourage Federal agencies and non-Federal jurisdictions to take recovery plans under serious consideration as they make the following sorts of decisions and allocate their resources:

- Actions carried out to meet Federal ESA section 7(a)(1) obligations
- Actions that are subject to ESA sections 4d, 7(a)(2), or 10
- Hatchery and Genetic Management Plans and permit requests
- Harvest plans and permits
- Selection and prioritization of subbasin planning actions
- Development of research, monitoring, and evaluation programs
- Revision of land use and resource management plans
- Other natural resource decisions at the state, Tribal, and local levels

NMFS will emphasize recovery plan information in ESA section 7 (a)(2) consultations, section 10 permit development, and application of the section 4(d) rule by considering:

- The importance of affected populations to listed species viability
- The importance of the action area to affected populations and species viability
- The relation of the action to recovery strategies and management actions
- The relation of the action to the research, monitoring, and evaluation plan for the affected species

In implementing these programs, recovery plans will be used as a reference and a source of context, expectations, and goals. NMFS staff will encourage the Federal "action agencies" to describe in their biological assessments how their proposed actions will affect specific populations and limiting factors identified in the recovery plans, and to describe any mitigating measures and voluntary recovery activities in the action area.

2. Biological Background

This chapter describes population and habitat characteristics for Middle Columbia River steelhead in the Rock Creek subbasin. It also discusses influences on this population from the hatchery production and releases, harvest, and the Columbia River hydrosystem.

2.1 Populations and Major Population Groups

The ICTRT identified 17 extant and 3 extirpated independent steelhead populations in the Middle Columbia River steelhead DPS (McClure et al. 2003). These populations are shown in Figure 2.1. The ICTRT delineated the populations based on genetic information, geography, life-history traits, morphological traits, and population dynamics.

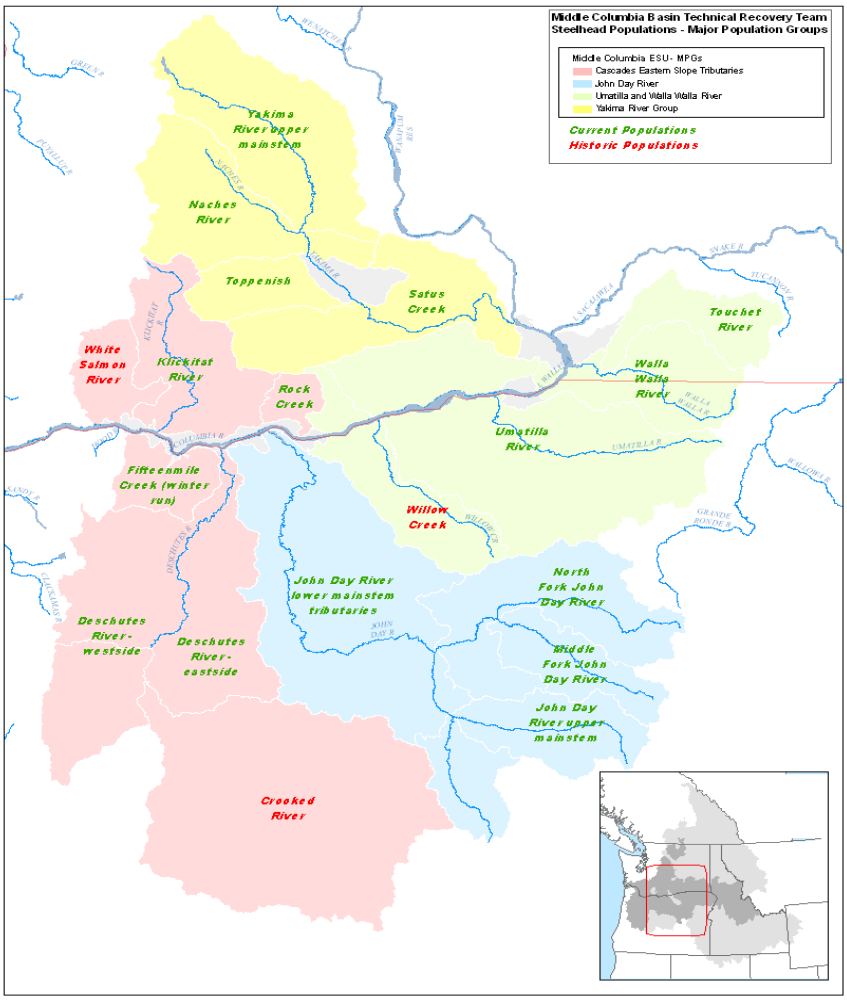

Figure 2-1 Independent Populations in the Middle Columbia River Steelhead DPS (ICTRT 2003).

The ICTRT grouped these independent populations into four major population groups (MPGs) within the DPS: the Cascades Eastern Slope Tributaries MPG, Yakima River MPG, John Day River MPG, and Umatilla/Walla Walla MPG. The Klickitat River population is one of five extant populations (Klickitat River, Fifteenmile Creek, Rock Creek, Deschutes River Eastside, and Deschutes River Westside) and two extirpated populations (White Salmon River and Deschutes Crooked River) comprising the Cascades Eastern Slope Tributaries MPG (Figure 2-2). Populations in the group are united primarily by proximity and occupy diverse habitats, generally those draining the eastern slopes of the Cascades and the Columbia Plateau.

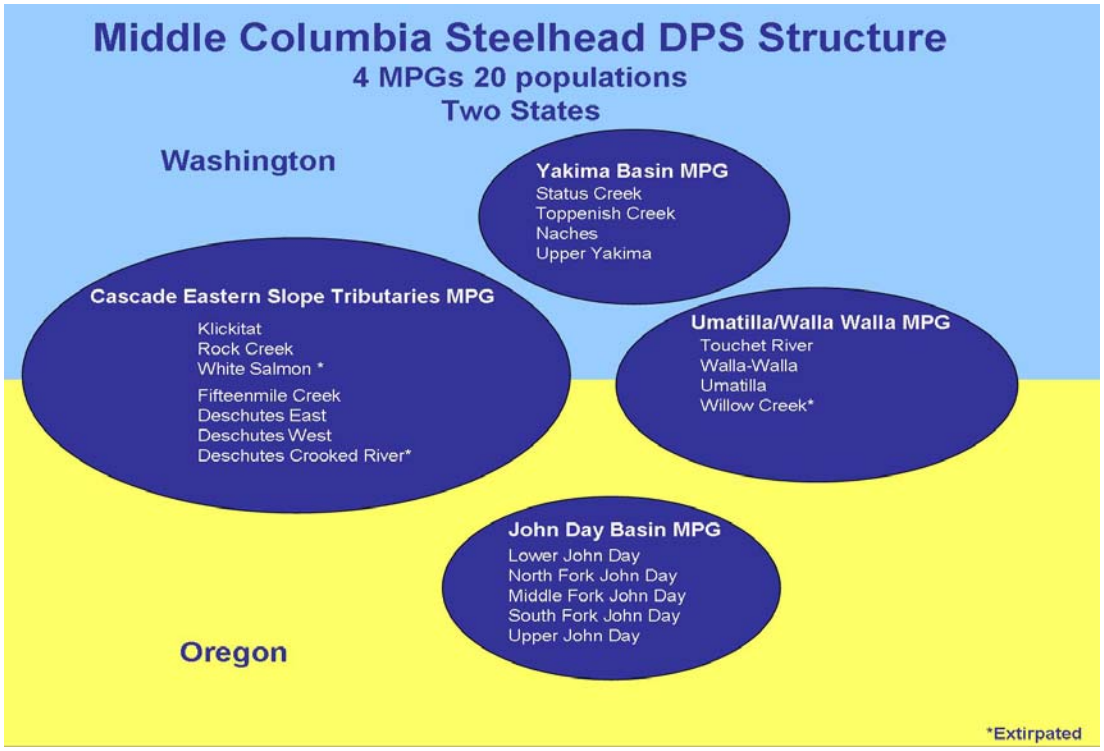

Figure 2-2. Major Population Groups and Populations of Middle Columbia Steelhead.

2.2 Physical Setting

Rock Creek joins the Columbia River at RM 230, about 12 miles upstream of John Day Dam. The watershed encompasses an area of 223.2 sq. miles (578.1 sq. km). Lake Umatilla, the reservoir behind the dam, inundates the lower mile of Rock Creek. Headwater tributaries of Rock Creek flow out of the Simcoe Mountains, which form the subbasin's northern border and the southern edge of the Yakama Indian Reservation. Major tributaries to Rock Creek include Badger Gulch, Harrison Creek, Luna Gulch, Quartz Creek, White Creek and Squaw Creek (Figure 2-3).

Figure 2-3. Geology and Stream Location of Rock Creek Subbasin (WPN and Aspect Consulting 2004).

The entirety of the Rock Creek subbasin is located within Klickitat County, and the subbasin's population, as of the 2000 census, was 503 persons. It is also part of the area the Yakama Nation ceded to the United States in the Treaty of 1855, while reserving fishing, hunting and gathering rights, among other rights and responsibilities. In the lower and eastern portions of the watershed, the Yakama Nation and its members own a significant amount of trust allotments.

Lands in the Rock Creek subbasin remain generally undeveloped, with nearly 47 percent rangeland, 26 percent forestland, and 4 percent dry land agriculture (Figure 2-4). Most forestland exists at upper elevations; range and agricultural lands generally cover the middle and lower watershed. No irrigated land was estimated to exist as of 2001 (Aspect Consulting and WPN 2004). Developed land accounts for less than one percent of the subbasin area (Aspect Consulting and WPN 2004). Deeply incised canyons with narrow valley floors comprise most of the upper portions of fish-bearing tributaries. Floodplain development has occurred in the lower alluvial sections of these streams (especially Rock Creek).

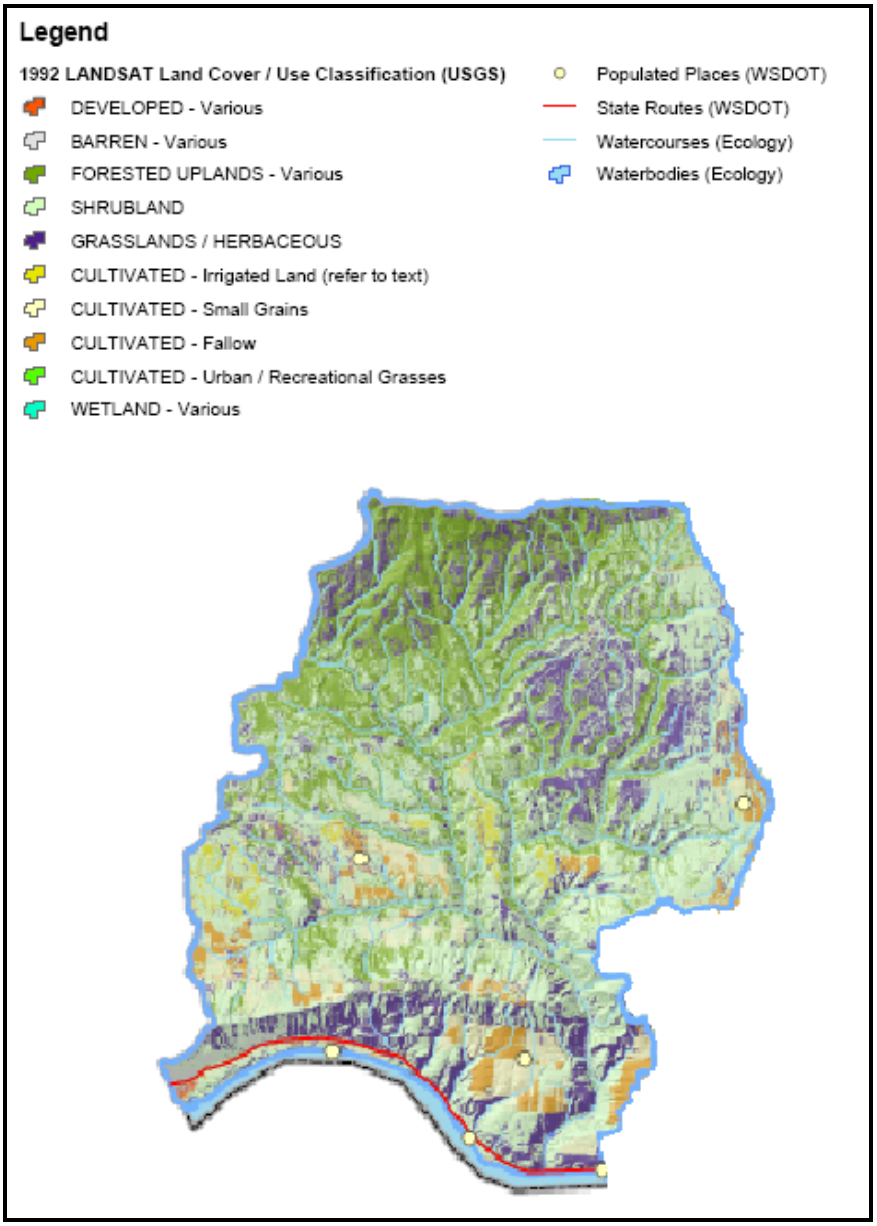

Figure 2-4. Land Use in the Rock Creek subbasin (Adapted from Aspect Consulting and WPN 2004).

2.3 Ecosystem Condition

The Rock Creek drainage displays a high basalt plateau and deeply incised canyons that reflect its underlying basalt geology. Headwater streams cross a relatively flat basalt plateau that is primarily forested and above known anadromous use, and then drop into steep-walled canyons where gradients increase to 2-4 percent or more. Flows in the subbasin's canyon and alluvial reaches are considered flashy, rising and falling rapidly in response to precipitation and snowmelt. Snowmelt runoff from higher elevations appears to help sustain flows into early spring. Numerous springs also exist in the subbasin and their releases provide important cool water refuges for juvenile salmonids during the

summer and early fall (NPCC 2004) when stream flows are often insufficient. No flow regulation occurs in the drainage, although small amounts are diverted for stock watering.

2.3.1 Topography

The Rock Creek drainage displays a steep topography, with approximately 20 percent of the area having side slopes greater than 100 percent (Flynn et al. 2004). This is reflected in the subbasin's great stream velocities and erosion potential. The underlying basalt geology also creates several potential barriers to anadromous fish movement, including partial barriers on Quartz Creek (RM 2.4) and upper mainstem Rock Creek (RM 19.4, RM 20.7, RM 22.7), as well as barriers on the upper Rock Creek mainstem (RM 23.1). A falls on Box Canyon (RM 0.3) is likely the only currently impassable barrier under most flow conditions (Greg Morris, YN Fisheries biologist, pers. comm. 2006). The average Rock Creek basin elevation is 2,162 feet.

Streams in the Rock Creek subbasin share many similar geomorphic characteristics. From the headwaters, the streams cross a relatively flat basalt plateau at gradients of generally less than 1 percent. Headwater and plateau areas are primarily forested and presumed to be above most anadromous use. Coming off the plateau, streams enter steep-walled canyons where gradients increase to 2-4 percent or more, and substrates consist of cobbles and boulders. Although limited by narrow floodplains, riparian vegetation in these canyon reaches is often of relatively good quality (Berg et al. 2001), although there are some areas at the lower end of the Rock Creek canyon reach where flooding and resulting channel widening has damaged or obliterated riparian vegetation over several hundred feet of stream. Suitable spawning gravel and rearing areas (pools) are intermittent and limited by geomorphic conditions. In many areas, they are minimal in extent and quality, and limited to protected areas behind boulders and along stream margins (Lautz 2000).

Below the canyon reaches, streams flow through alluvial valleys that support agriculture and range uses. Gradients in these reaches generally drop from between 1 percent and 2 percent near the upper end to less than 1 percent as streams approach the Columbia River (Lautz 2000). Substrate in alluvial reaches varies, with particle sizes ranging from boulder to silt.

2.3.2 Hydrology

Average annual precipitation in Rock Creek is 16.2 inches (Flynn et al. 2004). Flows in the subbasin's canyon and alluvial reaches are considered flashy, rising and falling rapidly in response to precipitation and snowmelt. Snowmelt runoff from higher elevations appears to help sustain flows into early spring. Numerous springs in the subbasin also discharge groundwater through the incised underlying basalt. These springwater releases provide important cool water refuges for juvenile salmonids during the summer and early fall when stream flows are at their lowest and stream temperatures are high (NPCC 2004). The releases, however, are generally insufficient to sustain continuous stream flows in the lower subbasin during the dry season (Flynn et al. 2004). No flow regulation occurs in the drainage, although small amounts of water are diverted for stock watering.

Stream flow data are very limited for the subbasin and consist of historical information collected by the General Land Office in the 1860s, USGS recorded flows from 1962 to 1968, and incomplete staff gauge data being collected by the Yakama Nation since 2005. A comparison of the data from the 1860s to one hundred years later indicates that stream flows in lower Rock Creek may naturally drop to low or intermittent levels in late summer and early fall (Flynn et al. 2004). Figure 2-5 displays stream flow data collected by the USGS at a gauge near Roosevelt, WA (Gage # 14036600) for water years (WY; October 1 through September 30) 1963-1968 (YN Fisheries 2006). Mean stream flow over the period of record was 45.8 cfs, with average flow between November and April during the same period being 94 cfs. The maximum mean annual discharge was 113 cfs and occurred in water year 1965, which included the Christmas floods of 1964 when Rock Creek peaked at 4,800 cfs. The minimum mean annual flow of 25 cfs occurred during water year 1964. However, annual and even monthly stream flow values do not adequately communicate the seasonally episodic flow distribution pattern. Much of the runoff generally occurred in two or three discrete events. Although the graph does not represent the range of flows possible during the year ─ sometimes ranging into the thousands of cfs ─ the general shape of the hydrograph is representative of the runoff pattern typical for Rock Creek (YN Fisheries 2006).

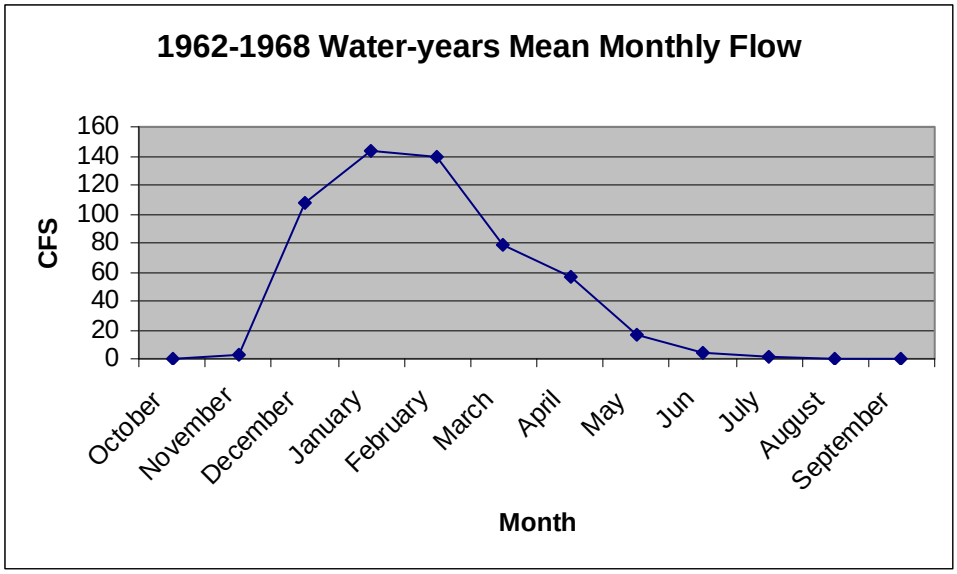

Figure 2-5. 1962-1968 Mean Monthly Flow (USGS data, prepared by YN Fisheries 2006).

2.3.3 Water Quality

Rock Creek was listed twice on the Washington Department of Ecology's (Ecology) 2002/2004 water quality assessment list as being impaired but not requiring a TMDL (not on the 303[d] list). The upper reach was listed as Category 4b because of high temperatures and the lower reach of Rock Creek was listed as Category 4c, which means impaired by a non-pollutant (fish habitat) (Flynn et al. 2004). The headwater reach of Rock Creek was changed from Category 4B to Category 5 on 3/24/05 because Ecology had not been able to confirm the results of implementation of items contained within the

Memorandum of Agreement (MOA) between Ecology and the Eastern Klickitat Conservation District (EKCD) (http://apps.ecy.wa.gov/wats/WATSQBEHome.asp).

In 1995, the Washington Department of Ecology, in cooperation with the EKCD and the Natural Resources Conservation Service (NRCS), completed an evaluation of water temperature, including the influence of riparian canopy cover, on Rock Creek (Ehinger 1996). For the study, EKCD and the NRCS deployed continuous water temperature loggers at ten stations within Rock Creek during summer 1995. They also conducted a stream habitat evaluation at each station. During the study period, the loggers recorded daily maximum stream temperatures above the current default water temperature standard of 63.5°F (17.5°C) throughout the 1995 summer months at most stations monitored (Flynn et al. 2004). In addition, stream habitat evaluation results showed that six of the ten stations had riparian canopy (vegetative) cover more than 10 percent below state target goals for eastern Washington Class A streams (Flynn et al. 2004).

The study inferred that the high water temperatures in upper Rock Creek "may be natural for a small creek in a hot, sunny summer climate." It was inferred that the lack of riparian shading and rocky substrate contribute to elevated water temperatures in the lower stream reaches (Flynn et al. 2004).

2.4 Life History Characteristics

Based on their level of sexual maturity at the time they enter freshwater and the duration of the spawning migration, steelhead populations in the Mid-Columbia DPS can be classified into one of three major life history patterns: summer run, winter run or a summer/winter run arrangement (ICTRT 2008). Although some documentation classifies Rock Creek steelhead as summer-run, some literature suggests that both winter and summer-run may utilize Rock Creek as a result of the timing of steelhead holding, migration and spawning (Figure 2-6). Yakama Nation biologists suspect that a portion of the steelhead population in Rock Creek consists of winter-run fish (YN Fisheries 2006). Winter-run fish enter freshwater streams between November and April, while summer-run fish enter rivers between May and October. Summer steelhead are of the stream-maturing type and enter freshwater in a sexually immature condition, requiring several months in freshwater to mature and spawn. Winter steelhead mature in the ocean and enter freshwater with well-developed gonads and spawns relatively shortly after river entry (Bambrick et al. 2004). All steelhead in the Columbia River Basin upstream of The Dalles Dam, including the Rock Creek population, are classified as summer-run fish (Chapman et al. 1994; ICTRT 2008).

A combination of environmental cues, including flow and temperature, triggers spawn timing throughout the Rock Creek watershed. Spawning begins in the middle of March and peaks in early April. Upper watershed steelhead appear to spawn about three weeks later. Steelhead generally spawn in clear, cool streams with suitable gravel size, depth and flow velocity. Figure 2-6 illustrates general timing of steelhead holding, migration, and spawning in Rock Creek as observed by Yakama Nation biologists 2003-2006 (YN Fisheries 2006).

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Sum Sthd	Holding		Spawning				Migration (mouth of Rock Creek is dry)*					Holding
Win Sthd	Migration			Spawning								Migration

Figure 2-6 Spawn Timing for Winter and Summer Steelhead in Rock Creek. (YN Fisheries 2006).
*Unknown: during these months, there is often no water at the mouth to allow fish immigration, and if so, only as far as the backwatered pool (YN Fisheries).

Data regarding the average age, sex ratio, etc. of steelhead spawners in Rock Creek is unavailable, and considered to be a research need. This includes an unknown number of kelts (repeat spawners): some steelhead are *iteroparous* (do not die after spawning), and may return to the ocean for a short period and repeat the spawning migration, a life history adaptation that may be fundamental to ensuring population stability. Respawning rates may be affected by environmental conditions, location of the natal stream, sex, size at maturity, and differences in the energy investment of spawning among different stocks and species (Fleming 1998). Reduced genetic contributions from populations formerly supplemented by repeat spawners may contribute to the decline of steelhead stocks in the Columbia River basin (NMFS 2000).

Iteroparity for Mid-Columbia steelhead ranges from reported rates of 2-4 percent above McNary Dam (at RM 292 measured from the mouth of the Columbia) (Busby et al. 1996) to 17 percent in the unimpounded tributaries below Bonneville Dam (at RM 146.1) (Leider et al. 1986). Iteroparity rates for Rock Creek River steelhead were reported at 3.2 percent from combined sampling periods 1979 to 1981 and 2005 (Howell et al. 1985; Yakama Nation and WDFW adult trapping data 2005). Sampling of adults at Lyle Falls Fishway in 2004 and 2005 has indicated repeat spawning rates of 2.9 percent for summer steelhead and 8.8 percent for winters. Most repeat spawners are females. Iteroparity is a life history trait that should be assessed in the Rock Creek subbasin and other neighboring, fish-bearing tributaries, and should be taken into account when management decisions for Rock Creek steelhead are made. Researchers are currently investigating ways to reinvigorate kelts to increase their survival and success in repeat spawning (NPCC 2004).

Steelhead eggs incubate at the same time that temperatures are increasing. In the lower mainstem Rock Creek where densities are highest, fry emerge very rapidly. Densities from electro-shocking suggest that emergence occurs in approximately 60 days (NPCC 2004). Because the lower mainstem becomes intermittent from July to late October, juvenile steelhead in the reach must use a number of life history strategies. While juveniles likely continue to rear in upper watershed areas during these months, juveniles reared in the lower watershed may either move out of the system, take advantage of pools (but encounter small mouth bass and other predators) in the lower 3.5-4.0 miles, or may move higher in the watershed (NPCC 2004). It is unknown if juveniles rearing in the upper watershed undertake a winter migration to positions lower in the subbasin, such as in the inundated lower section.

While limited information exists on steelhead abundance in the Rock Creek drainage, some observations suggest that a significant number of steelhead may use the Rock Creek watershed in years of good water and ocean conditions. Surveys conducted by the Yakama Nation in lower Rock Creek in 2002, 2003 and 2004 show as many as 35 to 45 steelhead redds per mile in the lower five miles, and extensive distribution of redds throughout the watershed (NPCC 2004). These surveys, however, were intermittent and were not conducted across all potential habitat. More surveys are needed to determine steelhead abundance and distribution in the drainage, and considered a research need.

There are also insufficient data to determine whether steelhead spawning and rearing in and occupying other eastern tributary subbasins are part of the same distinct population that has been associated with Rock Creek, or strays from elsewhere in the Columbia River system. In order to increase data collection and analysis of Rock Creek steelhead, the YN has proposed conducting extensive habitat surveys and population and genetic assessments. Increased data collection and analysis in other eastern tributary subbasins is also critical to gaining an understanding of the genetic composition, distribution and other characteristics of this distinct, independent population of Middle Columbia steelhead. For further information please see Appendix I.

Historically, steelhead utilized virtually all of the accessible major streams and tributaries of Rock Creek for some aspect of their life history. Spawning distribution probably included all accessible portions of the Rock Creek watershed. Then as now, the highest spawning densities likely occurred in the more complex, braided reaches of the lower mainstem of Rock Creek, and in third- and fourth-order tributaries with moderate (1-4 percent) gradients (NPCC 2004). The headwaters of the mainstem are generally above known anadromous fish use (NPCC 2004), though spawning has been observed up to the falls in Box Canyon (RM 0.3).

The current steelhead range in the Rock Creek watershed generally resembles the historical condition. Yakama Nation biologists observed live steelhead adults, redds, and fry in Rock Creek above the confluence of Quartz Creek; in Quartz Creek above the Box Canyon confluence; and in lower Box Canyon up to the falls at RM 0.3 (from the Quartz Cr. confluence). Live steelhead and redds have also been confirmed 0.5 RM up an unnamed tributary located below the confluence of Rock and Quartz creeks (RM 19.2). Additionally, steelhead adults and fry have been observed in Badger Gulch. Landowners report having seen steelhead adults, redds, and fry up Luna Gulch, from the confluence with Rock Creek, and into Squaw Creek, as well as catching steelhead in White and lower Harrison creeks (up to RM 2.5). There is also anecdotal evidence of steelhead being observed in mainstem Squaw Cr. 2.0 miles upstream of the confluence with White Cr. (YN Fisheries 2007). In the Rock Creek mainstem, BLM staff recorded seeing steelhead above the confluence with Quartz Creek (BLM 1985; BLM 1986). The BLM also found steelhead in lower Quartz Creek (BLM 1985; BLM 1986). Figure 2-7 shows the current distribution of Rock Creek steelhead.

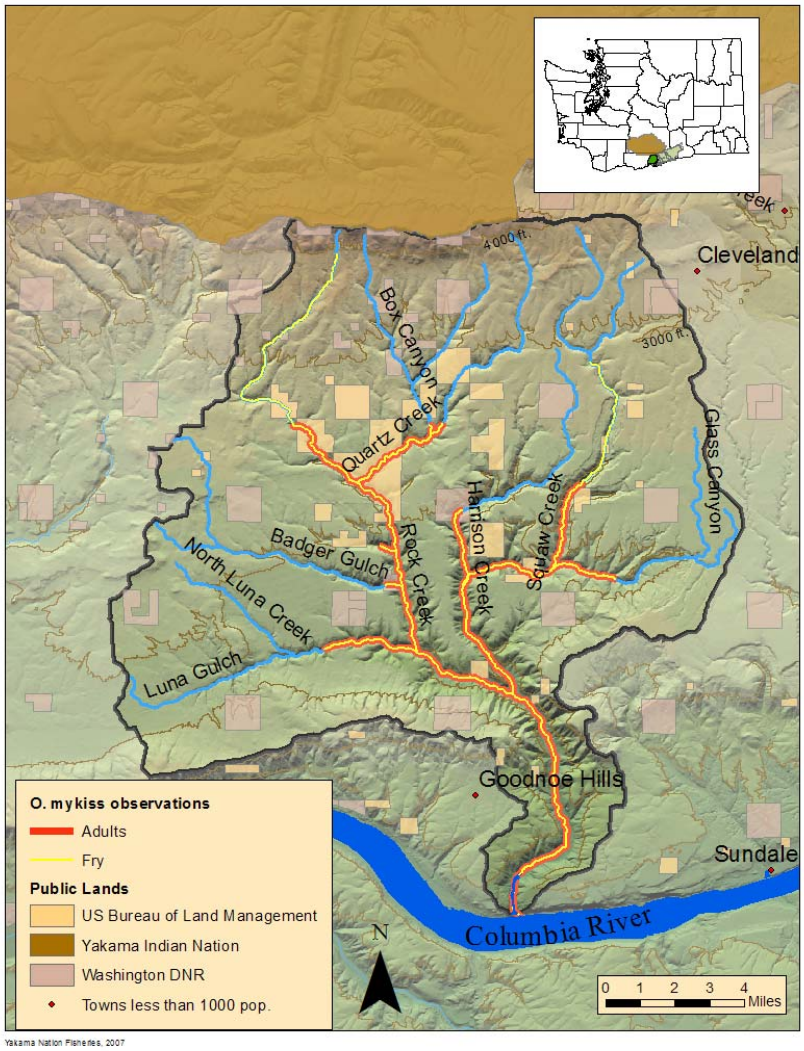

Figure 2-7. Rock Creek subbasin major streams and steelhead distribution (YN Fisheries 2007).

2.5 Hatchery Production and Releases

Anadromous fish production within the subbasin is almost exclusively natural. There are no fish production hatcheries and there is no documentation of historical plantings of hatchery fish within the watershed. However, steelhead in the Rock Creek drainage may have to compete with out-of-DPS stray hatchery fish that have been documented in neighboring populations.

2.6 Harvest

Steelhead destined for Rock Creek are harvested in tribal and non-tribal fisheries in the Columbia River. In addition, fish may be harvested for ceremonial purposes by members of the Yakama Nation. Rock Creek is open to recreational fisheries from June 1 to October 31, and the area inundated by the John Day Pool (up to the Army Corps of

Engineers Park) is open year around to allow for warm water fisheries (WDFW 2008/2009 Sport Fishing Regulations). Adult steelhead are not present in Rock Creek during the summer due to low or non-existent flows and enter the creek after flows resume and temperatures drop, generally after the season is closed (see Figure 2-6).

2.7 Hydro Development and Operations

While steelhead are not influenced by hydro developments or operations within the Rock Creek drainage, they are influenced by hydro projects on the Columbia River. Steelhead from the Rock Creek subbasin must pass three dams in the Federal Columbia River Power System (FCRPS) while migrating to and from the Pacific Ocean: Bonneville Dam, The Dalles Dam and John Day Lock and Dam. They are also influenced by changes in flow and water quality conditions in the Columbia River due to operation of the FCRPS.

The FCRPS consists of 14 projects, each comprising dams, powerhouses, and reservoirs, that are operated as a coordinated system for power production and flood control (while also effectuating other project purposes) on behalf of the Federal government under various Congressional authorities. These projects are: Dworshak, lower Granite, Little Goose, lower Monumental, and Ice Harbor dams, power plants, and reservoirs in the Snake River Basin; Albeni Falls, Hungry Horse, Libby, Grand Coulee and Banks Lake (features of the Columbia Basin Project), and Chief Joseph dams, power plants, and reservoirs in the upper Columbia River Basin; and McNary, John Day, The Dalles, and Bonneville dams, power plants, and reservoirs in the lower Columbia River Basin. Historically, flow extremes were both higher and lower than today ─ creating an ecosystem that was highly productive for salmonids. The Columbia River estuary was particularly productive because a tremendous amount of energy was released as the force of river flows and the ocean interacted with surrounding landscapes.

3. Recovery Goals and Viability Criteria

Under the Endangered Species Act, a species no longer requires protection when it is no longer in danger of extinction or likely to become endangered within the foreseeable future based on evaluation of the listing factors specified in ESA section 4(a)(1). To remove the Middle Columbia River steelhead DPS from protection under the ESA, NMFS must determine that the DPS, as evaluated under the ESA listing factors, is no longer likely to become endangered.

The ESA requires that recovery plans, to the maximum extent practicable, incorporate objective, measurable criteria which, when met, would result in a determination in accordance with the provisions of the ESA that the species be removed from the Federal List of Endangered and Threatened Wildlife and Plants (50 CFR 17.11 and 17.12). The recovery criteria comprise the core standards that NMFS believes will lead to conditions upon which the decision to delist a species will be based. The ESA's listing factors, and not the recovery plan, are the legal basis upon which delisting decisions will be made.

This chapter identifies recovery goals, which include biological and broad sense goals, for the Rock Creek steelhead population. It also provides the delisting criteria, both biological criteria and threats criteria, used to determine how and when recovery will be achieved.

3.1 Recovery Goals

The primary goal of this plan is for the Rock Creek steelhead population to be restored to a sufficiently robust condition to support recovery of the Mid-Columbia steelhead DPS. It needs at least to be maintained on a trajectory toward viable status, with the ultimate goal being viability.

If a local, collaborative Washington Gorge Area Regional Board is formed, it may choose to define additional, broad-sense goals for the Rock Creek subbasin and other areas within the Washington (WA) Gorge Management Unit. The Board's broad-sense goals for the area would likely build upon direction from, and respond to interests identified by various stakeholders in the area. These goals would then guide the Board as it defines and implements future recovery actions for the Rock Creek subbasin.

The visions, goals, and actions of many of the parties involved in the Rock Creek recovery planning process may go beyond ESA delisting. The vision for broad-sense recovery incorporates ESA delisting goals in the sense that delisting would be achieved first during an extended and stepwise process of achieving broad sense recovery goals. Broad sense recovery goals incorporate many of the local and traditional uses, as well as rural and Native American values, deemed important in the Pacific Northwest.

3.2 Biological Viability Criteria

The ICTRT developed biologically based viability criteria for ESA-listed salmon and steelhead in the Interior Columbia domain. The ICTRT based its approach to recovery on guidance from the NMFS Technical Memorandum, *Viable Salmonid Populations and the Recovery of Evolutionarily Significant Units* (McElhany et al. 2000). This memorandum provides general direction for setting viability objectives at the ESU/DPS and component population levels.

Viability criteria at the population level address four VSP parameters (McElhany et al. 2000):

- *Abundance* – the average number of spawners in a population over a generation or more,
- *Productivity* – the performance of a population over time in terms of recruits produced per spawner,
- *Spatial Structure* – a population's geographic distribution and the processes that affect that distribution, and
- *Diversity* – the distribution of genetic, life history and phenotypic variation within and among populations.

The ICTRT grouped specific population level criteria into two categories to assess viability at the independent population level: measures addressing abundance and productivity, and measures addressing spatial structure and diversity. The viability of an independent population is determined by integrating risks across the four parameters. Additionally, the VSP guidelines (McElhany et al. 2000) recommend that a viable DPS population should be large enough to:

1. have a high probability of surviving variation observed in the past and expected future;
2. be resilient to environmental and anthropogenic disturbances;
3. maintain genetic diversity; and
4. support/provide ecosystem functions.

They also recommend that viable populations demonstrate sufficient productivity to support a net replacement rate of 1:1 or higher at abundance levels established as long-term targets. Productivity rates at relatively low numbers of spawners should, on average, be sufficiently greater than 1.0 to allow the population to rapidly return to abundance target levels.

However, in order to apply these four parameters to the viability of an independent population, MPG, and ESU/DPS it first becomes necessary to understand the hierarchical structure of salmonid populations.

Defining DPS Structure

The ICTRT applies overall DPS-level viability and criteria based on smaller units of major population groups and independent populations to determine a path toward viability. Central to this approach is the recognition that salmonid population structure is hierarchical. Biological criteria for populations and DPS-level viability are based on the existence of a biological hierarchy that spans ESUs/DPSs, major groupings, populations and substructure within populations (Figure 3-1). The approach recognizes that historical salmonid populations within the DPS retain some genetic similarities because they move between different habitats during their life cycle. This distribution across the landscape ─ and the diverse genetic, life history and morphological characteristics that evolve ─ contribute significantly to a population's long-term persistence.

Two levels in this hierarchy were formally identified by McElhany et al. (2000) for recovery planning purposes, the ESU/DPS level and the population level. The ICTRT identified another level in the hierarchy, the major population group, which exists between the population and ESU levels.

- **Evolutionarily Significant Unit or Distinct Population Segment**: Two criteria define an ESU or DPS listed under the ESA: 1) it must be substantially reproductively isolated from other conspecific 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.

- **Major Population Groups*:*** Larger populations that share similar genetic, geographic (hydrographic), and/or habitat characteristics (McClure et al. 2003). These "major groupings" of populations are isolated from one another over a longer time scale than that defining the individual populations, but retain some degree of connectivity greater than that between ESUs. The ICTRT defines these larger populations as major population groups (MPGs). MPGs are analogous to "strata" as defined by the Willamette/Lower Columbia TRT (W/LC TRT) and "geographic regions" described by the Puget Sound TRT.

- **Independent Population:** 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. Groups are considered to be independent populations if they are isolated to such an extent that exchanges of individuals among the populations do not substantially affect the population dynamics or extinction risk of the independent populations over a 100-year time frame."

Hierarchy in Salmonid Population Structure

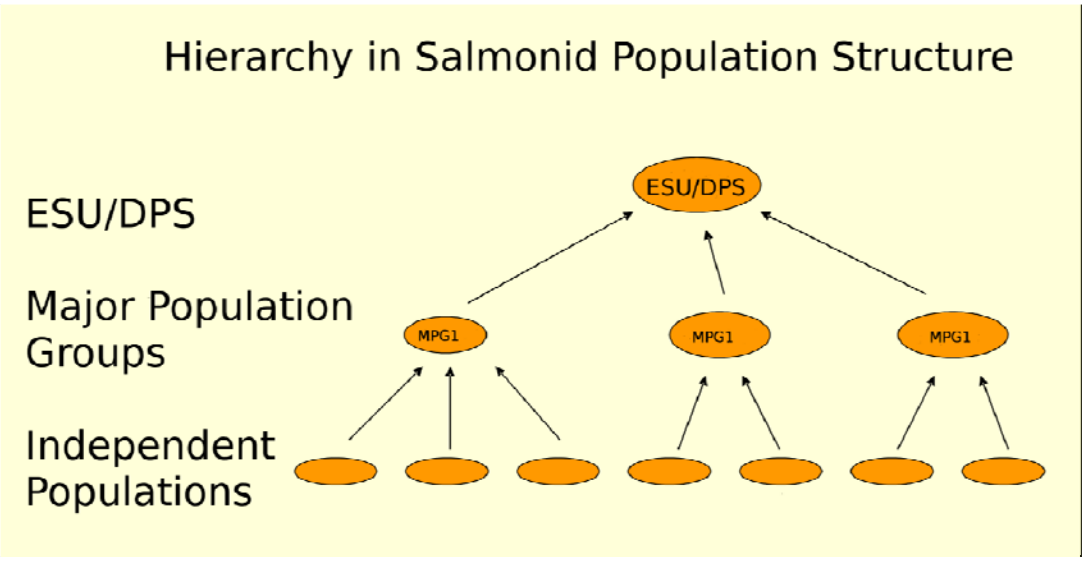

Figure 3-1 Hierarchical levels of salmonid species structure as defined by the TRTs for ESU/DPS recovery planning.

3.2.1 DPS and MPG Viability Criteria

The major objectives of the ICTRT's viability criteria are to ensure preservation of basic historical metapopulation processes including 1) genetic exchange across populations within an ESU/DPS over a long time frame; 2) the opportunity for neighboring populations to serve as source areas in the event of local population extirpations; 3) population distribution within an ESU/DPS so that they are not all susceptible to a specific localized catastrophic event (ICTRT 2007).

Since MPGs are geographically and genetically cohesive groups of populations, they are critical components of ESU/DPS spatial structure and diversity. Having all MPGs within an ESU/DPS at low risk provides the greatest probability of persistence for the ESU/DPS. Thus, the ICTRT criterion for a viable ESU/DPS is that all extant MPGs and any extirpated MPGs critical for proper functioning of the ESU/DPS should be at low risk.

The population level assessments provide the basis for evaluation viability at the MPG level and, in turn, for the DPS as a whole. The combined effects of requiring each MPG to sustain a minimum number of viable populations, representation of larger size classes of populations, major life history patterns and the maintenance requirement provide for a network of populations that would sustain the DPS.

Further, the following five criteria should be met for an MPG to be regarded as low risk (viable) (ICTRT 2007):

1. At least one-half of the populations historically within the MPG (with a minimum of two populations) should meet viability standards. This equals to four for this MPG.

2. At least one population should be classified as "Highly Viable."

3. Viable populations within an MPG must include some populations classified (based on historical intrinsic potential) as "Very Large," "Large" or "Intermediate" generally reflecting the proportions historically present within the MPG. In particular, Very and Large populations should be at or above composite historical fraction within the MPG.

4. All major life history strategies (e.g. spring and summer run timing) that were present historically within the MPG should be represented in populations meeting viability requirements. Since Fifteenmile Creek is the only strictly winter run population, it should meet viability criteria.

5. Remaining MPG populations should be maintained with sufficient abundance, productivity, spatial structure, and diversity to provide for ecological functions and to preserve options for DPS recovery.

The ICTRT recognizes that a variety of recovery scenarios may lead to a viable DPS. Different recovery scenarios may reflect alternative combinations of viable populations and specific policy choices regarding acceptable risk levels. The population level assessments provide the basis for evaluation viability at the MPG-level and, in turn, for the DPS as a whole. The combined effects of requiring each MPG to sustain a minimum number of viable populations, representation of larger size classes of populations, major life history patterns and the maintenance requirement provide for a network of populations that would sustain the DPS.

3.2.2 Application of Biological Viability Criteria to Rock Creek Population

As previously discussed, the biological recovery goal for the Rock Creek steelhead population is to contribute to recovery for the Middle Columbia River Steelhead DPS by maintaining a trajectory toward viable status. A viable population is defined as an independent population that has negligible risk of extinction due to threats from demographic variation, local environmental variation, and genetic diversity changes over a 100-year timeframe (ICTRT 2008).

The ICTRT classified the Rock Creek steelhead population as "Basic" in size based on historical habitat potential (ICTRT 2008). Applying the ICTRT's viability criteria to the Cascades Eastern Slopes and Tributaries MPG results in the conclusion that Rock Creek steelhead population is at high risk. This rating was assigned because of the lack of direct estimates of abundance and productivity for this population.

The following information delineates the viability criteria, as applied to the Rock Creek steelhead population.

Abundance
A steelhead population classified as "Basic" has a mean minimum abundance threshold criteria of 500 natural-origin spawners with sufficient intrinsic productivity to achieve 5 percent or less risk of extinction over a 100-year timeframe. This determination is predicated on the assumption that abundance levels below 500 individuals for any population pose unacceptable risk for inbreeding depression and other genetic concerns (ICTRT 2008; McClure et al. 2003).

Productivity
Viable populations demonstrate sufficient productivity to support a net replacement rate of 1:1 or higher at abundance levels established as long-term targets. Productivity rates at relatively low numbers of spawners should, on average, be sufficiently greater than 1.0 to allow the population to rapidly return to abundance target levels. In order for the Rock Creek population to achieve a 1% or less risk of extinction over a 100-year timeframe, productivity would need to be at or greater than 2.0 recruits per spawner at the minimum abundance threshold.

Spatial Structure and Diversity
The ICTRT's viability criteria for spatial structure and diversity provide a measure of the status of a population. The criteria are structured around two goals, or biological or ecological objectives, that spatial structure and diversity criteria at intended to achieve:

1. *Maintaining natural rates and levels of spatially mediated processes*. This goal serves to minimize the likelihood that populations will be lost due to local catastrophe, to maintain natural rates of recolonization within the population and between populations, and to maintain other population functions that depend on the spatial arrangement of the population.

2. *Maintaining natural patterns of variation*. This goal serves to ensure that populations can withstand environmental variation in the short and long-terms.

Based on historical potential analysis, the ICTRT gave the Rock Creek population a combined integrated Spatial Structure/Diversity rating of "Moderate" risk. The Rock Creek population was a relatively simple population structure, containing a single MaSA. Although observations indicate that steelhead spawning may occur across much of the historical range, the relatively simple population structure results in a moderating rating for complexity. There have likely been minor reductions in life history diversity and phenotypic variation, but these changes are not severe enough to raise risk levels above low.

3.3 Delisting Criteria

The ESA requires that recovery plans, to the maximum extent practicable, incorporate objective, measurable criteria which, when met, would result in a determination in accordance with the provisions of the ESA that the species be removed from the Federal List of Endangered and Threatened Wildlife and Plants (50 CFR 17.11 and 17.12). Court rulings and NMFS policy indicate that delisting criteria must include both biological criteria and listing factor criteria that address threats to the species (i.e., the listing factors in ESA section 4[a][1]).

3.4 Threats Criteria

Listing factors are those features that were evaluated under section 4(a)(1) when the initial determination was made to list the species for protection under the ESA. These may or may not still be limiting recovery when in the future NMFS reevaluates the status of the species to determine whether the protections of the ESA are no longer warranted and the species could be delisted.

At the time of a delisting decision, NMFS will examine whether the section 4(a)(1) listing factors have been addressed. To assist in this examination, NMFS will use the listing factors (or threats) criteria described below in addition to evaluation of biological recovery criteria and other relevant data and policy considerations.

To determine that the affected DPS is recovered to the point that it no longer requires the protections of the ESA, NMFS will review the status of the listing factors according to the specific criteria identified for each of them (see below). The threats need to have been addressed to the point that delisting is not likely to result in their re-emergence. It is possible that current perceived threats will become insignificant in the future due to changes in the natural environment or changes in the way threats affect the entire life-cycle of salmon. Consequently, NMFS expects that the ranking of threats will change over time and that new threats may be identified. During the status reviews, NMFS will evaluate and review the listing factor criteria under conditions at the time.

The specific criteria listed below for each of the relevant listing/delisting factors helps to ensure that underlying causes of decline have been addressed and mitigated before considering a species for delisting. NMFS expects that if the proposed actions described in this plan are implemented, they will make substantial progress toward meeting the following listing factor (threats) criteria.

Factor A: The present or threatened destruction, modification, or curtailment of its habitat or range.

To determine that the DPS is recovered, threats to habitat should be addressed to a degree sufficient to support a viable Middle Columbia River steelhead DPS as outlined below:

1. Passage obstructions (e.g., dams and culverts) are removed or modified to improve survival and restore access to historically accessible habitat where necessary to support recovery goals.
2. Flow conditions that support adequate steelhead rearing, spawning, and migration of a viable DPS are achieved where possible through management of mainstem and tributary irrigation and hydropower operations, and through the improvement of other water user efficiencies and conservation, including for municipal supply and other consumptive purposes.
3. Forest management practices that protect watershed and stream functions are implemented on Federal, state, tribal, and private lands.
4. Agricultural practices, including grazing, are implemented to protect and restore riparian areas, floodplains, and stream channels, and to protect water quality from sediment, pesticide, herbicide, and fertilizer.
5. Urban and rural development, including land use conversion from agriculture and forestland to residential uses, avoids impairment of water quality or natural stream conditions.
6. The effects of toxic contaminants on salmonid fitness and survival in the mainstem and tributaries are sufficiently limited so as not to affect recovery.
7. Channel function, including vegetated riparian areas, canopy cover, stream-bank stability, off-channel and side-channel habitats, natural substrate and sediment processes, and channel complexity is restored to provide adequate rearing and spawning.
8. Floodplain function and the availability of floodplain habitats for salmon are restored to a degree sufficient to support a viable DPS. This restoration should include connectedness between river and floodplain and the restoration of impaired sediment delivery processes.

Factor B: Over-utilization for commercial, recreational, scientific or educational purposes

To determine that the DPS is recovered, any utilization for commercial, recreational, scientific, or educational purposes should be managed as outlined below:

1. Fishery management plans for steelhead are in place that (a) accurately account for total fishery mortality (i.e., both landed catch and non-landed mortalities) and constrain mortality rates to levels that are consistent with achieving population viability (i.e., provide for adequate spawning escapement given their productivity); and (b) are implemented in such a way as to avoid deleterious genetic effects on populations or negatively affect the distribution of populations.
2. Federal, state, and local fishing rules and regulations are effectively enforced.
3. Technical tools accurately assess the effects of the harvest regimes so that harvest objectives are met but not exceeded.

4. Handling of fish is minimized to reduce indirect mortalities associated with education or scientific programs, while recognizing that monitoring, research, and education are key actions for conservation of the species.

5. To the degree necessary to support a viable DPS, routine instream construction and maintenance practices are implemented in a manner to reduce or eliminate mortality of listed species.

Factor C: Disease or predation

To determine that the DPS is recovered, any disease or predation that threatens its continued existence should be addressed as outlined below:

1. Hatchery operations do not subject steelhead populations to deleterious diseases and parasites and do not result in increased predation rates of wild steelhead;

2. Predation by avian predators is managed in a way that promotes recovery of salmon and steelhead populations;

3. The northern pikeminnow and other exotic piscivorous species are managed to reduce predation on steelhead to a degree sufficient to meet recovery goals;

4. Populations of introduced smallmouth bass, walleye, channel catfish and other exotic piscivorous species are managed such that competition or predation does not impede steelhead recovery.

5. Predation of steelhead runs below Bonneville Dam by marine mammals is managed within the framework of applicable statutes and to the degree necessary to protect upstream migration of steelhead..

6. Physiological stress and physical injury that may cause disease or increase susceptibility to pathogens during rearing or migration should be reduced during critical low flow periods (e.g. low water years) or poor passage conditions (e.g. at diversion dams or bypasses).

Factor D: The inadequacy of existing regulatory mechanisms

To determine that the DPS is recovered, any inadequacy of existing regulatory mechanisms that threatens its continued existence should be addressed to the degree necessary to support a viable DPS, as outlined below:

1. Sufficient resources, priorities, regulatory frameworks, and coordination mechanisms are established and/or maintained for effective enforcement of land and water use regulations that protect and restore habitats and for the effective management of fisheries.

2. Habitat conditions and watershed functions are protected through land-use planning that guides human population growth and development.

3. Habitat conditions and watershed function are protected through regulations that govern resource extraction such as timber harvest and gravel mining.
4. Habitat conditions and watershed functions are protected through land protection agreements as appropriate, where existing policy or regulations do not provide adequate protection.

5. Regulatory, control, and education measures to prevent additional exotic plant and animal species invasions are in place.

Factor E: Other natural or manmade factors affecting its continued existence

To determine that the DPS is recovered, other natural and man-made threats to its continued existence should be addressed as outlined below:

1. Hatchery programs are being operated in a manner that is consistent with individual watershed and region-wide recovery approaches; appropriate criteria should be used for the integration of hatchery steelhead populations and extant natural populations inhabiting watersheds where the hatchery fish return.

2. Hatcheries operate using appropriate ecological, genetic, and demographic risk containment measures for (1) hatchery-origin adults returning to natural spawning areas, (2) release of hatchery juveniles, (3) handling of natural-origin adults at hatchery facilities, (4) withdrawal of water for hatchery use, (5) discharge of hatchery effluent, and (6) maintenance of fish health during their propagation in the hatchery.

3. Mechanisms are in place to reduce the incidence of, and impacts from, introduced, invasive, or exotic plant and animal species.

4. Nutrient enrichment programs should be evaluated to determine where additional nutrient inputs can provide significant benefits.

4. Current Status Assessment

This chapter summarizes the ICTRT's viability assessment results for Middle Columbia River steelhead in the Rock Creek watershed. The assessment reflects existing data, previous assessment findings and GIS analysis.

4.1 Abundance and Productivity

At present, no direct estimates of abundance and productivity are available for Rock Creek steelhead. There have been no systematic redd surveys in this population area. The general presence of steelhead has been documented (NPCC 2004).
The ICTRT concluded that the Rock Creek steelhead population is at **high risk** based on the lack of direct information on current or indirect assessments of abundance and productivity (ICTRT 2008).

The Interior Columbia Technical Recovery Team (ICTRT) classified the Rock Creek population as "Basic" in size based on historical habitat potential (ICTRT 2008). As addressed in Chapter 3, a steelhead population classified as basic has a mean minimum abundance threshold criteria of 500 natural-origin spawners with a sufficient intrinsic productivity (≥ 1.56 recruits per spawner at the minimum abundance threshold) to achieve a 5 percent or less risk ("low risk") of extinction over a 100-year timeframe. In order for the Rock Creek population to achieve a 1% or less risk ("very low risk") of extinction over a 100 years, productivity would need to be at or greater than 2.00 recruits per spawner at the minimum abundance threshold.

Table 4-1 Rock Creek Summer Steelhead Basin Statistics (ICTRT 2006).

Drainage area (km^2)	586
Stream lengths km (total) [a]	169
Stream lengths km (below natural barriers) [a]	166
Branched stream area weighted by intrinsic potential (km^2)	0.665
Branched stream area km^2 (weighted and temp. limited) [b]	0.411
Total stream area weighted by intrinsic potential (km^2)	0.683
Total stream area weighted by intrinsic potential (km^2) temp limited [b]	0.419
Size / Complexity category	Basic
Number of Major Spawning Areas (MaSAs)	1
Number of Minor Spawning Areas (MiSAs)	0

a. All stream segments greater than or equal to 3.8m bankfull width were included
b. Temperature limited areas were assessed by subtracting area where the mean weekly modeled water temperature was greater than 22°C.

4.2 Spatial Structure and Diversity

The Rock Creek population has a single major spawning area (MaSA) (a system of one or more branches capable of supporting 500 spawners). Steelhead are known to occur in Rock Creek up to a point ¼ mile above the confluence with Quartz Creek (BLM 1985, 1986), and possibly above it. Steelhead have also been located in lower Quartz Creek (BLM 1985, 1986). Steelhead are known to occur in Squaw Creek up to the confluence with Harrison Creek, and have occurred historically as far as the confluence with Spring

Creek (C. Dugger, WDFW, pers. comm., 1999). Known utilization includes the lower and middle portions of Rock Creek, lower Quartz Creek and Squaw Creek.

The ICTRT rated the Rock Creek population at Moderate risk for Spatial Structure/Diversity (Table 4-2). Based on the ICTRT historical potential analysis, the Rock Creek population had a relatively simple population structure, containing a single MaSA. Although observations indicate that steelhead spawning may occur across much of the historical range, the relatively simple population structure results in a moderate rating for complexity. There have likely been minor reductions in life history diversity and phenotypic variation, but these changes are not severe enough to raise risk levels above low.

Table 4-2 Rock Creek summer steelhead population spatial structure and diversity risk rating summary (ICTRT 2008).

<table>
<tr><th rowspan="2">Metric</th><th colspan="5">Risk Assessment Scores</th></tr>
<tr><th>Metric</th><th>Factor</th><th>Mechanism</th><th>Goal</th><th>Population</th></tr>
<tr><td>A.1.a</td><td>H (-1)</td><td>H (-1)</td><td rowspan="3">(Mean = 0.33)
Moderate Risk</td><td rowspan="3">Moderate Risk</td><td rowspan="14">Moderate Risk</td></tr>
<tr><td>A.1.b</td><td>L (1)</td><td>L (1)</td></tr>
<tr><td>A.1.c</td><td>L (1)</td><td>L (1)</td></tr>
<tr><td>B.1.a</td><td>M (0)</td><td>M (0)</td><td rowspan="3">Moderate Risk (0)</td><td rowspan="11">(Mean=0.25)
Moderate Risk</td></tr>
<tr><td>B.1.b</td><td>M (0)</td><td>M (0)</td></tr>
<tr><td>B.1.c</td><td>M (0)</td><td>M (0)</td></tr>
<tr><td>B.2.a(1)</td><td>M (0)</td><td rowspan="4">M (0)</td><td rowspan="4">Moderate Risk (0)</td></tr>
<tr><td>B.2.a(2)</td><td>L (1)</td></tr>
<tr><td>B.2.a(3)</td><td>L (1)</td></tr>
<tr><td>B.2.a(4)</td><td>VL (2)</td></tr>
<tr><td>B.3.a</td><td>M (0)</td><td>M (0)</td><td>M (0)</td></tr>
<tr><td>B.4.a</td><td>L (1)</td><td>L (1)</td><td>L (1)</td></tr>
</table>

4.3 Overall Risk Rating

The Rock Creek steelhead population does not currently meet viability criteria because the Abundance/Productivity risk rating is assigned a High risk rating (Figure 4-1). The overall Spatial Structure/Diversity rating is at Moderate risk. The lack of direct estimates of abundance and productivity for this population was a factor in assigning a High risk rating.

		Spatial Structure/Diversity Risk			
		Very Low	**Low**	**Moderate**	**High**
Abundance/ Productivity Risk	**Very Low** (<1%)	**HV**	**HV**	**V**	**M**
	Low (1-5%)	**V**	**V**	**V**	**M**
	Moderate (6 – 25%)	**M**	**M**	**M**	**HR**
	High (>25%)	**HR**	**HR**	**HR Rock Creek***	**HR**

Figure 4-1. Integrated Risk Rating for the Rock Creek Steelhead Population (ICTRT 2008). ***Viability Key: HV – Highly Viable; V – Viable; M – Maintained; HR – High Risk; * = Candidate for Maintained; Shaded cells – does not meet viability criteria (darkest cells are at greatest risk).***

4.4 Major Spawning Area

The ICTRT identified potential intrinsic habitat in the Rock Creek subbasin as a major spawning aggregation (MaSA) for Middle Columbia River steelhead (Figure 4-2). The ICTRT delineated this MaSA using model results that estimated the historical amount of potentially accessible spawning and rearing habitat available to a specific population based on stream width, gradient, and valley width from GIS-based analysis of tributary habitat associated with each population (ICTRT 2005).

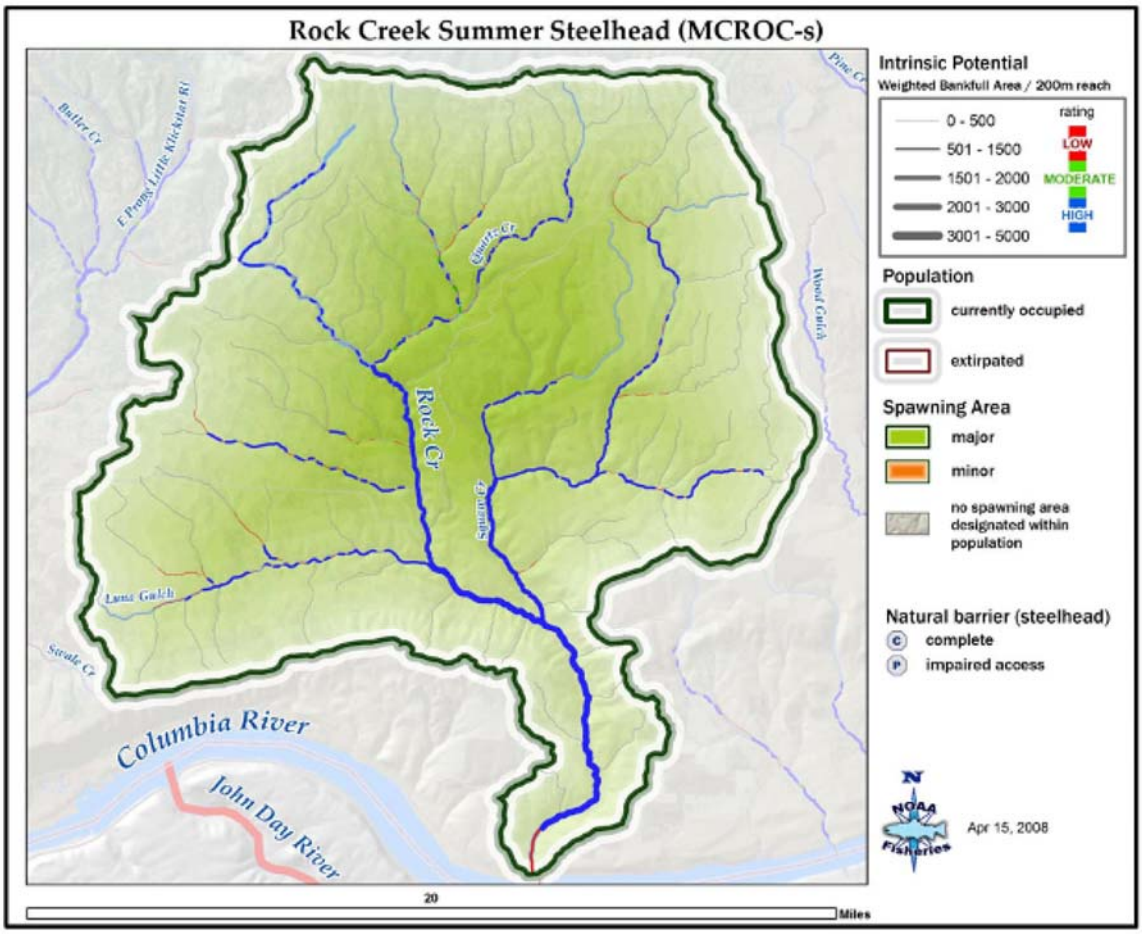

Figure 4-2. Rock Creek summer steelhead population boundary and major (MaSA) and minor (MiSA) spawning areas (ICTRT 2008).

5. Limiting Factors and Threats Analysis

The reasons for a species' decline are generally described in terms of limiting factors and threats. Analysis of limiting factors and threats across the entire species' life cycle forms the basis for designing recovery strategies and actions. NMFS defines limiting factors as the biological and physical conditions limiting DPS and population status (e.g. elevated water temperature), and defines threats as those human activities or naturally induced actions that cause the limiting factors (e.g. removal of riparian vegetation for agricultural or residential purposes, which causes loss of shade and, consequently, elevated water temperature).

While the term "threats" carries a negative connotation, it does not mean that activities identified as threats are inherently undesirable. They are typically legitimate human activities that may at times have unintended negative consequences on fish populations—and that can also be managed in a manner that minimizes or eliminates the negative impacts.

For steelhead and other salmonids, survival to reproduce depends on a complex, interacting system of environmental conditions, with different conditions needed for each life stage. Optimal water temperature, for example, varies (within limits) for adult migration vs. egg incubation or juvenile rearing. In addition, the particular factors limiting production may vary across different sections of the tributary drainage used by a particular population. Data on a full range of potential limiting factors is rarely available at the reach level. As a result, the identification of potential limiting factors affecting the Rock Creek steelhead population includes elements based on inference and expert opinion.

The list of limiting factors for the Rock Creek steelhead population, as for the other populations that make up the Middle Columbia steelhead DPS, is based on a substantial body of research on salmonids, local field data and field observations, and the considered opinions of regional experts. These are implicitly hypothetical statements, made with the expectation that by taking action in the face of some degree of scientific uncertainty, monitoring the results, continuing to conduct research as a high priority, and adapting our management actions in response, the state of our knowledge will improve and so will the survival of these fish, although not necessarily in a directly parallel process.

In that spirit, this chapter describes factors that may be limiting Middle Columbia River steelhead production in the Rock Creek subbasin. Using the set of general limiting factors described in this chapter as a starting point, more detailed analyses are used in subsequent chapters to identify key opportunities for recovery efforts.

5.1 Freshwater Habitat Degradation

While the Rock Creek watershed is sparsely populated, anthropogenic influences occur throughout the subbasin. Much of the watershed has been grazed or logged, and

primitive roads extend from near the Columbia River to the headwaters of most streams in the subbasin. Beaver were once likely abundant but are now all but absent. Still, while grazing, roads and other uses contribute to habitat problems in some parts of the watershed, considerable forest canopy remains and many stream reaches support at least shrub dominated riparian areas.

The major factors limiting abundance, productivity, spatial structure and diversity of Middle Columbia River steelhead in the Rock Creek watershed are discussed briefly below and described in Table 5-1. The factors were identified based on information in the Northwest Power and Conservation Council's subbasin plan for the Lower Mid-Columbia Mainstem, including Rock Creek (NPCC 2004); the Watershed Assessment for Rock Creek, part of WRIA 31 (Flynn et al. 2004); and Yakama Nation Fisheries reports. They also reflect findings from an Ecosystem Diagnosis and Treatment (EDT) analysis for Rock Creek, however, information on Rock Creek is sparse and sporadic, and much of the information used to complete the EDT analysis was based on best professional judgment. Orthophotos, field observations, and unpublished Yakama Nation data were incorporated into this summary by reach (NPCC 2004).

- ***Altered natural hydrograph.*** Seasonally low to non-existent stream flows are a primary factor limiting steelhead production in the Rock Creek watershed. While flows in the system are naturally flashy, the loss of riparian vegetation, instream habitat complexity and diversity, and floodplain connectivity in some reaches because of grazing, roads, and other land uses have increased the intensity of flows in some parts of the drainage. Low summer stream flows occur in the lower part of the subbasin ─ lower Rock Creek mainstem, lower Squaw Creek, and lower Luna Gulch ─ but also occur in some headwater and canyon reaches (NPCC 2004). Low to intermittent and/or subterranean flows in all streams during late summer, fall and early winter limit juvenile mobility and can cause mortality due to stranding. Most flow in lower Rock Creek is below the surface due to the high proportion of alluvial material in the substrate. Spring releases feed some reaches and pools, and provide important refuge habitat during periods of low flow.

- ***Degraded water quality, high stream temperatures.*** Late summer water temperatures in the lower Rock Creek subbasin sometimes rise above 63.5°F, a level considered potentially lethal for steelhead and other salmonids. Rock Creek is listed twice on the Washington State Department of Ecology's 2002/2004 water quality assessment list as being impaired, but not requiring a TMDL (not on the 303(d) list). The upper reach is listed for temperature, but it is listed as a Category 4b stream because a pollution control plan has been established. Lower Rock Creek is listed as Category 4c, because fish habitat is impaired (Flynn et al. 2004). Loss of habitat quantity and diversity, channel degradation due to flooding and other factors, low summer flows, and loss of riparian vegetation contribute to this limiting factor. High stream temperatures during summer and early fall, especially in the lower watershed, limit juvenile mobility and may result in stranding or mortality because of thermal stress (NPCC 2004). Spring outflow

into fish-bearing streams provides important cool water refuges for steelhead and other salmonids during summer and early fall when stream temperatures rise.

- ***Degraded riparian function and condition.*** While the stream system's rocky substrate and steep topography naturally inhibit riparian forest stand development along many reaches, riparian function and condition have been affected by major flood events, grazing, timber practices, road construction, and other land uses. Grazing affects much of the Rock Creek watershed, but its impacts can be directly observed in lower subbasin drainages. A 1995 stream habitat evaluation along Rock Creek showed that six of ten sites examined during the evaluation had riparian vegetative cover more than 10 percent below the target for eastern Washington Class A streams (Flynn et al. 2004; Ehinger 1996).

- ***Reduced channel structure and complexity.*** Degraded channel structure and complexity in the subbasin reduce key habitat quantity and habitat diversity for steelhead. Key habitat quantity refers to the amount of key habitat, such as riffles, that is present in the stream for each life stage. If key habitats are limited, fewer steelhead can be supported by the stream. Habitat diversity refers to the extent of habitat complexity, such as large wood, boulders, undercut banks and pools, within a stream reach. Greater complexity increases survival and provides better habitat.

  Findings from a reconnaissance survey of portions of Rock Creek indicate that the creek's general channel characteristics may be similar to those noted in a 1860s survey (e.g., broad rocky reaches), with the exception that the lowermost reach may be somewhat wider today than historically (Flynn et al. 2004). Over the years, however, key habitat quantity and habitat diversity have declined in some reaches due to disturbance of channel and riparian habitats from grazing, timber harvest, road construction, other anthropogenic changes and from major flood events. These factors have contributed cumulatively to changes in the hydrograph, altering available perennial wet habitat as well as decreasing riparian quality and function and instream habitat and function (YN Fisheries 2006). Key habitat quantity and habitat diversity have also been lost in the one mile reach above Rock Creek's mouth due to inundation by Lake Umatilla behind John Day Dam on the Columbia River.

- ***Reduced floodplain function and channel migration processes.*** Bridges for the Bickleton Highway and Old Highway 8 have increased hydro confinement, constricting flow and channel migration processes, but are currently considered necessary parts of the transportation network. A series of dikes also exists in the middle mainstem Rock Creek reaches, limiting the stream's ability to naturally meander. Extensive grazing historically and currently has diminished riparian health and affected channel plan form in many areas in the lower watershed, decreasing channel stability. Extirpation of beavers from the upper portions of Rock Creek has also had a significant impact on hydrologic and channel-forming processes.

- ***Altered sediment routing.*** Sediment loads (the percentage of fines in spawning gravel, embeddedness and turbidity) in the Rock Creek subbasin have likely increased over historic conditions. Actions contributing to increased sediment delivery include forest practices (skidding and road building, clearing of upland forests and stream-banks), agricultural and grazing practices (rill irrigation, streamside grazing) and road building and maintenance activities.

- ***Increased competition for food sources.*** Changes in the hydrological regime and riparian conditions affect the food web and thus increase competition among species. Macroinvertebrates produce in reduced quantities due to poorly functioning hyporheic zones, diminished pool and riparian presence, and a lack of stream structure.

- ***Increased predation and competition.*** The building of the John Day Dam and subsequent inundation of the bottom mile of Rock Creek introduced exotic piscivorous fish not only to the lower mile and reservoir through which the steelhead must travel, but also made it possible for these fish to travel up Rock Creek. Exotic piscivorous species have been observed in Rock Creek up to the confluence with Squaw Creek.

Some of these limiting factors ─ such as low summer flows and high summer water temperatures ─ occur naturally in some parts of the watershed because of bedrock terrain and steep slopes, but their intensity has increased because of anthropogenic changes in the subbasin. For example, forest practices, including logging and road construction, have adversely impacted functional quality of riparian areas in some portions of the headwaters and canyon reaches (e.g., upper Rock Creek, Box Canyon and Quartz Creek) (NPCC 2004). In addition, channel widening and incision, such as along lower Rock Creek, may have caused a reduction or loss of summer base flows.

Table 5-1. Freshwater Limiting Factors for Middle Columbia River steelhead in Rock Creek.

Limiting Factor	*VSP Parameter Impacted*	*Sites Affected*	*Threats*	*Life stages affected**	*Significance (Scope/Severity)*	*Action*
Reduced channel structure and complexity (lack of key habitat quantity)	Abundance, productivity, spatial structure, diversity	Mainstem Rock Creek, Squaw Creek, Harrison Creek, Luna Gulch, Unnamed Trib at RM 19.2 , Quartz Creek, Box Canyon	John Day Pool inundation, overgrazing, upland management, channel modification absence of beaver, road building	S,E,IO-1,R1, R2	Actions will restore year-round fish habitat. **Severe:** Rock Creek to RM 14.6, Squaw Creek to RM 7.7, Luna Gulch **Moderate:** Upper Squaw Creek, Harrison Creek, Unnamed trib at Rm 19.2 Badger Gulch, Rock Creek RM 14.6-RM19.2, Box Canyon **Low:** Lower and Middle Quartz Creek, Upper Rock Creek	Improve instream structure, easements and acquisition, fencing
Loss of riparian function and condition	Abundance and productivity	Mainstem Rock Creek, Squaw Creek, Harrison Creek, Luna Gulch, Unnamed Trib at RM 19.2 , Quartz Creek, Box Canyon	John Day Pool inundation, overgrazing, upland management, channel modification, exotic vegetation, road building	S, F, PH, PM, R0, R1, R2+	Actions will improve quality of existing habitat. **Severe**: Rock Creek to RM 14.6, Squaw Creek to RM 7.7, Luna Gulch **Moderate:** Upper Squaw Creek, Harrison Creek, Unnamed trib at Rm 19.2 Badger Gulch, Rock Creek RM 14.6-RM19.2, Box Canyon **Low:** Lower and Middle Quartz Creek, Upper Rock Creek	Riparian planting, bio-engineering roads, fencing, exotic vegetation removal
Reduced channel structure and complexity(loss of habitat diversity)	Productivity, abundance, spatial structure and diversity	Mainstem Rock Creek, Squaw Creek, Harrison Creek, Luna Gulch, Unnamed Trib at RM 19.2 , Quartz Creek, Box Canyon	Overgrazing, upland management, channel modification, exotic vegetation	S,F,R0,IO-1,M1,R1,R2+, M2+	Actions will restore year-round habitat **Severe:** Rock Creek to RM 14.6, Squaw Creek to RM 7.7, Luna Gulch **Moderate**: Upper Squaw Creek, Harrison Creek, Unnamed trib at RM 19.2 Badger Gulch, Rock Creek RM 14.6-RM 19.2, Box Canyon **Low:** Lower and Middle Quartz Creek, Upper Rock Creek	Place LWD and other structure in stream channel, Improve instream structure
Increased competition for food sources	Productivity, abundance, diversity	Mainstem Rock Creek, Squaw Cr., Harrison Cr., Luna Gulch, Unnamed trib., Quartz Cr., Box Canyon	Overgrazing, upland management, channel modification	F, R0, IO-1, R1	Actions will improve quality of existing habitat **Severe**: Rock Creek to RM 14.6, Squaw Creek to RM 7.7, Luna Gulch **Moderate:** Upper Squaw Creek, Harrison Creek, Unnamed trib at RM 19.2 Badger Gulch, Rock Creek RM 14.6-RM 19.2, Box Canyon **Low:** Lower and Middle Quartz Creek, Upper Rock Creek	Riparian planting, instream structure, fencing
Degraded water quality (increased summer water temperatures, loss of thermal refugia)	Productivity, abundance, spatial structure, diversity	Rock Creek to RM 19.2, Squaw Cr., Harrison Cr., Luna Gulch	John Day Pool inundation, overgrazing, upland management, channel modification, absence of beaver	S, E, F, R0	Actions will improve quality of existing habitat **Severe**: Rock Creek, mouth to Badger Gulch; Squaw Creek, mouth to White Creek; Luna Gulch, mouth to extent of distribution. **Moderate:** Squaw Creek, White Cr. to extent of distribution ; Harrison Cr, mouth to extent of distribution; Unnamed trb at RM 19.2; Badger Gulch, Rock Creek, Badger Gulch to Quartz Creek **Low:** Quartz Cr, mouth to Box Canyon; Box Canyon, mouth to falls; Rock Creek, Quartz Cr to Small Fall, Small Fall to Super Slide and Super Slide to Triple Falls	Plant conifers and other native riparian vegetation; Protect springs.
Altered hydrology, timing	Productivity, abundance,	Mainstem Rock Creek, Squaw Cr.,	John Day Pool Inundation, overgrazing, upland	S, E, R0, M1, R1, R2+, M2+,	Actions will restore year-round habitat	CRP, riparian planting, easements,

Limiting Factor	*VSP Parameter Impacted*	*Sites Affected*	*Threats*	*Life stages affected**	*Significance (Scope/Severity)*	*Action*
and duration; degraded upland processes	diversity	Harrison Cr., Luna Gulch, Unnamed Trib at RM 19.2, Quartz Creek, Box Canyon	management, channel modification, road building/density, timber harvest practices	PH	**Severe**: Rock Creek - mouth to Badger Gulch; Squaw Cr. - mouth to White Creek; Luna Gulch **Moderate:** Upper Squaw Cr.; Harrison Cr.; Unnamed tributary at RM 19.2; Badger Gulch; Rock Creek - Badger Gulch to Quartz Cr.; Quartz Cr. – mouth to Box Canyon; upper Rock Creek	acquisition
Reduced floodplain function and channel migration processes	Productivity, abundance, diversity	Mainstem Rock Creek, Squaw Cr., Harrison Cr., Luna Gulch, Unnamed Trib at RM 19.2, Quartz Creek, Box Canyon	John Day Pool Inundation, overgrazing, upland management, channel modification, road building/density, timber harvest practices	S, E, PM, PH, F, RO, M1, R1, R2+, M2+	Actions will improve quality of existing habitat **Severe**: Rock Creek up to confluence with Badger Gulch, Lower Squaw Creek, Luna Gulch **Moderate:** Upper Squaw Creek, Harrison creek, Unnamed tributary at Rm 19.2, Badger Gulch, Quartz Creek, Box Canyon, Upper Rock Creek	Fencing, instream structure, dike removal
Altered sediment routing and increased fine sediment	Productivity, abundance, diversity	Mainstem Rock Creek, Squaw Cr., Harrison Cr., Luna Gulch, Unnamed Trib at RM 19.2, Quartz Cr., Box Canyon	Road building and density, overgrazing, upland management, timber harvest practices	E	Actions will improve quality of existing habitat **Severe:** Rock Creek to RM 14.6, Squaw Creek to RM 7.7, Luna Gulch **Moderate:** Upper Squaw Creek, Harrison Creek, Unnamed trib at Rm 19.2 Badger Gulch, Rock Creek RM 14.6-RM19.2, Box Canyon **Low**: Lower and Middle Quartz Creek, Upper Rock Creek	CRP, sediment control basins
Increased predation	Productivity, abundance	Rock Creek mainstem, lower 8.7 miles	Exotic species, piscivorous predation	IO-1, M1, R1, M2+	Actions will improve survival **Severe:** Rock Creek up to confluence with Squaw Creek	Adjust management in Mainstem Columbia
Increased competition	Productivity, abundance	Rock Creek mainstem, lower 8.7 miles	Exotic species from John Day Pool	R1	Actions will improve survival **Severe:** Rock Creek up to confluence with Squaw Creek	Adjust management in Mainstem Columbia
Lack of steelhead kelts	Abundance and diversity	All reaches	Mainstem Columbia Dam and Pool Management	all	Unknown	Assess presence of steelhead kelts, proceed as necessary

* Key to life history stage codes: S= spawning, E= egg incubation, F= fry colonization, R0= 0-age active rearing, IO-1= 0,1-age inactive; M1= 1-age migrant, R1= 1-age active rearing, R2+= 2+ age active rearing, M2+= 2+ age active migrant, TR2+= 2+ age transient rearing, PM= pre-spawning migrant, PH= pre-spawning holding.

5.2 Hatchery Effects

Steelhead are not stocked in Rock Creek, and very few fin-clipped steelhead have been observed in the subbasin. Hatchery strays of upriver origin may enter and spawn in Rock Creek, but the effects of out-of-subbasin hatchery programs on the Rock Creek steelhead population are unknown.

5.3 Out-of-Subbasin Limiting Factors and Threats

Factors outside of the Rock Creek subbasin may have a profound influence on the viability of Rock Creek steelhead, as well as other anadromous salmonid populations. These factors are discussed briefly below. NMFS provides more discussion on each factor in both The Columbia River Estuary Module and the 2008 FCRPS Biological Opinion. The estuary module, http://www.nwr.noaa.gov/Salmon-Recovery-Planning/ESA-Recovery -Plans/upload/Estuary-Module.pdf, discusses factors that limit viability of Rock Creek steelhead in the Columbia River Estuary; while the 2008 FCRPS opinion (NMFS 2008b) details the influences of the Columbia River hydrosystem on Middle Columbia River steelhead MPGs and populations.

Table 5-2 exemplifies the influence of out-of-subbasin factors on Middle Columbia River steelhead destined for the Rock Creek and other subbasins. The table displays adult steelhead counts at Columbia River dams from 1994-2003. As the table shows, there is great variability in year-to-year counts, and sometimes large disparity between the number of fish passing one dam and reaching another. For example, in 2000 more than 90,000 wild steelhead were unaccounted for between John Day and McNary Dams, which would include fish destined for Rock Creek. Differences between dam counts after accounting for tributary escapement and reported harvest can be due to a number of factors including, but not limited to, delayed mortality due to dam passage, adverse environmental conditions, unreported harvest (both sport and tribal), counting methods at the dams, and estimating tributary escapement. It is not known to what degree these out-of-subbasin factors are causing this loss of migrants (Yakama Nation Fisheries 2006).

Table 5-2 Adult steelhead Counts at Columbia Dams 1994-2003 (NPPC 2004).

	Dalles Dam		John Day Dam		McNary Dam The	
	Steelhead	**Wild Steelhead***	**Steelhead**	**Wild Steelhead***	**Steelhead**	**Wild Steelhead***
2003	273,172	85,287	286,176	83,959	230,418	66,554
2002	387,920	116,565	390,300	112,755	286,805	81,439
2001	503,327	125,117	483,409	112,335	389,784	94,384
2000	205,241	53,711	220,325	56,798	130,063	31,072
1999	156,874	41,379	165,314	41,316	84,088	17,711
1998	116,682	22,302	158,567	31,286	99,705	17,859
1997	164,756	20,399	157,088	21,513	129,817	16,707
1996	162,456	23,583	156,002	23,157	124,177	16,733
1995	145,844	19,484	123,240	na	114,821	na
1994	112,253	20,263	93,075	17,343	94,427	17,202
10-year averages	222,853	52,809	223,350	55,607 (9 yr average)	168,411	35,966 (9 yr average)

*Wild steelhead are a subset of the steelhead count

5.3.1 Harvest

Rock Creek and its tributaries are opened to steelhead and trout fishing from June 1 to October 31 annually, and the area inundated by the John Day Pool (up to the Army Corps of Engineers Park at river mile 1) is open year around to allow for warm water fisheries (WDFW 2008/2009 Sport Fishing Regulations). Adult steelhead are not present in Rock Creek during the summer due to low or non-existent flows and enter the creek after flows resume and temperatures drop, generally after the season is closed. There are some minor tribal catches reported for ceremonial purposes, but they are currently considered insignificant. Poaching has been observed in the subbasin, however, and is considered a problem. While increased patrols are desired, funding levels are mostly inadequate to provide for such services.

The fishery at the mouth of Rock Creek is quite active at times and it is expected that some steelhead are unintentionally caught by recreational anglers, of which only marked hatchery fish are permitted to be retained. Better educational opportunities at the Army Corps of Engineers Park may assist in preventing accidental catch and retention of wild steelhead. Without clear estimates of Rock Creek steelhead abundance, and without targeted tagging of Rock Creek fish, it is unknown what percentage of steelhead destined for Rock Creek may be harvested in the Columbia.

The various fisheries that harvest Rock Creek steelhead as they migrate through the Columbia River and Pacific Ocean are discussed briefly below.

Ocean Fisheries

Since steelhead are rarely caught in ocean fisheries, these fisheries are not considered a significant source of mortality to Middle Columbia River steelhead (NMFS 2000). Ocean fishing mortality on Middle Columbia River steelhead is assumed to be zero.

Columbia River Mainstem Non-tribal Fisheries

As they migrate to their natal streams, Middle Columbia River steelhead may be caught in non-tribal mainstem Columbia River recreational and commercial fisheries (Table 5-3). NMFS estimates that 1 to 2 percent of the summer-run Middle Columbia River steelhead are harvested during fall mainstem fisheries (NMFS 2002b). NMFS (2001) indicates an incidental harvest of <2 percent of the wild Middle Columbia River steelhead during the winter, spring, and summer non-tribal Columbia River fisheries. Non-tribal commercial fisheries directed at steelhead in the Columbia River were prohibited in 1975 and remain closed. Commercial salmon fisheries are designed to optimize Chinook or coho catch and minimize steelhead catch using time and area closures and gear restrictions.

Mainstem harvest will continue to be managed through the *U.S. v. Oregon* process, and will be subject to consultation with NMFS. Enhanced public education and fisheries enforcement will be incorporated along with new selective fisheries regulations to insure understanding and compliance.

Treaty Indian fishing rights in the Columbia basin are under the continuing jurisdiction of the U.S. District Court for the District of Oregon in the case of *United States v. Oregon*, No. 68-513 (filed in 1968). The parties to *U.S. v. Oregon* are the United States acting through the Department of Interior (USFWS and Bureau of Indian Affairs) and Department of Commerce (National Marine Fisheries Service), the Warm Springs, Umatilla, Nez Perce, Yakama, and Shoshone-Bannock Tribes, and the states of Oregon, Washington, and Idaho. In *U.S. v Oregon*, the Court affirmed that the treaties reserved for the tribes 50 percent of the harvestable surplus of fish destined to pass through their usual and accustomed fishing areas.

Starting in 1977, tribal and state fisheries subject to *U.S. v Oregon* have been regulated pursuant to a series of court orders reflecting court-approved settlement agreements among the parties. The last long-term agreement, known as the Columbia River Fishery Management Plan (CRFMP) was adopted and approved by the Court in 1988 and expired in 1999. Since 1999, Columbia River mainstem fisheries have been managed via short term settlement agreements adopted by the Court. Artificial propagation programs upstream of Bonneville Dam have also been incorporated into these agreements, because of their importance to providing fish for harvest. Harvest plans for tributary fisheries are developed cooperatively by the management entities with primary management responsibility in the respective subbasin. The current agreement (2005-2007 Interim Management Agreement for Upriver Chinook, Sockeye, Steelhead, Coho and White Sturgeon) expired at the end of 2007.

A new *U.S. v. Oregon* Management Agreement has been completed and NMFS has recently completed a section 7 Biological Opinion addressing the impacts of the fisheries management action and hatchery production in the new agreement (NMFS 2008a) (https://pcts.nmfs.noaa.gov/pls/pcts-pub/biop_results_detail?reg_inclause_in=('NWR')&idin=107547). The new management

agreement will cover Columbia River fisheries management and hatchery production actions from 2008 to 2017.

During the last 10-15 years, harvest has been managed pursuant to the CRFMP and successor agreements that contain restraints on the fisheries necessitated by ESA listings. The agreements quantify and allocate between tribal and non-tribal fishing subject to ESA-imposed constraints for listed species. The interim *U.S. v Oregon* harvest constraint for steelhead is set to protect Group "B" index fish returning to Idaho with impacts from Non-Indian fisheries limited to 2 percent and tribal fisheries to 15 percent. Group "A" index fish are affected by tribal fisheries at a substantially lower rate than Group "B" index fish. The new agreement set an impact limit on naturally produced Mid-Columbia River steelhead of no more than 2 percent in non-treaty fisheries, but it does not set a limit for treaty fisheries. NMFS expects impacts from the treaty fisheries to continue to be in the range observed since 1998, averaging around 6.64 percent (NMFS 2008a).

Table 5-3 presents a few years data to exemplify estimated Indian and non-Indian harvest which impacts the Rock Creek population.

Commercial gillnets are used in The Dalles and John Day reservoirs. When gear is lost during commercial fishing seasons because of river traffic, vandalism, or water and weather conditions, they sink and sometimes trap fish, including white sturgeon and occasionally salmon. Because a project to retrieve lost gear is relatively new, there are many years worth of the lost synthetic net and buoys to recover (WCT 2003).

Table 5-3. Non-Indian and Indian Columbia River Harvest of Steelhead above Bonneville (NPCC 2004).

Year	Upriver A Hatchery			Upriver A Wild			Upriver B Hatchery			Upriver B Wild		
	Columbia River Run	Non-Indian Total	Treaty Indian Total	Columbia River Run	Non-Indian Total	Treaty Indian Total	Columbia River Run	Non-Indian Total	Treaty Indian Total	Columbia River Run	Non-Indian Total	Treaty Indian Total
2004	N/A	N/A	9400	N/A	909	2790	N/A	N/A	5470	N/A	214	1730
2003	215850	25005	14710	70870	883	3690	55240	6660	8550	11600	203	1720
2002	238430	24225	6173	87470	969	1814	99040	10375	3866	32460	457	1908
2001	386510	43320	17178	137940	641	5509	75800	1298	1260	12180	4774	1388

***Steelhead destined above Bonneville Dam. **Includes Ceremonial, Subsistence and Commercial. ***Total Non-Indian Mainstem Hatchery A&B was 1,123. Source: OR/WA Joint Staff Report 2004.**

5.3.2 Columbia River Hydro Operations

Hydrosystem construction and operation (flow regulation) in the Columbia River Basin has been a major cause of changes to the Columbia River and estuary from historical conditions. The effects of Columbia River hydro operations are summarized below.

Within the Rock Creek subbasin, steelhead and salmon were affected by the creation of the John Day Dam on the mainstem Columbia River, which effectively inundated the lowest reach of Rock Creek, reducing riparian habitat and increasing predation by native and non-native fish in the lower river. A lack of historical data inhibits quantitative

evaluation of the impacts of John Day pool inundation on native fish, plant, and wildlife species.

In the mainstem Columbia River, changes in river flow, circulation, water quality, contaminants, channel alterations, and predation have negative impacts on adult and juvenile fish. Hydro operations have changed flow conditions in the Columbia River and through the estuary. Before the development of the hydrosystem, Columbia River flows were characterized by high spring-runoff from snowmelt and regular winter and spring floods. Dam construction and operation have altered Columbia River flow patterns substantially throughout its basin. Historical flow records at The Dalles, Bonneville Dam, and Beaver, Oregon, demonstrate that annual peak flows have been reduced by about 50 percent, as water is stored for power generation and irrigation, and winter flows have increased approximately 30 percent .

The Columbia River Estuary Module http://www.nwr.noaa.gov/Salmon-Recovery-Planning/ESA-Recovery -Plans/upload/Estuary-Module.pdf provides more information on factors that limit viability of Rock Creek steelhead in the Columbia River Estuary.

5.3.3 Ocean Conditions

The effects of ocean conditions on abundance of Pacific salmon and steelhead vary among species and populations within species. Migration patterns in the ocean may differ dramatically and expose different stocks to different conditions in different parts of the ocean. Some species have broad, offshore migration patterns that may extend as far as the Gulf of Alaska (steelhead, chum, some Chinook). Others have migration patterns along the Washington, British Columbia, Oregon and California coasts (Chinook, coho, cutthroat). Thus, ocean conditions do not have coincident effects on survival across species or populations.

Ocean survival of steelhead has been dramatically affected by widespread changes in ocean conditions. Cooper and Johnson (1992) showed that variation in steelhead run sizes and smolt-to-adult survival was highly correlated between runs up and down the West Coast. Smolt-to-adult survival rates generally varied 10-fold between good and bad years. Ocean survival rates for three West Coast steelhead populations where good annual index data were available showed high variability and a generally declining trend since the late 1970s.

5.3.4 Climate Change

Climate change represents a potentially significant threat to recovery of Rock Creek steelhead, as well as Mid-Columbia steelhead DPS. The Independent Scientific Advisory Board (ISAB) for the Northwest Power and Conservation Council, Columbia River Basin Indian Tribes, and NMFS reviewed the potential effects of climate change on salmonids in the Columbia River basin (ISAB 2007). The ISAB report shows that changes in climate may adversely affect steelhead in freshwater habitats across the DPS by exacerbating existing problems with water quantity (lower summer streamflows) and water quality (higher summer water temperatures). Consistently identified types of

impacts on snow pack, stream flow, and water quality in the Columbia Basin are the following (ISAB 2007, p. 15-17):

- Warmer temperatures will result in more precipitation falling as rain rather than snow.
- Snow pack will diminish, and the timing of stream flow will be altered.
- Peak river flows will likely increase.
- Water temperatures will continue to rise.

These changes may affect steelhead more than other salmonids because of their long rearing period in freshwater.

Changing conditions could also affect salmonid health and survival in the ocean through a variety of mechanisms, including increased ocean temperatures, increased stratification of some waters, changes in the upwelling season, shifts in the distribution of salmonids, long term variability in winds and ocean temperatures, increased acidity, and increased atmospheric and oceanic variability. (NMFS 2007, 2008a; ISAB 2007)

All other threats and conditions remaining equal, future deterioration of water quality, water quantity, and/or physical habitat can be expected to cause a reduction in the number of naturally produced adult steelhead returning to these populations across the DPS. This possibility further reinforces the importance of achieving survival improvements throughout the entire steelhead life cycle. Recent research also indicates that neighboring populations with differences in habitat may show different responses to climate changes (Crozier and Zabel 2006; Crozier et al. 2008). This research reinforces the importance of maintaining habitat diversity.

5.3.5 Other Large-Scale Threats

- Projected continued population growth will increase pressures for conversion of forestry and agricultural land uses to residential uses, with potential impacts on habitat and water conditions.
- Increase in exotic invasive species that potentially compete with native flora and fauna, and provide food and/or cover to species that potentially compete with, prey on or carry diseases which could affect native species.
- New disease and/or pathogen introductions (e.g. from marine aquaculture operations on steelhead ocean migration routes, illegal stocking of out-of-subbasin species).
- Natural catastrophic events (e.g. earthquake, volcanic eruption and related effects).

6. Recovery Strategy and Actions

The preceding chapters summarize recovery goals, biological criteria and threats criteria, current status assessment, and the major limiting factors and threats identified for the Rock Creek steelhead population. How will we reach recovery? Appendix II describes the many efforts already underway to improve watershed conditions in the Rock Creek subbasin—efforts that will benefit salmonids as well as other wildlife and human communities.

Lack of information about the Rock Creek steelhead population is a major problem for recovery planning for the Middle Columbia River steelhead DPS. Using the ICTRT criteria for DPS viability, this population needs to achieve "maintained" or moderate risk status for the DPS to be considered viable. The Rock Creek population's high risk rating was assigned primarily on the basis of uncertainty and lack of direct information on current or indirect assessments of abundance and productivity. Thus, the recovery strategy for the Rock Creek steelhead population must focus on these uncertainties and tailor research and monitoring needs to address such gaps.

A targeted monitoring program is needed for the following purposes:

- To determine abundance and productivity of natural spawners
- To determine the factors limiting the production of Rock Creek steelhead

To reduce the factors and threats that are limiting Rock Creek steelhead, as identified by the targeted monitoring program, and ultimately place the population on a trajectory toward viability, it would likely be necessary to increase abundance and productivity by restoring habitat throughout the basin. Protecting the existing good quality habitat, restoring habitat where appropriate, and improving access to spawning areas would likely improve not only abundance and productivity, but spatial structure and diversity as well.

It is, however, important to recognize that significant uncertainties remain with regard to the incremental benefits that can be expected from each specific action, as well as the net effect of a prescribed suite of actions over time. Existing data, models and theories provide only a qualified answer to the question of what it will take to recover these fish. Nevertheless, a decision to delay actions for recovery while waiting for more data, better models, or more certainty may have irreversible consequences for populations that are already at risk of extinction.

While current knowledge may not be adequate to categorically guarantee that recovery goals will be met with the prescribed set of actions, existing information and analyses are adequate to set a recovery trajectory and a scale of effort that can reasonably be expected to achieve them. To address uncertainties, the Plan includes direction for evaluating progress toward recovery and making necessary 'course' adjustments (Section 10: Implementation/Adaptive Management). During Plan implementation, efforts will be refined based on new information that addresses current uncertainties.

The actions recommended to support recovery are described in more detail in the following sections. Table 6-1 organizes recommended actions in terms of larger categories, called, in this context, strategies. The strategies and actions targeting Rock Creek steelhead apply to four categories: hatcheries, freshwater habitat, harvest, and hydropower configurations and operations. Out-of-basin limiting factors and threats are addressed in two NMFS documents, the 2008 FCRPS Biological Opinion (NMFS 2008b) and The Columbia River Estuary Module, available at http://www.nwr.noaa.gov/Salmon-Recovery-Planning/ESA-Recovery-Plans/Other-Documents.cfm.

Table 6-1. Recovery Strategies and Actions for Listed Salmon and Steelhead Populations in the Rock Creek Subbasin.

Priority Strategies	Priority Locations	Key Types of Actions	VSP Parameters Addressed	Primary Limiting Factors Addressed
Freshwater Habitat				
Protect and conserve natural ecological processes that support the viability of populations and their primary life history strategies throughout their life cycle.	Throughout watershed	• Protect highest quality habitats through acquisition and conservation. • Adopt and manage Cooperative Agreements. • Consistently apply Best Management Practices and existing laws to protect and conserve natural ecological processes. • Review, modify, and enforce existing land use planning documents and ordinances pertaining to riparian and floodplain management.	All Parameters	Degradation of tributary habitat-forming processes and functions (loss of channel structure, floodplain connectivity, riparian vegetation and LWD recruitment)
Gain information needed to identify and prioritize habitat actions that will provide the greatest opportunity to contribute to recovery.		• Conduct surveys to determine steelhead distribution. • Gather information to calculate abundance and productivity estimates and complete gap analyses. • Evaluate population phenotypic and genetic variations.	All Parameters	Many factors, including key stock status indicators now not available. Would be able to determine trends in populations.
Restore floodplain function and channel migration processes.	Rock Creek below unnamed tributary at RM 19.2, Luna Gulch, Squaw Creek watershed, upper watershed tributaries, Rock Cr between Old Highway 8 bridge and Badger Gulch	• Reconnect side channels. • Remove dikes. • Reconnect floodplain to channel. • Relocate or improve floodplain infrastructure and roads. • Relocate beaver to suitable areas.	Abundance, Productivity, Spatial Structure	Degraded floodplain connectivity and function (loss of side channels, channel morphology, key habitat quantity, and connected hypoheic zone)
Restore riparian function and condition.	Rock Creek below unnamed tributary at RM 19.2, Luna Gulch, lower Squaw Cr. Watershed	• Restore/enhance natural riparian vegetative communities. • Develop grazing strategies that promote riparian recovery. • Eradicate invasive plants species from riparian areas.	Abundance, Productivity	Degraded riparian condition (native riparian vegetative communities, LWD recruitment)
Restore channel structure and complexity	Rock Creek below unnamed tributary at RM 19.2, Luna Gulch, lower Squaw Cr. Watershed	• Place stable wood and other large organic debris in streambeds. • Stabilize streambanks. • Restore natural channel form. • Fertilize stream with fish carcasses.	Abundance, Productivity	Degraded channel structure and complexity (loss of spawning and rearing habitat, LWD, pools); altered food web
Restore degraded upland processes	Upper watershed	• Restore native upland plant communities. • Implement BMPs to forest, agriculture, and grazing practices that mimic natural runoff and sediment production. • Implement road management actions to reduce erosion and fine sediment inputs.	All parameters	Degraded upland processes, altered natural hydrology

Priority Strategies	Priority Locations	Key Types of Actions	VSP Parameters Addressed	Primary Limiting Factors Addressed
Restore natural hydrograph to enhance flows during critical periods.	Rock Creek below unnamed tributary at RM 19.2, Luna Gulch, lower Squaw Creek, upper watershed	• Employ BMPs to forest, agriculture and grazing practices and to road management. • Protect and/or rehabilitate springs • Increase pool habitat. • Develop water and sediment control basins.	Abundance, Productivity	Altered hydrology, degraded watershed conditions and/or streamflow alterations
Improve degraded water quality, reduce summer water temperatures.	Rock Creek below unnamed tributary at RM 19.2, Luna Gulch, lower Squaw Creek, upper watershed	• Restore natural functions and processes through actions identified in strategies above. • Construct water and sediment control basins	Abundance, Productivity	Degraded water quality (abnormal temperatures or fine sediment)
Hatchery				
Reduce the uncertainty of origin of hatchery strays and increase ability to recognize hatchery-origin fish.	Reduce the uncertainty of origin of hatchery strays and increase ability to recognize hatchery-origin fish.	Reduce the uncertainty of origin of hatchery strays and increase ability to recognize hatchery-origin fish.	Reduce the uncertainty of origin of hatchery strays and increase ability to recognize hatchery-origin fish.	Reduce the uncertainty of origin of hatchery strays and increase ability to recognize hatchery-origin fish.
Harvest				
Improve quality of harvest and natural-origin fish	Improve quality of harvest and natural-origin fish	Improve quality of harvest and natural-origin fish	Improve quality of harvest and natural-origin fish	Improve quality of harvest and natural-origin fish
Hydrosystem				
Improve hydropower operations and facilities to enhance steelhead survival, Restore normative migration patterns.	Columbia River	• Adjust hydro operations on the Columbia River to restore normative migration patterns and improve the survival of steelhead smolt during outmigration.	All Parameters	Hydrosystem development and operations in mainstem Columbia River alter steelhead migration conditions and delay passage.
Reduce predation on, and competition between, salmonids	Columbia River Lower Rock Creek	• Reduce predation by pinnipeds • Re-distribute cormorants	Abundance, Productivity	Hydrosystem development and operations in mainstem Columbia River increase predation on, and competition between, salmonids.

6.1 Freshwater Habitat Strategies and Actions

The Plan proposes a number of tributary habitat strategies and actions to rebuild the Rock Creek steelhead population to the desired level of viability. The suites of strategies and actions are designed to protect and improve ecosystem functions and restore normative ecological processes. Together, the strategies and actions call for the protection of the highest quality habitats, maintenance of existing unimpaired habitats and ecosystem functions, and habitat restoration through passive and active measures.

- Protection of existing high quality habitats is a broad economical approach of ensuring no net loss in habitat quality and maintenance of normative ecological processes. Many objectives are likely to be met through habitat protection and the associated natural recovery of upland and riparian areas. Land acquisitions, easements, cooperative agreements, and protective land designations facilitate the accomplishment of high quality habitat protection.

- Maintaining improved habitats from degradation, such as through land use practices or changes in land use laws and ordinances, is an important element of habitat management. Where applicable, county land-use planning and land-use controls provide habitat protection by managing growth and land use so that critical areas and watershed functions are preserved.

- Broad opportunities exist to improve habitat conditions for salmon and steelhead populations. The success of these strategies is enhanced when actions build from existing restoration efforts and incorporate a range of project types that address the many interrelated habitat impairments.

The Plan identifies eight tributary habitat strategies that address identified factors and threats limiting Rock Creek steelhead viability:

1. Protect and conserve natural ecological processes that support the viability of populations and their primary life history strategies throughout their life cycle.
2. Gain information needed to identify habitat strategies and actions that will provide the greatest opportunity to contribute to steelhead recovery.
3. Restore floodplain function and channel migration processes.
4. Restore riparian function and condition.
5. Restore degraded upland processes to minimize unnatural rates of erosion and runoff.
6. Restore channel structure and complexity.
7. Restore natural hydrograph to enhance instream flow during critical periods.
8. Improve water quality, reduce summer water temperatures.

Actions proposed under these strategies aim to gather needed data on the Rock Creek steelhead population, stream temperatures, wetted perennial areas in the lower watershed, habitat diversity, food availability, fine sediment levels and peak flows. Together, they will provide information about and improve freshwater habitat in the drainage and, thus, improve the viability of Rock Creek steelhead. The strategies and actions were defined

through review and analysis of currently available information. They are consistent with actions identified in the Lower Mid-Columbia Mainstem Subbasin (including Rock Creek) Management Plan (NPCC 2004), and address risks identified in the ICTRT's viability assessment for the population.

Tables 6-2 through 6-9 present these freshwater habitat strategies and actions designed to improve the viability of Rock Creek steelhead. The tables link strategies to the factors and threats limiting steelhead viability in the subbasin, and the viability parameters and life stages that would be most affected. Priority locations are provided for some strategies, and identify the stream reaches or areas where actions should be applied first to gain the greatest benefit. Table 6-9 identifies specific actions and the costs of specific types of projects.

Table 6-2 Strategy 1: Protect and Conserve Natural Ecological Processes that Support the Viability of Populations and their Primary Life History Strategies throughout their Life-Cycle.

Protect and conserve natural ecological processes					
Actions	**Factors Addressed**	**Threats Addressed**	**VSP Parameters Addressed**	**Life Stages Affected**	**Discussion**
a. Apply BMPs to livestock grazing practices b. Apply BMPs to forest practices c. Apply BMPs to road system management d. Apply BMPs to agricultural practices to control erosion and runoff e. Review, modify and enforce existing land use planning documents and ordinances pertaining to riparian and floodplain management to better address habitat and water quality issues. f. Acquire/manage stream corridor through conservation easement g. Adopt and manage cooperative agreements	Many factors, including key habitat quality and diversity, sediment load, water quality, flow	Road, timber and grazing management activities	Productivity, abundance, spatial structure	All	Protecting high quality habitats is the most cost effective way of ensuring fish will have high quality habitats in the future.
Priority Locations (geographic areas)					
Throughout watershed					

Table 6-3 Strategy 2: Gain Information needed to Identify Habitat Strategies and Actions that will provide the Greatest Opportunity to Contribute to Steelhead Recovery.

Gain information needed to identify and prioritize habitat strategies and actions.					
Actions	**Factors Addressed**	**Threats Addressed**	**VSP Parameters Addressed**	**Life Stages Affected**	**Discussion**
a. Gather information needed to calculate abundance and productivity estimates for Rock Creek population and complete gap analysis. b. Evaluate the phenotypic variation of Rock Creek steelhead c. Evaluate the genetic variation of Rock Creek steelhead d. Evaluate hatchery contributions to natural steelhead spawning within Rock Creek Subbasin. e. Conduct evaluation of steelhead distribution within the Rock Creek Subbasin f. Assess factors limiting steelhead population production	Many factors, including key stock status indicators now not available. Would be able to determine trends in populations.	Addresses baseline and trend in populations for assessing all threats.	Productivity, abundance, spatial structure, diversity	All	Better information on the Rock Creek steelhead and habitat is needed to calculate abundance and productivity estimates and complete the gap analysis. More information is needed to effectively prioritize some of the actions necessary for recovery of steelhead viability in the subbasin.
Priority Locations (geographic areas)					

Table 6-4 Strategy 3: Restore Floodplain Function and Channel Migration Processes.

Restore floodplain function and channel migration processes					
Actions	**Factors Addressed**	**Threats Addressed**	**VSP Parameters Addressed**	**Life Stages Affected**	**Discussion**
a. Reconnect floodplain habitats b. Reconnect side channels c. Increase role and abundance of wood and large organic debris in streambeds e. Relocate floodplain infrastructure, roads; improve maintenance, rehabilitate, decommission as appropriate f. Remove dikes g. Relocate beaver to suitable areas	Channel morphology, habitat diversity, key habitat quantity, riparian vegetation, fine sediments, flow, water temperature	Road, timber and grazing management activities	Productivity, abundance, spatial structure	All	Rock Creek Road and other infrastructure in the watershed have altered floodplain, confined river and tributaries. Hydrologic routing in watershed has been modified and altered flow timing, discharge, distribution of LWD and sediment. Summer/Early fall habitat availability is lower than in pre-settlement environment
Priority Locations (geographic areas)					
Rock Creek below unnamed tributary at RM 19.2, Luna Gulch, Squaw Creek watershed, upper watershed tributaries, Rock Cr between Old Highway 8 bridge and Badger Gulch					

Table 6-5 Strategy 4: Improve Riparian Function and Condition.

Restore riparian function and condition					
Actions	**Factors Addressed**	**Threats Addressed**	**VSP Parameters Addressed**	**Life Stages Affected**	**Discussion**
a Re-establish and/or enhance vegetative cover with conifers and other native riparian vegetation b. Exclude livestock from riparian areas c. Manage grazing in riparian areas d. Eradicate invasive plant species from riparian areas e. Relocate beaver to suitable areas	Riparian vegetation, habitat diversity, key habitat quantity, fine sediments, flow, altered food web, water temperature	Road, timber and grazing management activities	Productivity, abundance, spatial structure	All	Lack of riparian vegetation is common along lower portions of Rock Creek, Squaw Creek and Lund Gulch. Road parallels much of lower Rock Creek.
Priority Locations (geographic areas)					
Rock Creek below unnamed tributary at RM 19.2, Luna Gulch, lower Squaw Cr. Watershed					

Table 6-6 Strategy 5: Restore Degraded Upland Processes to Minimize Unnatural Rates of Erosion and Runoff.

Restore degraded upland processes to minimize unnatural rates of erosion and runoff					
Actions	**Factors Addressed**	**Threats Addressed**	**VSP Parameters Addressed**	**Life Stages Affected**	**Discussion**
a. Restore native upland plant communities b. Implement upland management practices that mimic natural runoff and sediment production c. Implement off-road vehicle management actions that reduce erosion and fine sediments d. Implement road management actions that reduce fine sediment inputs	Many factors, including altered hydrology, channel stability, fine sediments, water quality (temperature), key habitat quantity, habitat diversity, riparian vegetation	Road, timber, agriculture and grazing management activities; off-road vehicles	Productivity, abundance, spatial structure, diversity	All	Road, timber and grazing management activities have contributed to altered flow regime and increased sediment load from incoming tributaries Fluctuations in water quality parameters have reduced native aquatic vegetation and faunal (insect, zooplankton, vertebrates) communities and productivity
Priority Locations (geographic areas)					
Upper watershed					

Table 6-7 Strategy 6: Restore Channel Structure and Complexity.

Restore channel structure and complexity					
Actions	**Factors Addressed**	**Threats Addressed**	**VSP Parameters Addressed**	**Life Stages Affected**	**Discussion**
a. Artificially introduce LWD and other structure in stream as appropriate b. Improve riparian vegetation to provide future source of LWD to naturally enter and remain in stream system c. Stabilize and protect stream-banks d. Fertilize streams with fish carcasses	Channel morphology, Habitat diversity, key habitat quantity, fine sediments, flow, water temperature, thermal refugia, altered food web	Road, timber and grazing management activities; channelization	Abundance, productivity, spatial structure		Rock Creek Road and other infrastructure in the watershed have altered floodplain, confined river and tributaries. Hydrologic routing in watershed has been modified and altered flow timing, discharge, distribution of LWD and sediment. Summer/Early fall habitat availability is lower than in pre-settlement environment
Priority Locations (geographic areas)					
Rock Creek below unnamed tributary at RM 19.2, Luna Gulch, lower Squaw Creek, headwater streams					

Table 6-8 Strategy 7: Enhance Instream Flow During Critical Periods.

Enhance instream flow during critical periods.					
Actions	**Factors Addressed**	**Threats Addressed**	**VSP Parameters Addressed**	**Life Stages Affected**	**Discussion**
a. Restore natural hydrographic function and processes through actions identified in strategies 1 through 6 b. increase pool habitat by adding LWD and relocating beaver c. protect springs d. develop water and sediment control basins	Habitat diversity, key habitat quantity, fine sediments, flow, water temperature, thermal refugia, altered food web	Road, timber and grazing management activities; channelization; water withdrawals, beaver removal	Abundance, productivity, spatial structure		Hydrologic routing in watershed has been modified and altered flow timing, discharge, distribution of LWD and sediment. Changes in the upland plant community due to land management have reduced precipitation infiltration rates, which results in higher peak flows and lower low flows. Removal of large wood and channelizing streams also increases water velocities and reduces the ability of the stream to hold water for gradual release.
Priority Locations (geographic areas)					
Rock Creek below unnamed tributary at RM 19.2, Luna Gulch, lower Squaw Creek, upper watershed					

Table 6-9 Strategy 8: Improve Water Quality, Reduce Summer Water Temperatures.

Improve water quality, reduce summer water temperatures to levels that support salmonid production					
Actions	**Factors Addressed**	**Threats Addressed**	**VSP Parameters Addressed**	**Life Stages Affected**	**Discussion**
a. Restore riparian vegetative cover with conifers and other native vegetation to increase shading b. Restore natural habitat functions and processes through actions identified in strategies 1-6 c. Develop sediment control basins d. Manage livestock grazing in riparian areas e. Increase deep pool habitat	Channel morphology, Habitat diversity, key habitat quantity, fine sediments, flow, water temperature, thermal refugia	Road, timber and grazing management activities, particularly in riparian areas; channelization	Abundance, productivity, spatial structure		Riparian vegetation is limited in many parts of the drainage. Roads and other infrastructure have altered floodplain, confined river and tributaries and contribute fine sediment to stream channel. Loss of LWD and other structure limits availability of pools and other thermal refugia.
Priority Locations (geographic areas)					
Rock Creek below unnamed tributary at RM 19.2, Luna Gulch, lower Squaw Creek, upper watershed					

Table 6-10 provides a list of habitat actions identified by the Yakama Nation to implement the strategies identified in tables 6-2 through 6-9. Actions differ from strategies in that they address program deficiencies as well as biophysical habitat conditions. Table 6-10 identifies where the actions are needed, the likely responsible parties for implementation, the strategies that the actions address, likely time frames, the expected biophysical response, and anticipated certainty of outcome. Implementing entities are identified based on land ownership first, then in consideration of area of past interest and activity. Costs are general range summaries arranged to align with subbasin strategies and area based on the costs of specific reach actions proposed in Table 6-11.

Table 6-10 Habitat Actions for Rock Creek.

Action	Action Area	Implementing Entity	Implementation timeframe	Expected Biophysical Response[1]	Certainty of Outcome[2]
Apply BMPs to livestock grazing practices	Throughout watershed	NRCS, USFS, BLM, Private landowners, YN, Watershed Councils	Long-term	5-15 years	High
Apply BMPs to forest practices	Throughout watershed	USFS, BLM, YN	Long-term	5-15 years	High
Reconnect side channels	Rock Cr below unnamed trib at RM 19.2, Squaw Cr. Watershed, Luna Gulch, Upper watershed tributaries	YN, WDFW, USFS	2-10 years	0-5 years	High
Apply BMPs to road system management	Throughout watershed		Long-term	Immediate for sediment, other parameter 5-15 years	High
Apply BMPs to agricultural practices to control erosion and runoff	Throughout watershed	NRCS, SWCDs, private landowners, Farm Service Agency	Long-term	5-15 years	Moderate
Place LWD and other structure in stream	Rock Cr. Below unnamed trib. at RM 19.2, Luna Gulch, lower Squaw Cr.	DNR, Private timber companies, BLM, YN	2-10 years	0-10 years	High
Restore riparian vegetation cover with conifers and other native vegetation	Rock Cr. Below unnamed trib. at RM 19.2, Luna Gulch, lower Squaw Cr.	YN, SWCD, private timber companies, WDFW	Ongoing, 2-10 years	0-10 years	High
Relocate floodplain infrastructure, roads; improve maintenance, rehabilitate, decommission as appropriate	Rock Creek between Old Highway 8 bridge and Badger Gulch	YN	5-10 years	Immediate	Medium
Remove Dikes	Rock Creek between Old Highway 8 bridge and Badger Gulch	YN, Klickitat County Roads department	Long-term	5-10 years	Low
Sediment control basins	Upper watershed	YN, SWCD	5-10 years		Medium
Stabilize and protect streambanks	Rock Cr. Below unnamed trib. at RM 19.2, Luna Gulch, lower Squaw Cr. Headwater streams	YN, SWCD, landowners			
Manage grazing in riparian areas	Throughout watershed	NRCS, YN, private landowners	Long-term	5-15 years	High
Reconnect floodplain habitats	Rock Cr. Below unnamed trib. at RM 19.2, Luna Gulch, lower Squaw Cr.	YN, SWCD	Long-term	immediate	Moderate
Relocate beaver to	Throughout	YN, SWCD	Long-term	Within 5 years	Moderate-

Action	Action Area	Implementing Entity	Implementation timeframe	Expected Biophysical Response[1]	Certainty of Outcome[2]
suitable areas	watershed				high
Fertilize streams with artificial carcasses	Throughout watershed, except Rock Cr. from the boat ramp to Old Hwy 8	YN, WDFW	Long-term		
Acquire/manage stream corridor through conservation easements		SWCD, TNC	Existing conservation agreements are complete. Full implementation of conservation measures will take 5-15 years	immediate	High
Adopt and manage Cooperative Agreements		YN, WDFW, TNC, SWCD	Agreements are for 10-15 years	immediate	High, although not in perpetuity

[1] Expected response of action implementation – including how long for action to achieve full effectiveness
[2] Relative certainty that expected results will occur as a result of full implementation of action

Table 6-11 summarizes potential actions that could be implemented in the next ten years to improve steelhead habitat conditions in the Rock Creek Subbasin. Actions proposed for funding will be further refined and prioritized through a local collaborative process involving representatives from Klickitat, Yakima, and Benton counties, local landowners, and the Yakama Nation. Table 6-11 also presents associated and accumulative costs of all reach specific actions identified by the Yakama Nation for implementation in Rock Creek. In addition, it presents cost estimates for personnel needed to conduct such actions and cost estimates for a couple passive actions to address limiting factors (Conservation Reserve Program, acquisition and easements).

Table 6-11 Summary of Potential Foreseen Actions in the Rock Creek Subbasin and Costs. (2006-2015) (Yakama Nation Fisheries 2006).

Active Actions (one time)		**Costs**
Riparian planting #	44506 hand planted trees with protection	$489,566
Offsite water *	30 tank facilities	$45,000
Instream structures(rock weir etc) *	88 structures	$169,400
Revetment #	1900 revetments	$19,000
Rootwad #	96 rootwads	$54,400
Exotic vegetation removal	40 acres	$40,000
Bioengineered channel stabilization next to road	400 feet	$18,800
Fencing #	67.8 miles	$527,778.80
Dike removal	16,380 cubic yards	$131,040
Spring protection	7 springs	$5,600
Water and sediment control basin *	94 basins	$222,600
Total		$1,723,185
Passive Actions		**Annual Costs**
Subcontract	Total Annual	45,000
Personnel	Total Annual	$171,666
NRCS Conservation Reserve Program	6,000 acres (annual average)	250,000
Conservation Easements	450/ acre, 50 acres (annual average)	22,500
Land Acquisitions	600/ acre, 50 acres (annual average)	30,000
Total Average Annual Costs		$519,166

* Utilizing Oregon NRCS 2006 Conservation Practice Component Cost List.
** Costs summarize the costs of specific actions identified in Table 7-11.

6.2 Hatchery-Related Strategies and Actions

Hatchery strays of upriver origin may enter and spawn in Rock Creek, but their effect is unknown.

Strategy: *Reduce the uncertainty of origin of hatchery strays and increase ability to recognize hatchery-origin fish.*

Management action 1*: Monitor the potential for hatchery strays entering Rock Creek.* Introgression of hatchery steelhead into the naturally spawning population is a potential risk to the Rock Creek steelhead population.

Management action 2*: Increase the proportion of Columbia River Basin hatchery steelhead marked with coded-wire tags, especially in programs shown to stray at high rates in the past, and require the mass marking of all hatchery steelhead releases with, at a minimum, an adipose fin-clip*. These actions would allow for the detection and monitoring of stray hatchery steelhead in the Rock Creek subbasin.

6.3 Harvest-Related Strategies and Actions

Better educational opportunities at the Army Corps of Engineers Park may assist in preventing accidental catch of steelhead in Columbia River fisheries near the mouth of Rock Creek.

Strategy: *Improve harvest opportunities.*

Management action: *Increase outreach efforts to reduce the number of steelhead caught in recreational fisheries near the mouth of Rock Creek.*

6.4 Hydro-Related Strategies and Actions

Strategies and actions to address hydro-related limiting factors and threats are forthcoming and will be included in the Columbia River Hydropower Project Module http://www.nwr.noaa.gov/Salmon-Recovery-Planning/ESA-Recovery-Plans/upload/Hydro-Module.pdf. The module, based on the 2008 FCRPS Biological Opinion, will detail the influences from the Columbia River hydrosystem and proposed actions to address them. The 2008 FCRPS Biological Opinion details current Columbia River hydropower programs and operations intended both to avoid jeopardy to listed species, including Middle Columbia steelhead populations, and to contribute to the species' recovery.

The current plan for operation of the FCRPS through 2018 (NMFS 2008b) contains the following actions intended to address the needs for survival and recovery of ESA-listed salmon and steelhead:

- Continue adult fish passage operations that have resulted in improved survival.
- Improve juvenile fish passage: install removable spillway weirs or similar surface bypass devices at John Day and McNary dams, an extended tailrace spill wall at The Dalles Dam, and various modifications at Bonneville Dam. Passage for steelhead smolts at each of the four Lower Columbia River mainstem projects must reach 96 percent survival.
- Continue and enhance spill for juvenile fish passage.
- Continue reservoir operations and river flows to benefit spring migrating juveniles.
- Develop dry water year operations to better protect migrating juveniles

7. Implementation and Cost Estimates

Implementation of the Rock Creek Recovery Plan involves addressing data gaps through research, monitoring, and evaluation; establishing schedules and priorities; engaging stakeholders and landowners; identifying responsibilities; and securing funding. Implementation of this plan depends on the voluntary actions and cooperation of local entities and citizen groups.

7.1 Implementation

NMFS has worked independently with the Yakama Nation, Washington Department of Fish and Wildlife, and local entities to develop the recovery plan for the Rock Creek steelhead population. NMFS encourages the formation of a planning group for the WA Gorge Management Unit, a forum or entity that would take responsibility for coordinating implementation of the plan. Implementing the proposed recovery actions for steelhead in the WA Gorge Management Unit, including the Klickitat subbasin, would be a primary task for a Washington Gorge Area Regional Board, subject to concurrence by state, tribal and local governments and the opportunity for involvement and comment by the public.

The Board could consist of representatives from Klickitat, Yakima, and Benton counties, local landowners, and the Yakama Nation. The Washington Gorge Area Regional Board could also provide an opportunity for coordination with the Lower Columbia River Fish Recovery Board (LCFRB), since the WA Gorge Management Unit encompasses both the Middle Columbia River Steelhead DPS, and the Willamette/Lower Columbia ESUs for Chinook, coho, and chum ESA-listed populations, which are covered by the LCFRB. The Board could use the considerations identified above to prioritize recovery actions in the Rock Creek subbasin, and other areas within the WA Gorge Management Unit that builds upon, and responds to, interests identified by various stakeholders in the area.

The WA Gorge Area Regional Board could use the considerations identified in Chapter 6 to prioritize recovery actions in the Rock Creek subbasin and other areas within the WA Gorge Management Unit to respond to the interests identified by various stakeholders in the area.

Setting priorities for projects for funding should be based on a balance between the biological benefit of the project, its cost, and feasibility of implementation. Projects that address primary limiting factors, have high biological benefit, are relatively inexpensive, and are feasible should receive highest funding priority. Projects that are expensive, have low biological benefit to listed fish species, and have relatively low feasibility should receive lowest funding priority

7.2 Costs

Priority recovery actions, costs, and time frames are identified for Rock Creek steelhead. These costs, identified by the Yakama Nation, are general range summaries and are based on the costs of specific reach actions identified in tabular form. Habitat action costs for recovery over a 10-year time period are estimated to be $1.75 million ($0.58 million for years 1-3 and $1.17 million for years 4-10).

The Yakama Nation based the costs on specific project-related costs identified in Table 7-1, Proposed Reach Specific Actions and Related Costs. The costs for passive actions are those associated with Conservation Reserve Program costs and conservation easement and acquisition costs. The Conservation Reserve Program estimate was made by Farm Service Administration personnel based on general acreage thought to be involved in the program as well as a general presumption of soil rental rate. The acquisition and easement estimates were made by The Nature Conservancy personnel who have been involved with both easements and acquisitions within the Rock Creek watershed. Although each easement and acquisition negotiation is unique, these values were thought to be the best available estimate for such actions within Rock Creek. The direct habitat action cost estimate summaries come from Table 7-1.

Table 7-1 identifies types of on the ground habitat actions that could be implemented to improve conditions in specific reaches of the Rock Creek subbasin. These direct habitat actions represent all that are currently known to be available to address the currently identified limiting factors. In total, these actions encompass all direct habitat actions possible to bring the Rock Creek subbasin into a recovery state; they do include or account for out-of-subbasin effects or future degradation or damage to the watershed.

Table 7-1 Costs Associated with Proposed Reach-specific Actions for Rock Creek (YN Fisheries 2006).

	Rock Creek Actions and Costs ** = Utilized Oregon NRCS 2006 Conservation Practice Component Cost List* *# = Utilized Fiscal Year 2006 Montana NRCS Conservation Practices Cost List*				
Reach	**Action**	**Unit**	**Unit Cost**	**# Units**	**Cost**
RC1 – Rock Creek, mouth to boat ramp at RM 1.1	Due to reach's complete inundation by John Day Pool, only dam operation and reservoir actions can affect reach.				
RC2 – Rock Creek, boat ramp to Old Highway 8	Fencing #	per foot	1.4	2120	29568
	Riparian planting #	per tree	11	2890	31790
	Offsite water *	Each	1500	2	3000
	Instream structures(rock weir etc) *	Each	2000	8	16000
	Revetment #	per bank linear foot	10	350	3500
	Rootwad #	Each	600	15	9000
	Exotic vegetation removal	per acre	1000	10	10000
RC3 – Rock Creek, Old Hwy. 8 to Squaw Cr.	Bioengineered channel stabilization next to road	per foot of channel	47	400	18800
	Fencing #	per foot	1.4	46464	65049.6
	Riparian planting #	per tree	11	3468	38148
	Offsite water *	Each	1500	4	6000
	Instream structures(rock weir etc) *	Each	2000	7	1400
	Revetment #	per bank linear foot	10	400	4000
	Rootwad #	Each	600	15	9000
	Water and sediment control basin *	Each	3000	4	12000
	Exotic vegetation removal	per acre	1000	4	4000
SQ1 – Squaw Cr., mouth to Harrison Cr.	Fencing #	per foot	1.4	47520	66528
	Riparian planting #	per tree	11	1445	15895
	Offsite water *	Each	1500	4	6000
	Instream structures(rock weir etc) *	Each	2000	6	12000
	Revetment #	per bank linear foot	10	150	1500
	Rootwad #	Each	600	8	4800
	Water and sediment control basin *	Each	3000	5	15000
	Exotic vegetation removal	per acre	1000	2	2000
SQ2 – Squaw Cr., Harrison Cr. to White Cr.	Fencing #	per foot	1.4	33792	47308.8
	Riparian planting #	per tree	11	1445	15895
	Offsite water *	Each	1500	3	4500
	Instream structures(rock weir etc) *	Each	2000	6	12000

	Rock Creek Actions and Costs ** = Utilized Oregon NRCS 2006 Conservation Practice Component Cost List* *# = Utilized Fiscal Year 2006 Montana NRCS Conservation Practices Cost List*				
	Revetment #	per bank linear foot	10	150	1500
	Rootwad #	Each	600	4	2400
SQ3 – Squaw Cr., White Cr. to extent of distribution	Fencing #	per foot	1.4	31680	44352
	Riparian planting #	per tree	11	1445	15895
	Offsite water *	Each	1500	3	4500
	Instream structures(rock weir etc) *	Each	2000	6	12000
	Revetment #	per bank linear foot	10	200	2000
	Water and sediment control basin *	Each	3000	5	15000
	Rootwad #	Each	600	4	2400
HA1 – Harrison Cr., to extent of distribution	Fencing #	per foot	1.4	22176	31046.4
	Riparian planting #	per tree	11	1445	15895
	Offsite water *	Each	1500	2	3000
	Instream structures(rock weir etc) *	Each	2000	4	8000
	Revetment #	per bank linear foot	10	150	1500
	Rootwad #	Each	600	4	2400
RC4 – Rock Cr., Squaw Creek to Imrie Property Bridge	Spring protection	per site	800	3	2400
	Dike removal	Cubic yard	8	10800	86400
	Fencing #	per foot	1.4	27456	38438.4
	Riparian planting #	per tree	11	1445	15895
	Offsite water *	Each	1500	2	3000
	Instream structures(rock weir etc) *	Each	2000	8	16000
	Revetment #	per bank linear foot	10	300	3000
	Rootwad #	Each	600	8	3200
	Exotic vegetation removal	per acre	1000	6	6000
RC5 - Rock Creek, Imrie Property Bridge to Luna Gulch	Spring protection	per site	800	4	3200
	Dike removal	Cubic yard	8	4500	36000
	Fencing #	per foot	1.4	10560	14784
	Riparian planting #	per tree	11	1445	15895
	Offsite water *	Each	1500	1	1500
	Instream structures(rock weir etc) *	Each	2000	6	12000
	Revetment #	per bank linear foot	10	200	2000
	Rootwad #	Each	600	8	3200
	Exotic vegetation removal	per acre	1000	8	8000
LG1 - Luna Gulch: Rock Creek to Extent of	Fencing #	per foot	1.4	73920	103488

	Rock Creek Actions and Costs ** = Utilized Oregon NRCS 2006 Conservation Practice Component Cost List* *# = Utilized Fiscal Year 2006 Montana NRCS Conservation Practices Cost List*				
Distribution					
	Riparian planting #	per tree	11	3468	38148
	Offsite water *	Each	1500	7	10500
	Instream structures(rock weir etc) *	Each	2000	11	22000
	Rootwad #	Each	600	16	9600
	Water and sediment control basin *	Each	3000	7	21000
	Exotic vegetation removal	per acre	1000	8	8000
RC6 – Rock Cr., Luna gulch to Badger Gulch	Fencing #	per foot	1.4	24288	34003.2
	Riparian planting #	per tree	11	1445	15895
	Dike removal	Cubic yard	8	1080	8640
	Offsite water *	Each	1500	2	3000
	Instream structures(rock weir etc) *	Each	2000	5	11000
	Rootwad #	Each	600	8	4800
	Exotic vegetation removal	per acre	1000	2	2000
BG1- Badger Gulch	Water and sediment control basin *	Each	3000	4	12000
	Riparian planting #	per tree	11	1445	15895
RC7- Rock Cr., Badger Gulch to Unnamed Trib1	Fencing #	per foot	1.4	5280	7392
	Riparian planting #	per tree	11	1445	15895
	Instream structures(rock weir etc) *	Each	2000	3	6000
UN1 – Unnamed trib at Rock Cr. RM 19.2	Water and sediment control basin *	Each	3000	3	9000
	Riparian planting #	per tree	11	1445	15895
RC8 – Rock Cr., Unnamed Trib 1 to Quartz Creek	Fencing #	per foot	1.4	32736	45830.4
	Instream structures(rock weir etc) *	Each	2000	3	6000
	Rootwad #	Each	600	6	3600
QZ1 – Quartz Cr., mouth to small slide	Water and sediment control basin *	Each	3000	12	3600
	Riparian planting #	per tree	11	2890	31790
QZ3- Quartz Cr., small slide to Box Canyon	Water and sediment control basin *	Each	3000	10	3000
	Riparian planting #	per tree	11	2890	31790
QZ4 – Quartz Cr., Box Canyon to Extent of Distribution	Water and sediment control basin *	Each	3000	14	42000
	Riparian planting #	per tree	11	2890	31790
	Instream structures(rock weir etc) *	Each	2000	6	12000
BX1 – Box Canyon, mouth to Box Canyon falls	Water and sediment control basin *	Each	3000	10	30000
	Riparian planting #	per tree	11	2890	31790
RC9 – Rock Cr., Quartz Creek to Small Fall	NO ACTIONS				

	Rock Creek Actions and Costs ** = Utilized Oregon NRCS 2006 Conservation Practice Component Cost List* *# = Utilized Fiscal Year 2006 Montana NRCS Conservation Practices Cost List*				
RC11 – Rock Cr., Falls to Super Slide	Water and sediment control basin *	Each	3000	6	18000
	Riparian planting #	per tree	11	2890	31790
	Instream structures(rock weir etc) *	Each	2000	4	8000
RC13- Rock Cr., super slide to small slide	Water and sediment control basin *	Each	3000	6	18000
	Riparian planting #	per tree	11	2890	31790
	Instream structures(rock weir etc) *	Each	2000	5	10000
RC15 – Rock Cr., slide to Triple Falls	Water and sediment control basin *	Each	3000	8	24000
	Riparian planting #	per tree	11	2890	31790

8. Monitoring, Research, and Adaptive Management

The various research and monitoring efforts underway in the Rock Creek subbasin surrounding habitat restoration and other activities require comprehensive empirical monitoring data on fish populations and habitat to identify appropriate project actions and strategies, select suitable sites and priority locations for actions, populate habitat/production capacity modeling efforts (such as Ecosystem Diagnosis and Treatment [EDT] and All H's Analyzer [AHA]), and inform adaptive management for the salmonid recovery plan. Information on fish distribution, abundance, productivity, habitat conditions, genetic diversity, pathogen levels, and other population parameters, as well as on population limiting factors, is necessary to help direct and evaluate these efforts. A coordinated monitoring program is needed to ensure that these various needs, including salmonid recovery planning, are met.

8.1 Designing a Monitoring and Evaluation Program to Support Adaptive Management

Because of the length and complexity of the salmonid life cycle, there are many uncertainties involved in improving salmonid survival. Simply identifying cause-and-effect relationships between any given management action and characteristics of salmon populations can be a scientific challenge. It is essential to design a monitoring and evaluation program that will answer these basic questions: How will we know we are making progress? How will we get the information we need? And how will we use the information in decision making?

Designing an effective monitoring program for salmon recovery involves the following initial steps:

1. Clarify the questions that need to be answered for policy and management decision making. Include the full ESU and the full salmonid life cycle.
2. Identify entity or entities responsible for coordinating development of this program.
3. Identify:
    - Which populations and associated limiting factors to monitor
    - Metrics and indicators
    - Frequency, distribution, and intensity of monitoring
    - Tradeoffs and consequences of these choices
4. Assess the degree to which existing monitoring programs are consistent with NMFS guidance.
5. Identify needed adjustments in existing programs, additional monitoring needs, and strategy for filling those needs.
6. Develop a data management plan (See Appendix B of *Adaptive Management for ESA-Listed Salmon and Steelhead Recovery: Decision Framework and Monitoring Guidance (May 1, 2007)* http://www.nwr.noaa.gov/Salmon-Recovery-Planning/ESA-Recovery-Plans/upload/Adaptive_Mngmnt.pdf.

7. Prioritize research needs for critical uncertainties, testing assumptions, etc.
8. Identify entities responsible for implementation.

8.2 Adaptive Management

As part of implementing the Rock Creek subbasin recovery plan, a detailed monitoring and evaluation program will be designed and incorporated into an adaptive management framework based on the principles and concepts laid out in the NMFS guidance document, *Adaptive Management for Salmon Recovery: Evaluation Framework and Monitoring Guidance* (available at http://www.nwr.noaa.gov/Salmon-Recovery-Planning/ESA-Recovery-Plans/Other-Documents.cfm.)

Adaptive management means taking an experimental approach to a complex task, making one's assumptions clear, and continuously evaluating them in the light of new information. It works best when the collection of performance data and methods of evaluation are designed to get the information managers need to make sound decisions. As outlined in the NMFS *Adaptive Management* guidance document, several types of monitoring are needed: (1) implementation and compliance monitoring, which is used to evaluate whether the recovery plan is being implemented; (2) status and trend monitoring, which assesses changes in the status of an DPS and its component populations, as well as changes in status or significance of the threats to the DPS; and (3) effectiveness monitoring, which tests hypotheses and determines (via research) whether an action is effective and should be continued. In addition, it is important to build in some research to illuminate the many unknowns in salmon recovery—the "critical uncertainties" that make management decisions all the harder. Critical uncertainty research may seem expensive or unnecessary in light of basic information needs; however, in the long run, it may reduce monitoring and implementation costs.

NMFS' guidance document presents a decision framework that can guide the design of a research, monitoring, and evaluation plan. The framework (Figure 8-1 below) contains two basic sorts of questions: (1) questions regarding DPS status (biological viability criteria) and (2) questions regarding statutory listing factors and factors limiting recovery (limiting factor and threats criteria). Evaluating a species for potential delisting requires an explicit analysis of both types of criteria.

The guidance document contains a more detailed discussion of the framework and identifies the specific questions that should be answered to evaluate DPS status. These specific questions take the form of a series of decision-question sets that address the status and change in status of a salmonid ESU and the risks posed by threats to the ESU. The decision-question sets are designed to elicit the information NMFS needs to make delisting decisions. For recovery planners, the framework can guide future decisions about strategies and actions aimed at achieving recovery goals.

NMFS Listing Status Decision Framework

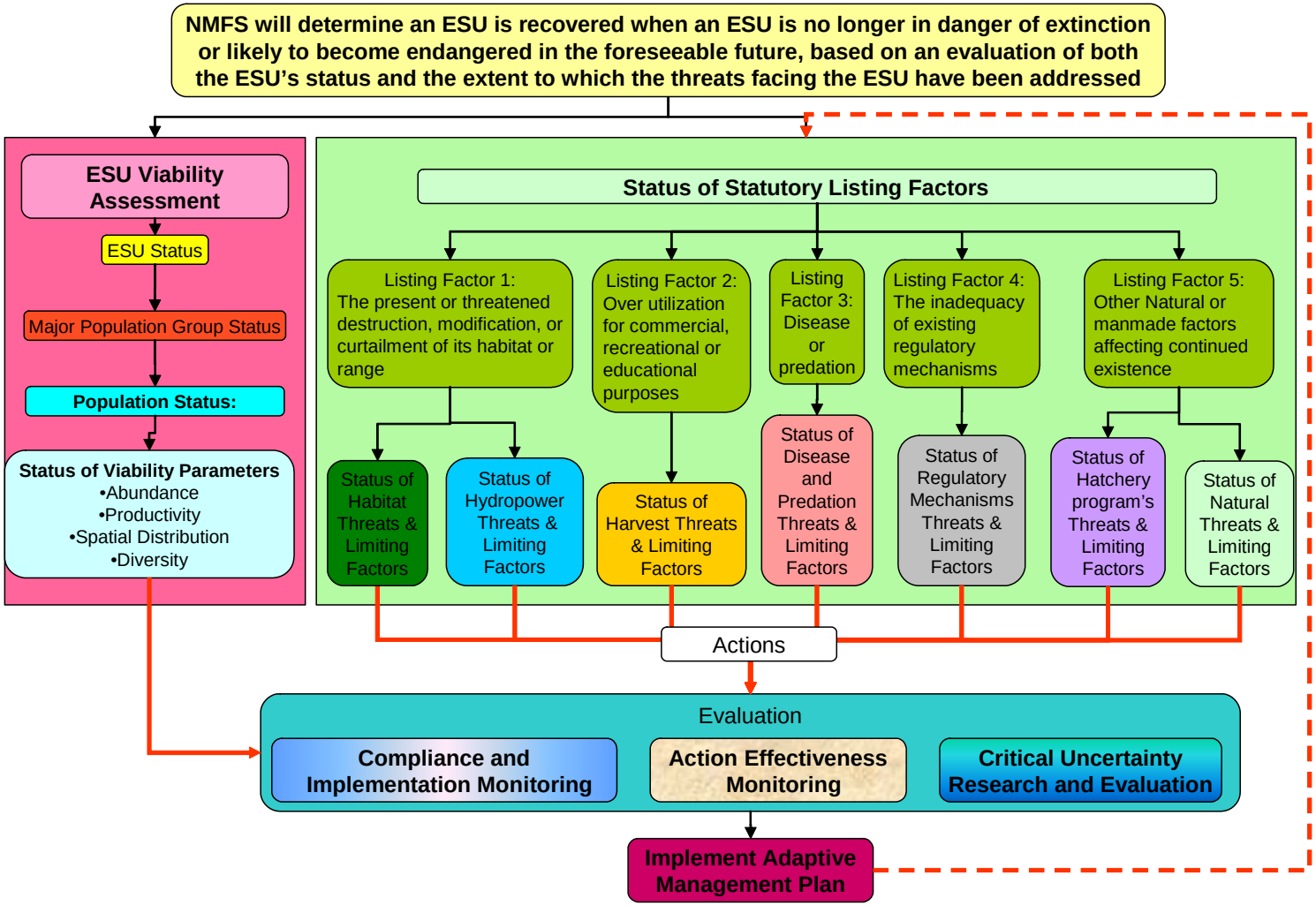

Figure 8-1 NMFS Listing Status Decision Framework.

The Rock Creek subbasin monitoring and evaluation program will build on existing programs designed for monitoring tributary habitat in the Rock Creek subbasin, hydropower actions in the Mid-Columbia, Mid-Columbia hatchery programs, and other actions outside of the Mid-Columbia tributary subbasins (e.g., Columbia mainstem hydropower, estuary and ocean conditions and salmon use, mainstem and ocean harvest). The Rock Creek monitoring and evaluation program will provide (1) a clear statement of the metrics and indicators by which progress toward achieving goals can be assessed, (2) a plan for tracking such metrics and indicators, and (3) a decision framework through which new information from monitoring and evaluation can be used to adjust strategies or actions aimed at achieving the Plan's goals.

Implementation and Compliance Monitoring

Recovery actions implemented within the Rock Creek subbasin will be monitored to assess whether the actions were carried out as planned. This will be carried out as an administrative review and will not require environmental or biological measurements.

Implementation and compliance monitoring simply check on whether activities were carried out as planned, and whether specified criteria are being met as a direct result of an implemented action.

Implementation monitoring will address the types of actions implemented, how many were implemented, where they were implemented, and how much area or stream length was affected by the action. Indicators for implementation monitoring may include visual inspections, photographs, and field notes on numbers, location, quality, and area affected by the action. For example, if a fence is planned for 20 miles of stream corridor to keep livestock off the stream-banks so that riparian vegetation will rebound, implementation monitoring would verify the presence of the fence. Compliance monitoring would take note of the presence or absence of livestock in the fenced-off area.

Success will be determined by comparing field notes with what was specified in the plans or proposals (detailed descriptions of engineering and design criteria). Thus, design plans and/or proposals will serve as the benchmark for implementation monitoring. Any deviations from specified engineering and design criteria will be described in detail.

Status & Trend Monitoring

Status and trend monitoring is a simple compilation of data-based descriptions of existing conditions. To be useful in decision making, the raw data, or metrics, should be reduced to a more directly applicable form or indicator. For example, if the question is "What is the annual spawning population size of steelhead in the Rock Creek?" the indicator would be total spawning numbers of steelhead over one season for the entire river basin; however, the metric, or directly measured thing, would be something quite different, perhaps steelhead redds sighted on weekly passes over known spawning grounds. Thus, the metric should be processed to translate it from the metric data type (e.g., redds) into the indicator data type (e.g., spawners), and then reduced to generate the indicator required (e.g., list of weekly counts on spawning grounds to annual total for watershed).

A future collaborative Washington Gorge Area Regional Board could direct implementation and develop a program to monitor the status and trend of steelhead population viability attributes, their habitats and their associated limiting factors throughout the Rock Creek subbasin. In the event that a collaborative Board cannot be established, co-managers along with participating local entities and individuals would establish such a program to utilize and comport with the guidelines developed in the NMFS, "Adaptive Management for Salmon Recovery: Evaluation Framework and Monitoring Guidance", the Pacific Northwest Aquatic Monitoring Partnership (PNAMP) and the Collaborative, and the Systemwide Monitoring and Evaluation Project (CSMEP).

Effectiveness Monitoring

Effectiveness monitoring specifically addresses cause-and-effect questions. Demonstrating the direct and indirect impact of management actions requires supporting all steps in the logical chain that connects the action to its expected impact. This chain is rarely short and usually contains several hypotheses. For this reason, it's better to build the effectiveness monitoring into the recovery action strategies, with, for example, pilot-scale tests or other methods carefully thought out beforehand.

Effectiveness monitoring, tests hypotheses and determines (via research) whether an action is effective and should be continued. Effectiveness monitoring should to be coordinated with implementation monitoring. Not all recovery actions recommended in this plan need to be monitored for effectiveness. However, it is important that a sufficient number of replicates of each "type" of action be assessed for effectiveness. To the extent possible, effectiveness monitoring of recovery actions should be coordinated with the Washington's effectiveness monitoring program and should be monitored using the Before-After-Control-Impact (BACI) design with stratified random sampling, as described in the Comprehensive Statewide Monitoring Strategy (Monitoring Oversight Committee 2002). This strategy describes in detail the approach, indicators, and protocols needed to assess effectiveness of habitat restoration classes.

Monitoring and evaluation will only provide the answers to the questions they were designed to address; they do not provide the framework for revising these questions if they are ill-posed, evaluating the assumptions upon which the strategy was built, or incorporating learning into future decisions on actions and strategies—this is the role of adaptive management. Further guidance on effectiveness monitoring and validation monitoring/research can be found in NOAA's "Adaptive Management for Salmon Recovery: Evaluation Framework and Monitoring Guidance."

8.3 Research and Critical Uncertainties

Critical uncertainties fall into several categories policy, legislation, and science. The RM&E will focus primarily on the scientific uncertainties.

Scientific Uncertainties

Uncertainties are primarily associated with information gaps, which can be divided into two major categories: (1) those that deal with critical uncertainties and (2) gaps in knowledge about the linkages between specific actions and their effects on habitat factors and VSP parameters. Some of the data gaps can be filled through monitoring and evaluation; others should be filled through research.

Critical uncertainties, the unknown aspects of environmental conditions vital to salmonid survival, are a major focus of the research, monitoring, and evaluation program. Monitoring is needed to establish linkages between specific actions and resultant environmental effects. Those linkages are complex and often not well understood. Understanding them requires input from experts from various fields. It is important that the actions recommended in the Plan to benefit listed fish species in the White Salmon subbasin be reviewed by fish ecologists, geologists, hydrologists, and other experts familiar with the recovery region to determine how uncertainties may affect the interpretation of results.

The Plan expects that specific benchmark values for the VSP parameters will be refined during plan implementation based on new information that addresses current uncertainties. The following are examples of questions/research that would significantly enhance the ability to answer the information gaps or other relevant questions by providing new information to reduce uncertainty.

Out-of-Subbasin Uncertainties

There are numerous out-of-subbasin uncertainties. The geographic area of the Middle Columbia steelhead DPS encompasses a large part of north-central Oregon and a large part of south-central Washington draining into the Columbia River, including the Rock Creek subbasin. Within the Middle Columbia steelhead DPS there are nineteen distinct populations of steelhead. Rock Creek contains only one population. This context is significant in terms of uncertainties: 1) Successful recovery of steelhead as defined by the regional recovery plan, requires achieving specific levels of productivity for populations within the entire DPS, not only acceptable productivity within any single basin that is a part of the DPS. This means that local communities in different watersheds/basins across local and state boundaries are dependent upon each other for successful delisting of these species; 2) Out of the subbasin components (e.g., hydropower operations, harvest, hatcheries, macro-economics, estuarine conditions), though significant to impacts on overall Middle Columbia steelhead mortality, cannot be directly affected by actions taken within the Rock Creek subbasin. This means there should be monitoring to measure the increases/decreases in productivity of the target populations within the subbasin, before

they migrate out of the subbasin, to demonstrate the scale of out of subbasin impacts on the population. Results of actions, monitoring and research associated with NOAA's Estuary Module and 2008 FCRPS Biological Opinion should be coordinated with an appropriate local collaborative Board.

Out-of-Subbasin Research Needs

- Evaluate innovative techniques (e.g., terminal fisheries and tangle nets) to improve access to harvestable stocks and reduce undesirable direct and indirect impacts to naturally produced steelhead.
- Develop better methods to estimate harvest of naturally produced steelhead and indirect harvest mortalities in freshwater and ocean fisheries.
- Assess the interactions between hatchery and naturally produced steelhead.
- Assess if hatchery programs increase the incidence of disease and predation on naturally produced fish.
- Evaluate if passage through hydroelectric projects affects reproductive success of listed fish species.
- Assess baseline survival estimates for juvenile listed fish species as they pass hydroelectric projects.
- Evaluate increased predation risks from native and non-native fish, birds and mammals.

In-Subbasin Research Needs

- Implement prioritized restoration projects identified by technically qualified professionals, which provide the highest restoration benefit.
- Implement selected restoration projects as experiments, and evaluate through effectiveness monitoring.
- Implement genetic research to identify genotypic variation, help establish presence of winter and summer runs in Rock Creek.
- Increase understanding of linkages between physical and biological processes so managers can predict changes in survival and productivity in response to selected recovery actions.
- Complete EDT model for Rock Creek and test assumptions and sensitivity of EDT model runs.
- Determine relative performance (survival and productivity) and reproductive success of naturally produced steelhead in the wild.
- Assess population structure.
- Assess steelhead distribution in neighboring subbasins and determine genetic relationship to Rock Creek steelhead population
- Determine the effects of exotic species on recovery of steelhead and the feasibility of actions to eradicate or control numbers of exotic species.
- Evaluate increased predation risks from native and non-native fish and birds.
- Assess eutrophication and aquatic vegetation impacts and determine ecologically sound solutions to address the problems in lower Rock Creek.
- Assess potential of conserving and rehabilitating springs

- Identify what current water temperatures in the lower river are, and whether fish can survive with higher average mainstem temperatures if in-stream and side channel/floodplain habitats are intact, diverse and provide thermal refugia.

8.4 Existing Monitoring and Research

Many entities have been or will be implementing recovery actions within and downstream from the Rock Creek subbasin. Monitoring programs to coordinate with include:

- Yakima Klickitat Fisheries Project,
- Yakama Nation Monitoring,
- NOAA Fisheries RME Program,
- Washington Salmon Recovery Funding Board Program,
- PACFISH/INFISH Monitoring Program,
- Pacific Northwest Interagency Regional Monitoring Program,
- USFWS, USGS, and BOR Monitoring Programs,
- WDFW and Department of Ecology monitoring programs, and
- Local Conservation District monitoring.

It is critical that these programs be consulted to emphasize utility, reduce redundancy, increase efficiency, and minimize costs.

8.5 Additional Needs

Additional monitoring needs may be identified in the future and should be incorporated into the RM&E plan during development or through the implementation of the adaptive management process.

8.6 Data Management

A formal and documented approach to data management is essential to adaptive management. A well-designed data management plan can help to ensure that data of a specified quality and quantity is available, at a specified time, to meet specified data analysis needs. Protocols, metrics, and other data standardization tools such as common data entry methods are a top priority for recovery plans. Coordination across existing monitoring programs and projects will be underpinned by an integrated monitoring and data management framework. The framework would, for example, require the use of common methodologies for sample design, data collection, data validation, and data sharing in order to address common questions. Data management systems should be developed and coordinated with national and regional efforts for consistency with regional and national data standards. Project implementation data management should be consistent with PCSRF protocols where appropriate and guidance from PNAMP's effectiveness work group. Further guidance on data management is provided in the NMFS Guidance document Adaptive Management for Salmon Recovery.

It may be appropriate to incorporate data management with the Yakima Klickitat Fisheries Project and other regional programs to provide easy comparison with existing large datasets within the DPS. There may be some administrative obstacles to this, but efficiency would dictate that this is likely the most appropriate resource. Storage of new monitoring information and access to existing information will be under contract with the local implementation body of this plan.

8.7 Consistency with Other Monitoring Programs

This recovery plan will utilize existing monitoring programs to evaluate the status/trend and effectiveness of recovery actions within the Rock Creek Basin. Specifically, this approach should incorporate strategies, indicators, and protocols described in the WRIA 31 Watershed Management Plan, the Upper Columbia Monitoring Strategy, the Comprehensive Statewide Monitoring Strategy, and Collaborative Systemwide Monitoring and Evaluation Project (CSMEP). The development of other regional monitoring programs may result in modifications to the monitoring programs used in the Rock Creek basin. These other programs, in various states of development, include such approaches as Pacific Northwest Aquatic Monitoring Partnership (PNAMP). As these programs develop more fully, they will provide guidance on valid sampling and statistical designs, measuring protocols, and data management. This information may be used to refine and improve the existing monitoring and evaluation programs in the Rock Creek basin. The intent is to make monitoring and evaluation programs in Rock Creek consistent with programs throughout the ESUs/DPSs and Columbia Basin.

8.8 Coordination

Many entities have been or will be implementing recovery actions within and downstream from the Klickitat Basin. Monitoring programs to coordinate with include:

- NOAA Fisheries RME Program,
- Washington Salmon Recovery Funding Board Program,
- PACFISH/INFISH Monitoring Program,
- Pacific Northwest Interagency Regional Monitoring Program,
- USFWS, USGS, and BOR Monitoring Programs,
- WDFW and WDOE Monitoring Programs,
- Local Underwood Conservation District Monitoring, and
- WRIA 31 Implementing Governments.

It is critical that these programs be consulted to emphasize utility, reduce redundancy, increase efficiency, and minimize costs.

8.9 Evaluation Schedule

The Rock Creek subbasin currently has no collaborative regional Board guiding and coordinating recovery implementation. Tracking progress or needs for adaptive management in the Rock Creek subbasin by evaluating information from the recovery plan's research and monitoring programs would be one of the roles of a Washington Washington Gorge Area Regional Board. Appropriate time intervals and triggers/goals

need to be established to evaluate project implementation, compliance and effectiveness; the status (and change in status) of a population's viability attributes; the status of a population's limiting factors; and the research needs identified in the recovery plan.

On an annual basis, the Washington Gorge Area Regional Board would review efforts within the Rock Creek subbasin to determine whether funding has been obtained and actions initiated. Further evaluations should occur at intervals coordinated with other subbasin in the DPS. Reviews at this time should start with funding and implementation effectiveness. If funding and implementation have taken place previously, their effectiveness should be reviewed and progress toward the overall implementation of projects within Rock Creek should be measured. Status reviews should be coordinated with NOAA Fisheries five-year status reviews. Progress, or the lack thereof, should be evaluated within context of the entire DPS.

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Appendix I. Eastern Tributaries in the Washington Gorge Management Unit

Appendix I describes steelhead distribution and current conditions in several small tributaries to the Columbia River that drain areas in Washington State upstream of Rock Creek. These tributaries are included in the WA Gorge Management Unit of the Middle Columbia River steelhead DPS, which also contains the White Salmon, Klickitat and Rock Creek subbasins. The Interior Columbia Technical Recovery Team (ICTRT) has included these small eastern Washington State tributaries in the delineated independent population boundaries of the Willow Creek and the Umatilla populations of the Middle Columbia River steelhead DPS. These two independent populations primarily occupy areas in the State of Oregon. Strategies and actions for recovery of the populations are discussed in Oregon's Middle Columbia River Steelhead Recovery Plan (Carmichael 2007).

Appendix I does not identify the factors that currently limit steelhead viability in these small eastern Washington State tributaries, nor provide a road map for their recovery. Currently, data on steelhead abundance, productivity, spatial structure and diversity in these eastern tributaries of the Rock Creek subbasin does not provide the information needed to effectively make these determinations. NOAA's National Marine Fisheries Service (NMFS) believes that a local board — people with knowledge of the geographic areas and the activities now underway to improve watershed conditions — can best determine the most efficient and cost effective ways to identify and address limiting factors and threats to steelhead recovery in these Rock Creek eastern tributaries. Consequently, NMFS would support the creation of a Washington Gorge Area Regional Board to undertake these tasks. The Board could consist of representatives from Klickitat, Yakima, and Benton counties, local land owners, and the Yakama Nation.

Introduction

Several small eastern Washington State tributaries of the Columbia River that drain lands to the east of the Rock Creek watershed are part of the Middle Columbia River steelhead DPS and included in the WA Gorge Management Unit. The management unit is comprised of the White Salmon, Klickitat, and Rock Creek subbasins, and the several small Washington State tributaries of the Columbia River — including Chapman Creek, Wood Gulch, Pine Creek, Alder Creek and Glade Creek — that drain lands to the east of the Rock Creek watershed (Figure ApI-1).

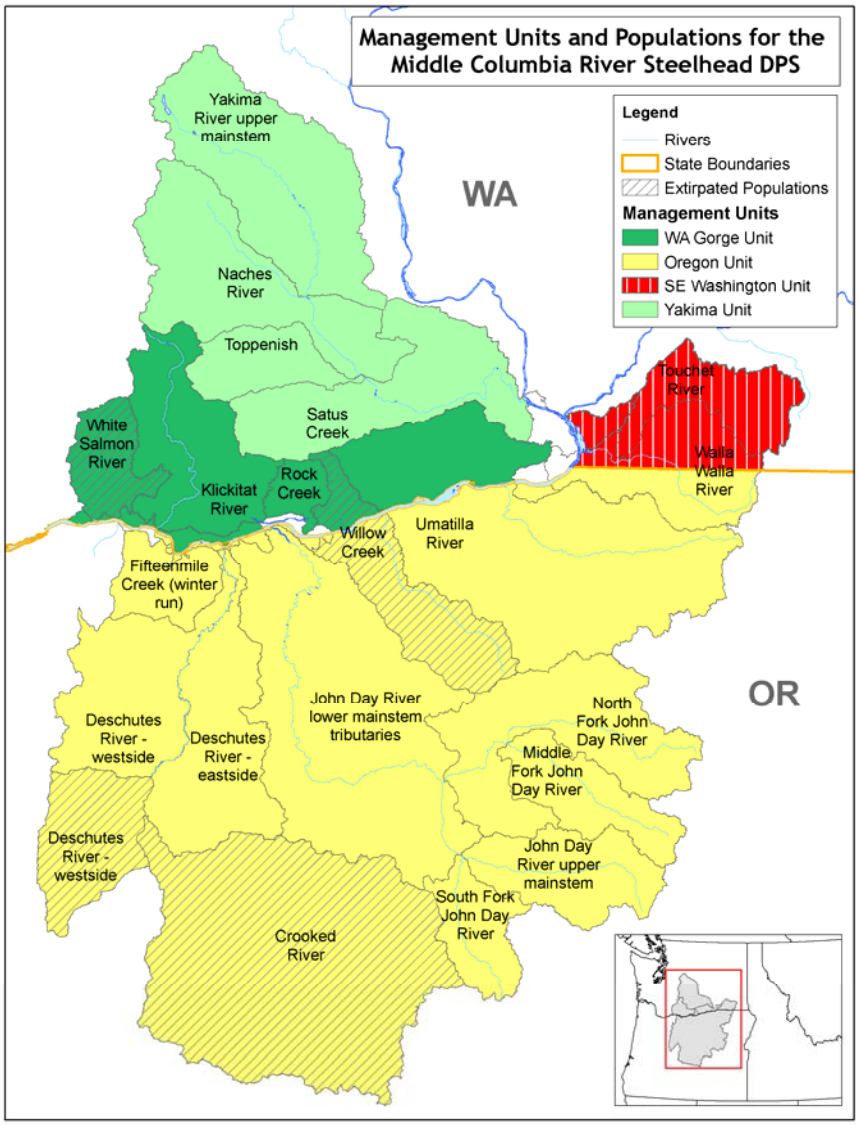


Figure ApI-1 NMFS Management Units for the Middle Columbia Steelhead DPS

NMFS 'Management Units' are defined as those geographical areas for which we are developing recovery plans. A management unit is a portion of a listed species (ESU/DPS) that might require different management due to different threats in certain geographic areas or management by different state, tribal, or local entities.

The small eastern Washington State tributaries — including Chapman, Wood Gulch, Pine, Old Lady, Alder and Glade creeks — are included within the Interior Columbia Technical Recovery Team (ICTRT)-delineated independent population boundaries of the Willow Creek and the Umatilla populations of the Middle Columbia River steelhead DPS. These two independent populations primarily occupy areas in the State of Oregon (Figure ApI-2). The ICTRT included the areas in the Umatilla and Willow Creek populations because they are the closest upstream independent populations to the

Columbia River. This is consistent with the ICTRT's determination that the long-term occupancy of these small, relatively isolated spawning areas likely depends on straying from a variety of areas, with the nearest upstream population likely being the largest contributor of strays (ICTRT 2003). However, occurrence of Middle Columbia River steelhead in the 'eastern tributaries' to the Rock Creek subbasin drainage has not been thoroughly analyzed by the ICTRT because of lack of data. The Willow Creek and Umatilla populations are part of the Oregon-Washington Bi-State Umatilla/Walla Walla major population group (MPG) within the Middle Columbia River steelhead DPS. The Umatilla/Walla Walla MPG also includes the Walla Walla and Touchet populations.

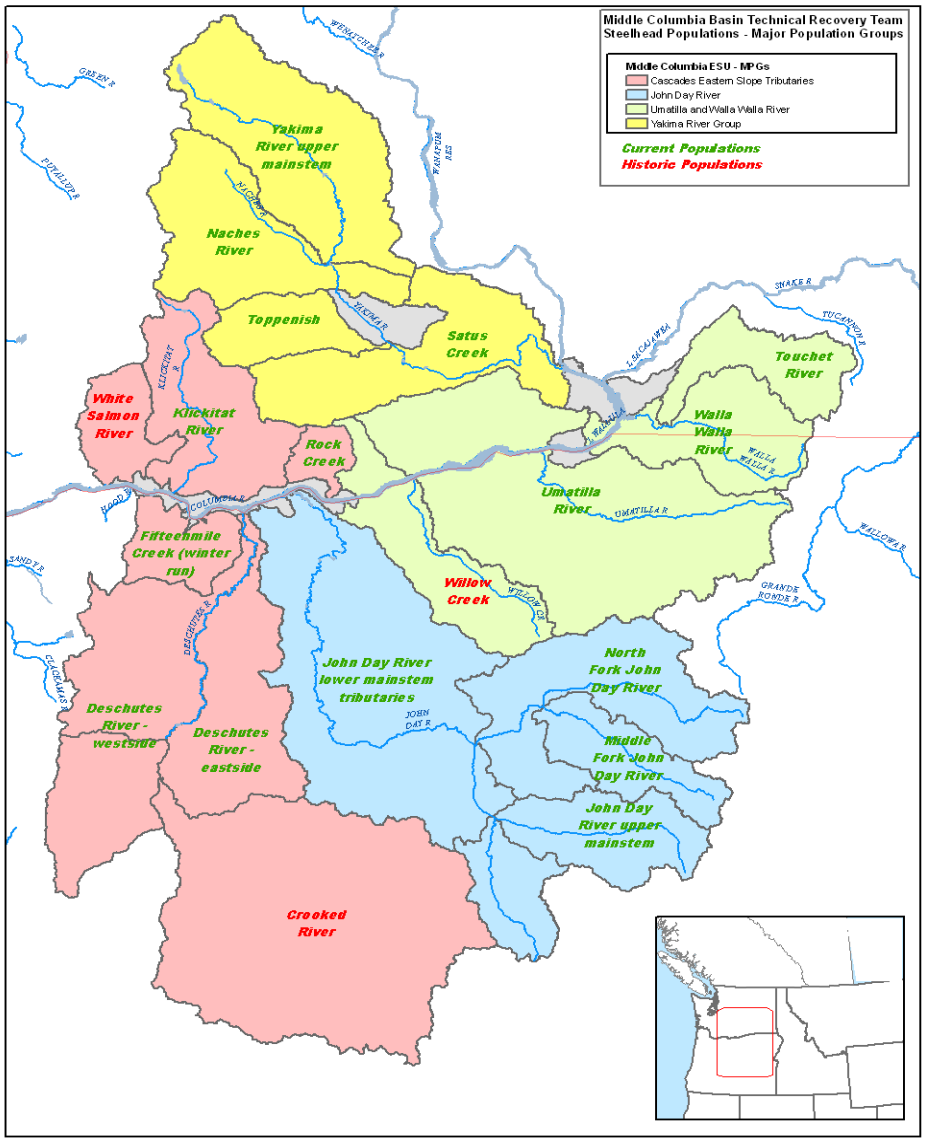


Figure ApI-2 NMFS Populations and Major Population Groups for the Middle Columbia River Steelhead DPS

According to ICTRT viability criteria (ICTRT 2005, ICTRT 2007a), the Umatilla/Walla Walla MPG, and other MPGs in the DPS, should be at low risk (viable) for the Middle

Columbia River steelhead DPS to be considered viable. ICTRT criteria recommend that for the Umatilla/Walla Walla MPG to be regarded as viable:

1. Two of the historical populations in the MPG should meet at least minimum viability standards.
2. Viable populations within the MPG should include one large and one intermediate sized populations.
3. All major life history strategies present historically should be represented.
4. One population should be highly viable.
5. All populations that do not meet viable status should be maintained.

Given the above criteria, the ICTRT has identified two viability scenarios as options:

- Umatilla River—this population is recommended to meet the large size requirement because it is the only large size population.
- Walla Walla River or Touchet River—either population could meet the second population recommended at intermediate size.

The recovery scenario for the Umatilla/Walla Walla MPG includes improving the status of the Umatilla population to a viable level. The Willow Creek population is considered extirpated and is not currently included in the recovery scenario for the Umatilla/Walla Walla MPG. This is consistent with ICTRT direction, which gives highest priority initially to implementing actions within currently occupied areas, and thus to improving the status of extant populations and MPGs in the DPS (ICTRT 2007a). The ICTRT further recommends that extirpated populations and subpopulations within MPGs in the Middle Columbia River steelhead DPS should be considered within the context of MPG and population viability (ICTRT 2007b). Suggest the following language to incorporate…..Preliminary analysis of the Mid-Columbia steelhead population identified by the YN as occupying the 'Eastern Tributaries' to the Rock Creek subbasin suggest they are part of the ICTRT-identified Umatilla/Walla Walla MPG (OR Management Unit Recovery Plan and Southeast Washington Management Unit Plan), and, not part of the Cascades Eastern Slope Tributaries MPG which the individual WA Gorge Management Unit Plans are a part of, and address.

The ICTRT's approach does not suggest that such historically occupied areas are not important to the ultimate long-term persistence of the DPS, but rather that preserving extant populations should take temporal priority over reintroductions in situations where resources are limited perhaps should note the latest draft White Salmon Middle Columbia River Steelhead Recovery Plan?. In this approach, the ICTRT recognizes that predicting a quantitative benefit in risk reduction associated with re-establishment of populations in extirpated areas is challenging and includes a high degree of uncertainty. Therefore, given the logistic challenges associated with re-introducing fish to many of these areas, and the uncertainty of the contribution of re-established populations to ESU/DPS viability, the ICTRT recommends a staged, adaptive approach to recovery planning and

implementation that gives the highest priority to currently occupied areas (ICTRT 2007b).

Recovery Goal

NMFS' biological goal is to remove the Middle Columbia River Steelhead DPS from listed status under the ESA. Biological goals and criteria for the recovery of steelhead populations in the Middle Columbia River steelhead DPS were developed by the Interior Columbia Technical Recovery Team (ICTRT 2008).

The ICTRT has determined that to be viable the Umatilla steelhead population should reach a minimum abundance threshold of 1,500 naturally produced spawners with a sufficient intrinsic productivity to achieve a 5 percent or less risk of extinction over a 100-year timeframe (ICTRT 2008). The ICTRT considers a 5 percent probability of extinction in a 100-year period an acceptable risk level for a viable population.

The Willow Creek population is considered extirpated and is not currently included in the ICTRT's recommended recovery scenario for the Umatilla/Walla Walla MPG (ICTRT 2005, ICTRT 2007a).

Umatilla River Population, including Washington tributaries

The ICTRT has identified three Washington tributaries as spawning areas for the Umatilla River population. Alder Creek is considered a MaSA for the population and Glade Creek and Fourmile Canyon are MiSAs for the population (Figure ApI-3). The ICTRT defines a major spawning area as a system of one or more branches that contains sufficient habitat to support at least 500 spawners. This structure is typical of intermediate or large drainages. The ICTRT defines minor spawning areas as contiguous production areas capable of supporting between 50 and 500 spawners. The ICTRT does not consider any population fewer than 500 spawners to be viable, regardless of its intrinsic productivity (ICTRT 2005).

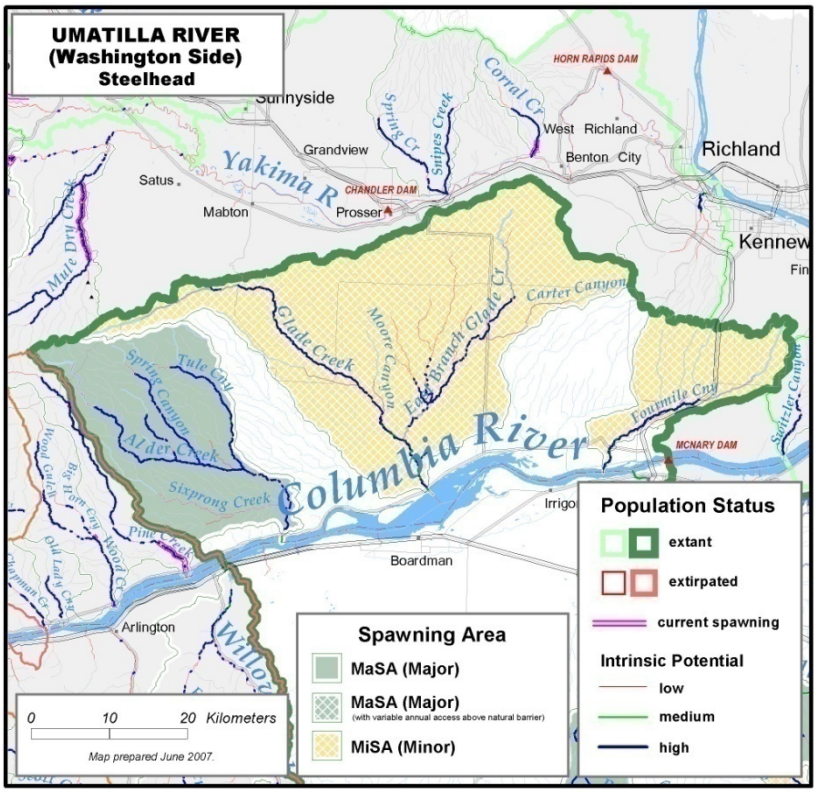


Figure ApI-3. Umatilla River (Washington Side) Summer Steelhead population boundaries and major and minor spawning areas.

The three Washington areas are considered in the viability assessment of spatial structure/diversity for the Umatilla steelhead population (Figure ApI-4). This assessment is discussed in Section 6.1.9 of Oregon's Middle Columbia River Steelhead Recovery Plan (Carmichael 2007).

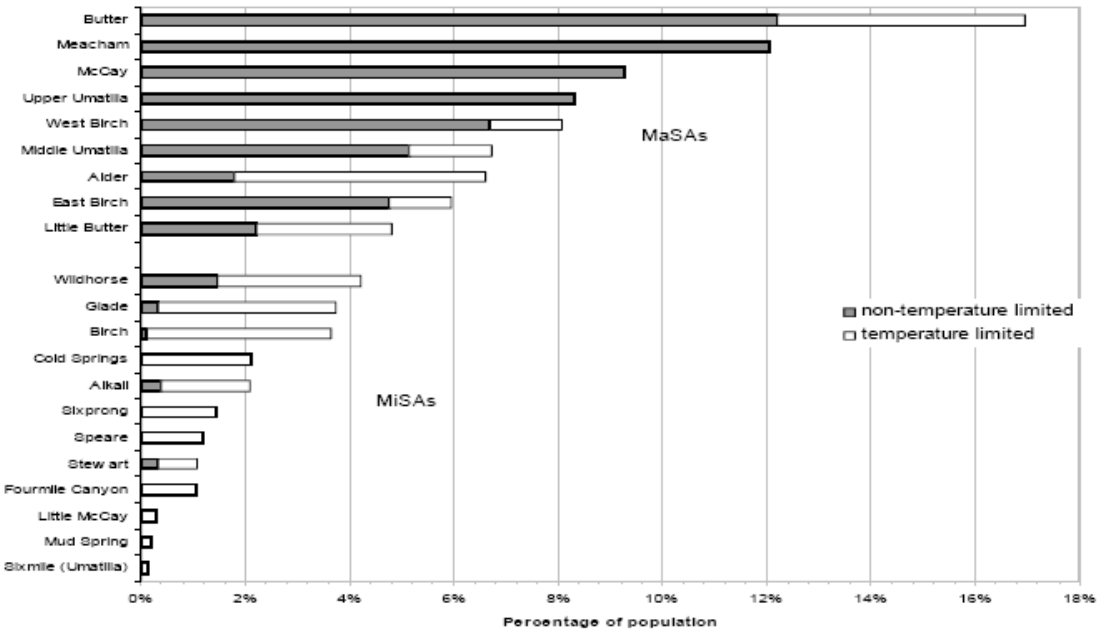


Figure ApI-4. Percentage of historical spawning habitat by major/minor spawning area. Temperature limited portions of each MiSA/MaSA are shown in white (Carmichael 2007).

The Umatilla population does not currently meet the recommended viability criteria because Abundance/Productivity and Spatial Structure/Diversity risks ratings are both moderate. It does meet criteria for a "maintained" population.

Recovery strategies and actions for the Umatilla population aim to improve viability to achieve at least viable status. Recovery efforts for the population focus on increasing population abundance and productivity and increasing spatial structure by restoring degraded habitats and fish access to habitat areas, increasing flows, and by improving hydrosystem operations and facilities.

Willow Creek Population, including Washington tributaries

The ICTRT has determined that four of the eastern Washington tributaries are minor spawning areas for the Willow Creek population — Pine Creek, Wood Creek, Old Lady Creek and Chapman Creek (Figure ApI-5). A full viability assessment has not been conducted for the Willow Creek population because it is considered extirpated.

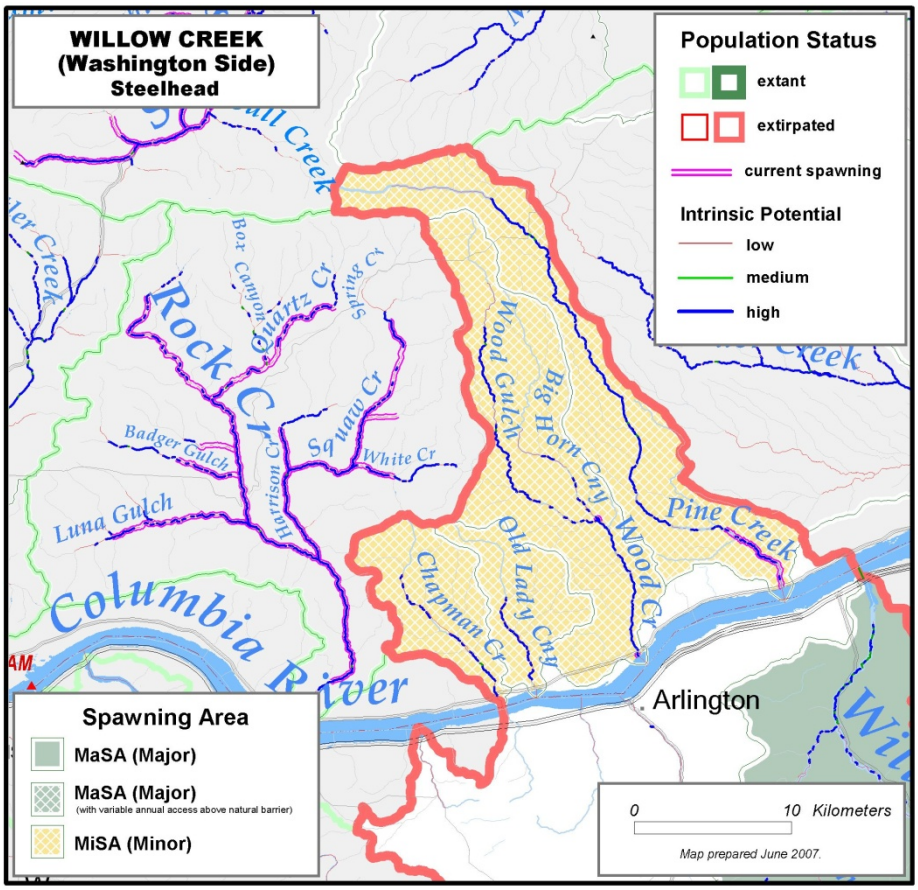


Figure ApI-5. Willow Creek (Washington Side) Summer Steelhead population boundaries and minor spawning areas.

Overview of Washington Eastern Tributaries Area

This section provides an overview of the eastern tributaries area. It also provides brief descriptions of the Washington major and minor spawning areas for the Umatilla River and Willow Creek populations of Middle Columbia River steelhead.

Overview

The eastern tributaries drain parts of Benton, Klickitat and Yakima counties in Washington State. The subbasins fall within Washington's Middle Columbia River Salmon Recovery Region, which comprises salmon-bearing streams in Benton, Kittitas, Yakima, and parts of Chelan and Klickitat counties. They are in the state's Rock-Glade Water Resource Inventory Area (WRIA) 31, which is bounded on the south and east by the Columbia River, by the Klickitat River subbasin on the west, and by the Simcoe Mountains and a basalt ridge of the Horse Heaven Hills to the north. They flow in a southerly to southeasterly direction to Lake Umatilla, the portion of the Columbia River impounded by the John Day Lock and Dam. Elevations range from 200 feet at the confluence of Rock Creek and the Columbia River to over 4,000 feet in the Horse Heaven Hills (WSCC 2005).

The tributaries drain an area of Washington State that is dominated by extensive basalt flows having a total thickness of up to 5,000 feet. The erosion-resistant nature of these flows has resulted in the creation of deep (500 to 800 feet), steep-walled canyons and has severely constrained floodplain development along substantial portions of the streams within this area (WSCC 2005).

The streams appear to have similar geomorphic characteristics. Headwater tributaries flow out of the mountains and across the relatively flat basalt plateau at gradients of generally less than 1%; this area is above known anadromous use. Coming off the plateau, streams enter steep-walled canyons; gradients increase to 2 – 4% or more; fish habitat quality is generally fair to poor, with little suitable spawning and rearing habitat. Below the canyon reaches, streams enter alluvial valleys; gradients range between 1% and 2% near the upper end, dropping to less than 1% as streams approach the Columbia. Fish habitat in the sections is highly variable, ranging from poor to excellent.

Climate over the area is typical of that found on the east side of the Cascades; average daily temperatures range from 70°F in the summer (with maximums commonly above 90° F) and 37° F in the winter. Annual precipitation ranges from 20 to 25 inches in the headwaters of Rock Creek to less than 10 inches over most of the eastern half.

Extensive flatlands which existed along the Columbia River prior to inundation by dams have formed shallow wetlands and embayments along the shore of Lake Umatilla. These serve as holding or resting areas for migrating adults and juveniles. Identified wetland areas are generally associated with springs which occur sporadically throughout the eastern subbasins. Many of these spring areas also serve as cattle watering areas, to the detriment or exclusion of wetland vegetation and water quality. Fish habitat within these wetland areas is unlikely owing to their small size; however, spring outflow in the immediate vicinity of fish-bearing waters may provide important cool-water refuges during the summer and early fall. Biologists have observed fry in the vicinity of these springs even when streams are intermittent or subsurface during summer months.

Riparian forest stand development in the canyon areas is limited by the narrow floodplain area available, but, due to difficult access, is of relatively good quality and is only minimally impacted by grazing and forest management activities. In the low elevation alluvial reaches, riparian forest stand development is limited by the lack of precipitation and runoff; where it is able to exist, it is generally limited to the area in the immediate vicinity of stream channels. Riparian quality is highly variable; the riparian zone is non-existent over significant portions of the alluvial reaches of all streams, while elsewhere, it occurs as a strip varying in width from 15 feet (essentially, a single row of trees) to over 150 feet. Riparian vegetation in this area is impacted by grazing activities, which tend to be concentrated along streams; these impacts are both direct (browsing, trampling, soil compaction) and indirect (bank instability and resulting channel widening).

All streams in this area are classified as Class A streams (excellent water quality). Identified water quality problems include high water temperatures recorded during the summer. Temperatures in Chapman Creek, Alder Creek, Wood Gulch and Pine Creek have been found to exceed the Washington Department of Ecology standard (18°C/64.4°F) (BLM 1986, EKCD 1997, Lautz 2000). A Washington Department of Ecology (WDOE) study in 1995 and 1996 found widespread nitrate contamination in the two uppermost aquifers of the Glade Creek watershed, in Glade Creek itself and its tributaries correlated to crop irrigation (Garrigues 1996).

Water temperatures in the nearby Rock Creek watershed may be indicative of the situation in its neighboring streams to the east. Stream monitoring by the Eastern Klickitat Conservation District (1997) confirmed exceedances of the standard at most of the 27 sites where thermographs were installed. Based on temperature data through 1997, it appears that exceedances of the standard at higher elevations (plateau and upper canyon reaches) are relatively minor and of short duration; some thermal stressing of juvenile salmonids may occur, but may be avoided if there is access to cool water refuges (areas of spring outflow or groundwater upwelling). In lower canyon and alluvial reaches, exceedances extend well into the sub-lethal or lethal ranges for salmonids and are of long duration. It is unknown to what extent cool water refuges exist in these reaches (Lautz 2000).

Land use is well correlated with climate, vegetation, and topography. Almost 50% of the land base is in agricultural use (primarily wheat and other dryland crops) and occurs primarily on the non-forested areas of the plateau and on level areas near the Columbia River. Non-forested rangeland is found in the canyons and in other non-forested areas unsuitable for agriculture. Less than 10% of the area is forested, primarily in the headwaters of Rock Creek and Pine Creek. Forest lands are owned by Washington Department of Natural Resources, Western Pacific Timber, Inc., and a number of non-industrial private owners. These forest lands are also considered suitable for grazing, and many currently have active grazing allotments.

Washington Spawning Areas for the Umatilla Population

Washington spawning areas that provide habitat for the Umatilla population of Middle Columbia River steelhead are discussed below. The sections briefly discuss watershed conditions and steelhead in the areas.

Alder Creek

Alder Creek encompasses an area of 199.09 sq. miles (127,418.3 acres). The lower portion of Alder Creek is perennial as a result of springwater inputs. Despite relatively dense riparian vegetation along the narrow creek, stream temperatures in the summer tend to be warm, with seven-day average temperatures exceeding the state standard. Pools and instream wood in the lower 5 miles were found to be abundant during one reconnaissance. Hill slopes of Sixprong Creek, a tributary to Alder Creek were found to be up to 50 feet in height, nearly vertical, and of highly erosive material, however the

creek channel seemed well-defined and riparian vegetation (Flynn et al. 2004). Based on GLO land notes, Alder Creek seemed to exhibit a high width-to-depth ratio in the lower two miles with scrubby riparian vegetation. Sixprong was apparently intermittent in the surveyed reaches.

Steelhead distribution: Steelhead adults have been observed in the lower 1.5 mi. of Alder Creek, but due to a lack of passage impediments, it is presumed that distribution is more extensive. *O. mykiss* fry have been observed to the headwaters and in Sixprong Creek.

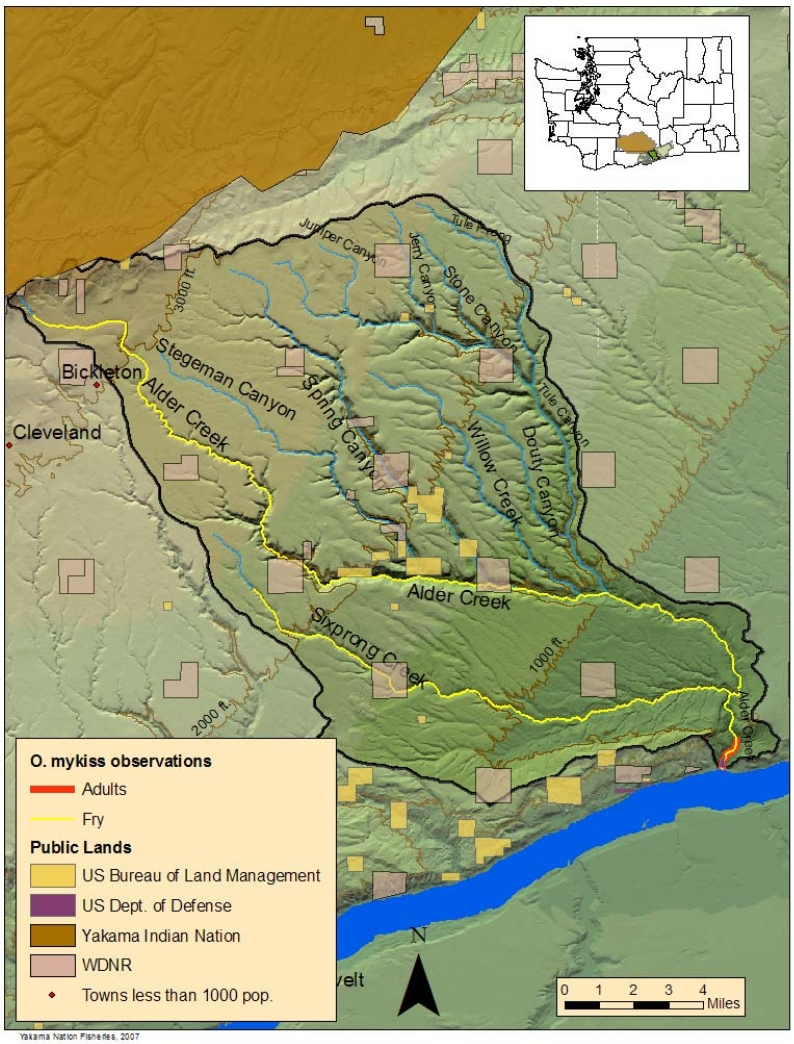


Figure ApI-6. Alder Creek subbasin major streams and steelhead distribution (YN Fisheries 2007).

Glade Creek

The Glade Creek watershed covers 432.7 square miles on a wide, open, treeless, gently south-sloping plateau in southeastern Washington known as the Horse Heaven Hills. The majority of the watershed, including the lower half of mainstem Glade Creek, the eastern tributaries of Moore Canyon, East Branch Glade Creek, and Carter Canyon, lies in western Benton County, while the main branch of Glade Creek and Coyote Canyon extend across the northeastern corner of Klickitat County and into the southeast corner of Yakima County. Its headwaters drain the east-west trending crest of the Horse Heaven Hills at elevations that range from 3,560 feet at the western end to 1,420 feet. East Branch joins the main branch of Glade Creek at an elevation of 365 feet; the confluence of Glade Creek at the Columbia River is at 266 feet above sea level (Garrigues 1996).

Annual precipitation ranges from about 13 inches in the high elevation northeast of Bickleton, WA, to 8 or 9 inches in the eastern portion of the watershed. About 90% of the precipitation falls between November and April, primarily as snow (Packard et al. 1994).

The Glade Creek watershed is underlain by at least 5,000 feet of basaltic flows forming three basalt formation, each composed of numerous, layered basalt flows with many potential fractured, water-bearing zones. Loess, alluvial, glaciofluvial and lacustrine deposits overlie the basalt and range from less than five feet to about 200 feet thick (Packard et al. 1994). Groundwater flow direction in the watershed is determined to a large extent by geologic structure and topography, which combine to funnel groundwater flow toward the lower reaches of Glade Creek (Garrigues 1996).

Glade Creek and its tributaries are intermittent streams that, historically, have often been dry in the summer and autumn (Molenaar 1982; Davis 1993). Flow typically only occurs in the precipitation and snow-melt period, based on six crest-stage gauges on central Glade Creek and various tributaries and at a discharge measurement site at the creek's mouth (Molenaar 1982). Under normal precipitation conditions, nearly 100% of the flow in Glade Creek comes from baseflow (groundwater discharge), except during spring runoff and peak stream discharges after storm events (Garrigues 1996).

Crop production is the basis of the economy in the Glade Creek watershed. Dryland wheat occupies the greatest crop area, but irrigated lands have increased dramatically since the early 1970s (Packard et al. 1994) The principle groundwater use is for crop irrigation; surface water imported from the Columbia River is also used. A variety of nitrogen-based fertilizers as well as pesticides is applied to the fields of the Horse Heaven Hills, though information about the types and quantities applied is difficult to obtain. The irrigation water applied can serve as a transport mechanism by which fertilizers and pesticides are carried to the ground-water system and local streams (Garrigues 1996).

A study conducted by the Washington Department of Ecology (WDOE) investigated concentrations of nitrites and nitrates as well as other water quality parameters in various sampling sites throughout Glade Creek watershed in May and September 1995 (Garrigues 1996). Previous WDOE monitoring had found unusually high concentrations

of nitrite+nitrate as nitrogen in Glade Creek water samples (Davis 1993), indicating that agricultural practices in the watershed may be significantly affecting surface water quality. The 1995 study found widespread nitrate contamination in the two uppermost aquifers of Glade Creek watershed, in Glade Creek itself and its tributaries. Nitrate concentrations ranged from less than 1 milligram per liter (mg/L) to as much as 70 mg/L, seven times the maximum contaminant level for drinking water. Results of the study indicate a strong correlation between crop irrigation and the presence of nitrate in the underlying Alluvial and Saddle Mountain Basalt aquifers. In areas where little irrigation occurs, nitrate concentrations in the shallow aquifers is low, while concentrations are high in areas with intensive crop irrigation. Nitrate concentrations were found to dramatically increase with distance traveled down stream (Garrigues 1996). High nitrate concentrations in groundwater on the east side of the watershed indicate that groundwater discharge to the stream is also the most likely source of nitrate contamination in Glade Creek (Garrigues 1996).

Steelhead distribution: *O. mykiss* fry have been observed up to RM 5.5 in Glade Creek, though no spawning activity or redds have been visible (Figure ApI-7).

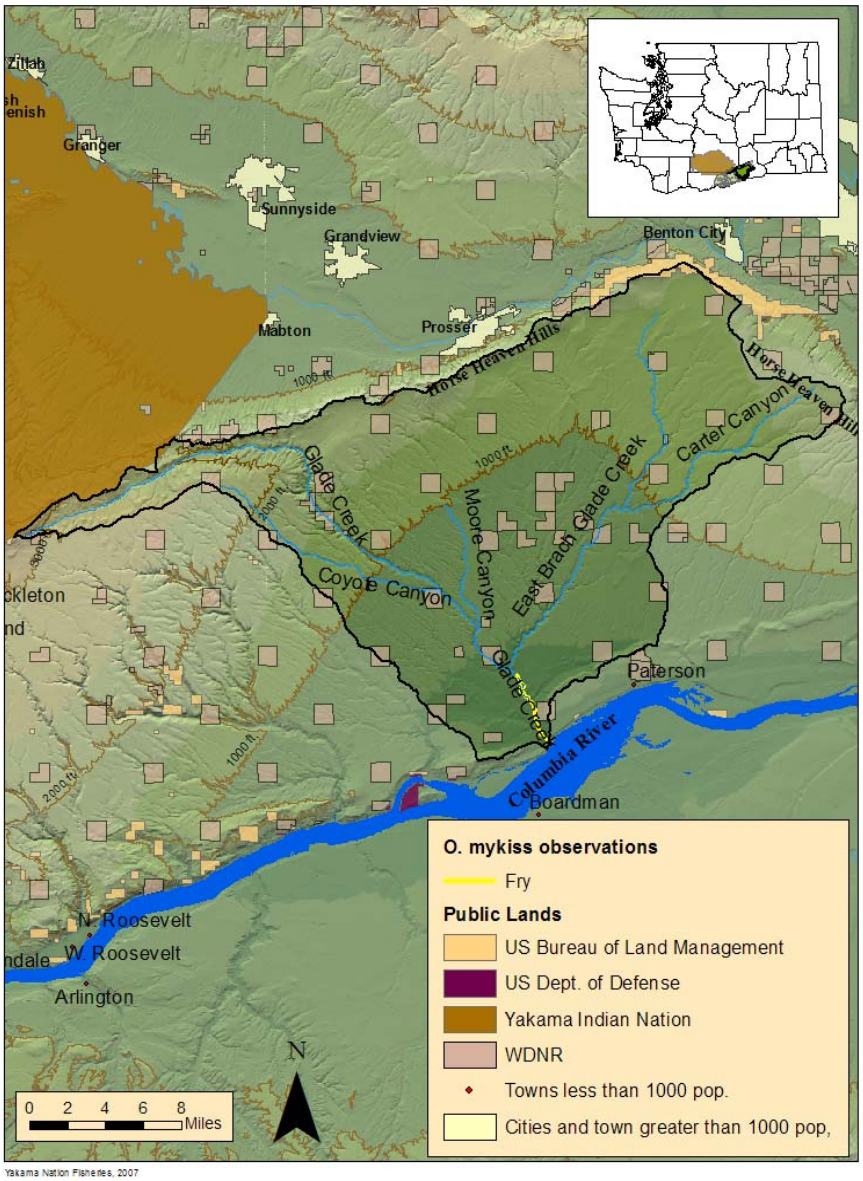


Figure ApI-7. Glade Creek subbasin major streams and steelhead distribution (YN Fisheries 2007)

Fourmile Canyon

No information is available for Fourmile Canyon.

Washington Spawning Areas for the Willow Creek Population

Washington spawning areas that provide habitat for the Willow Creek population of Middle Columbia River steelhead are discussed below. The sections briefly discuss watershed conditions and steelhead in the areas. They also list limiting factors and identify recovery actions and associated costs to address them.

Chapman Creek

The Chapman Creek watershed encompasses 24.15 sq. miles (15,453.5 acres). The headwaters and other stream sections are dry for parts of the year, except for occasional springs and seeps. Flows become subterranean between RM 5 and 7 (WSCC 2005).

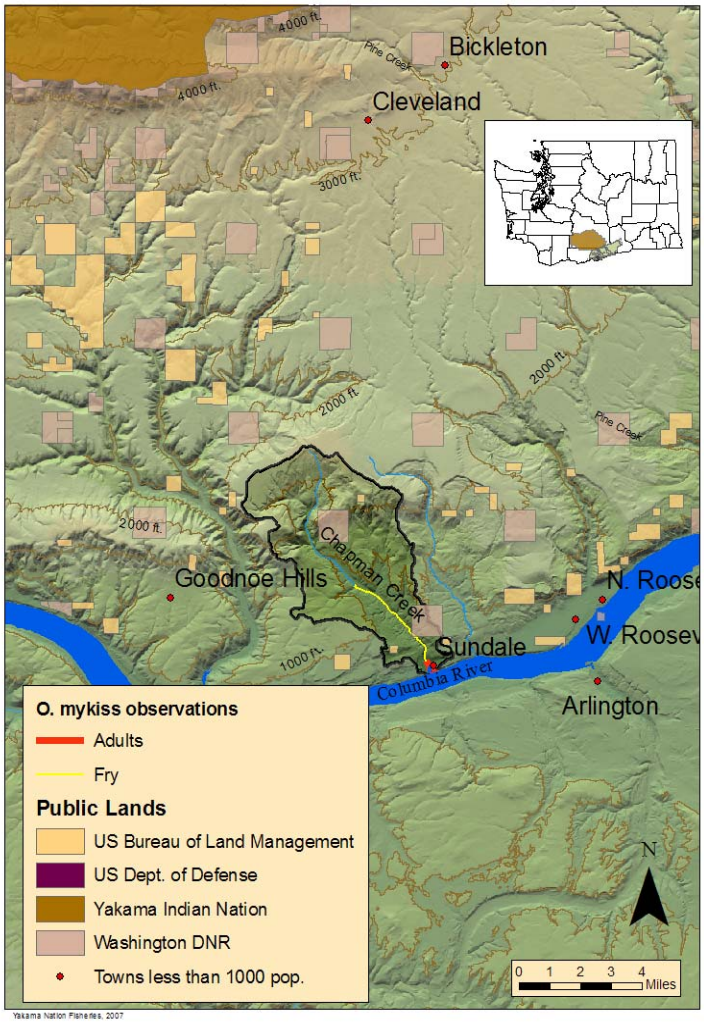


Figure ApI-8 Chapman Creek major streams and steelhead distribution (YN Fisheries 2007)

Steelhead distribution: No redds have been observed, but steelhead adults and *O. mykiss* juveniles have been observed in lower Chapman Creek (C. Dugger, WDFW, pers.

comm.) up to RM 4.5 (G. Morris, YN, pers. comm.). *O. mykiss* fry have been observed in springs from the mouth to RM 5, which is generally well-vegetated. If these are steelhead juveniles, it is uncertain whether they are from the Rock Creek stock, or are strays from other mid- or upper-Columbia stocks.

There is a possible fish passage barrier at the SR 14 crossing. The degree to which these and any other man-made structures impede fish passage in Chapman Creek is a data need.

Wood Gulch Creek

There is little data regarding habitat conditions in Wood Gulch Creek. The subbasin encompasses an area of 64.39 sq. miles (41,207.9 acres). The creek runs through a steep, arid canyon, with elevation gains between 500-800 feet from the stream channel to the top of the canyon. Human population is sparse in the subbasin, except for a few buildings. Extensive grazing is evident in the valley bottom and on the slopes of the canyon. There is intermittent fencing separating the riparian and upslope areas. Few roads traverse the basin, and most existing jeep trails are located at a distance from the stream, except a few which reach the valley bottom. The lower half mile of the stream crosses the town of Sundale (WPN 2004). The stream channel in the lower 5 miles possibly runs dry for portions of the year, likely going subsurface except for a few pools (WSCC 2005). Based on GLO Land Survey notes from June 1867, Wood Gulch Creek was dry at the mouth and intermittent from there to the confluence of Big Horn Canyon, upstream of which perennial water seemed to return and extend to four miles upstream of the confluence with Big Horn Canyon, as well as 2-3 miles upstream into Big Horn Canyon (WPN 2004).

Wood Gulch Creek is highly degraded from extensive land management activities ranching, farming and livestock grazing. Farming and ranching have severely deterred new riparian coverage throughout the watershed along with managing land up to and including the stream banks. Low flow to sub-surface flow conditions exist throughout the summer month's severely limiting rearing habitat in portions of the watershed.

Steelhead distribution: Steelhead have been observed spawning and rearing in the 0.1 mi. slackwater section upstream from the mouth of Wood Gulch Creek, and spawning has been observed in Big Horn Canyon. *O.* mykiss have been observed to approximately RM 4-5 (C. Dugger, WDFW, pers. comm.). Anecdotal evidence suggests that locals from the town of Cleveland fish for *O. mykiss* (G. Morris, YN, pers. comm.).

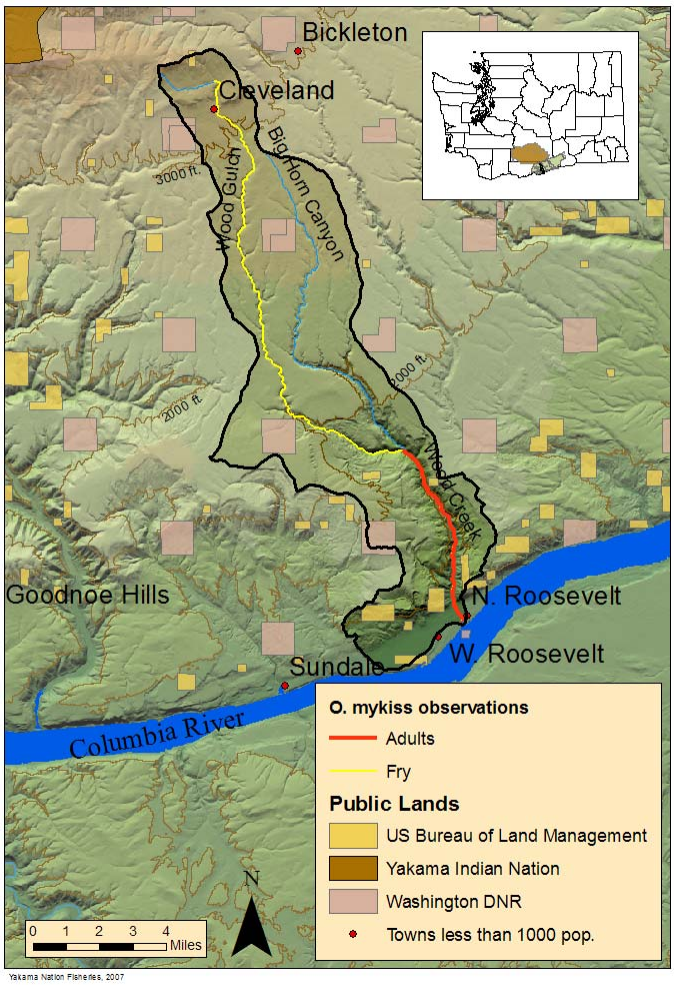


Figure ApI-9. Wood Gulch Creek subbasin major streams and steelhead distribution (YN Fisheries 2007)

Pine Creek

Pine Creek is a small, volatile stream with a basin area of approximately 62.64 sq. miles (40,086.8 acres). Pine Creek feeds Lake Umatilla on the Columbia River upstream of John Day Dam in WRIA 31. For much of its downstream reach, Pine Creek exists as a subsurface channel flowing under an alluvial deposition zone from June through November. At its confluence with the Columbia River, Pine Creek expands into a small riparian pool from which a system of five culverts passes flow under State Route (SR) 14 and the Burlington Northern Santa Fe (BNSF) railroad to Lake Umatilla. Average subbasin elevation is 1904 feet; average annual precipitation is 10.8 inches.

Pine Creek, while lacking in data, is hydrologically similar to Rock Creek. It is expected that Pine Creek's hydrograph would display the steep rising limb and high ratio of peak

to average flows, the result of rapid stream flow response during storm events due to infiltration-limited terrain (Harbor Consulting Engineers 2007).

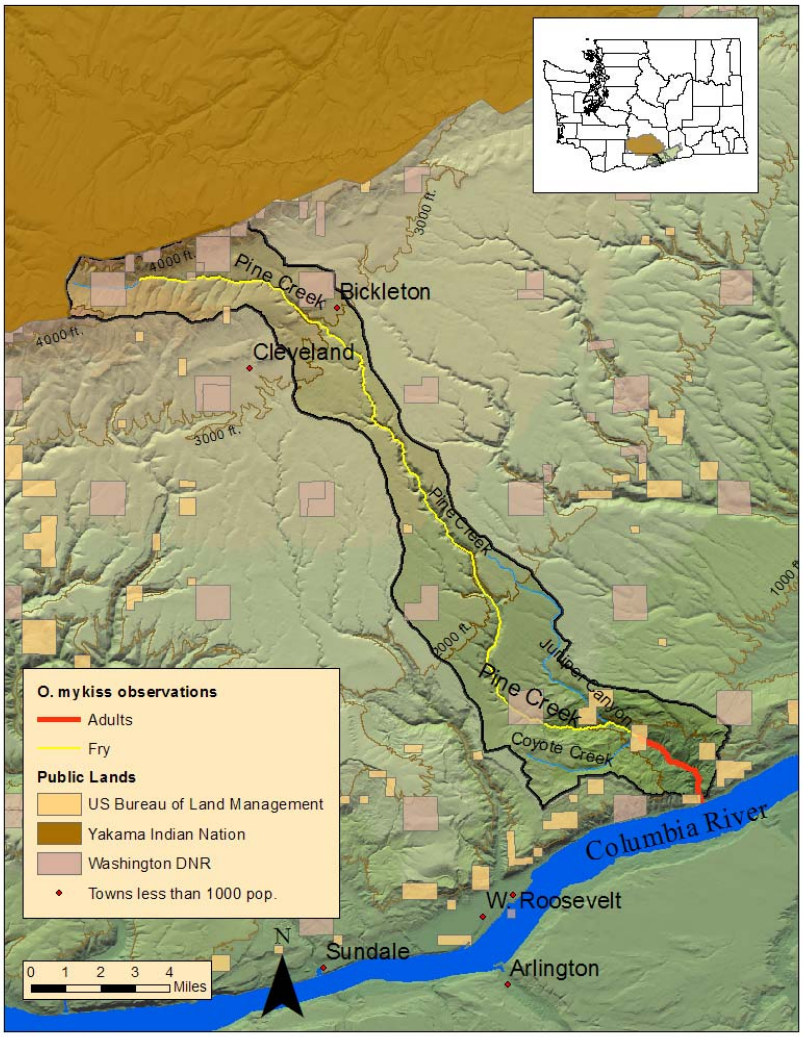
During dry summer months, surface water flows in Pine Creek, like Rock Creek, typically recede and become intermittent, going subsurface for extended reaches, where there are periods of zero flow between water years. Average annual flow in Pine Creek during the period of record for the USGS Gauge 14036600 Rock Creek near Roosevelt (1963-1968) was 11.5 cfs, with the average winter (November-April) flow being 23.5 cfs.

Table ApI-1. Miscellaneous Stream Flow Data for Pine Creek near Mouth (Yakama Nation 2007).

Frequency/Type	Flow (cfs)	Date	Source
50-year	2960	1960±	USACE Design Memorandum No. 1
60-day low	0.193	8/2/2001	WDFW – SSHEAR Report
Spot Measurement	29.4	3/4/1982	USGS (1989)
Spot Measurement	18.7	4/19/1982	USGS (1989)
Spot Measurement	1.94	5/24/1982	USGS (1989)

A system of five culverts at the SR 14 highway crossing of Pine Creek (milepost 140.8) was included in the WSDOT Fish Passage Barrier Inventory as of March 2006. The intended entrance is fully submerged at approximately 30 feet depth in Lake Umatilla. The upstream invert of the pipes is several feet above the pool water surface much of the year. A large volume of sediment and debris has filled in the previous creek channel nearly 15 feet, and obstructs the entrance to the submerged culvert. Only a small opening clogged with woody debris passes flow from the stream through the road fill. The constricted culvert entrance has created a barrier to fish passage due to physical obstructions and high water velocities (Harbor Consulting Engineers 2007). The culvert was attributed with 0% fish passage by WSDOT (2006). WSDOT has given this project a 34.25 (high) on its Prioritization Index, a calculation based on species-specific production potential of the gained habitat, amount of habitat gained, benefits or drawbacks from increased mobility to species present, stock status of species present (WDFW Salmonid Stock Inventory, SaSI), and cost of the project. The barrier culverts are slated for replacement in 2012, with an estimated potential gain of 490,830 m² of rearing area (WSDOT 2006).

No impassable natural barriers are confirmed, but various flow barriers exist. There are reports of tribal dipnetters fishing at a tributary confluence with Juniper Canyon in the past (Sam Jim, Yakama Tribal Council, pers. comm. with Greg Morris).



Yakama Nation Fisheries, 2007

Figure ApI-9. Pine Creek subbasin major streams and steelhead distribution (YN Fisheries 2007)

Steelhead distribution: YN biologists have seen live steelhead and redds in Pine Creek up to RM 3.5, and O. mykiss fry up to the headwaters (G. Morris, YN, pers. comm.).

Old Lady Creek

No information is available for Old Lady Creek.

References

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Appendix II. Current Efforts—Limiting Factors and Threats

Many positive steps have already been taken or are currently underway that will improve steelhead habitat and overall watershed function in the Rock Creek drainage, and thus improve the viability of Rock Creek steelhead. The breadth of these efforts illustrates how natural resource managers, local governments, tribes, soil and water conservation districts, non-profit organizations, local land owners and many others are working together to improve watershed conditions that will support a viable Rock Creek steelhead population throughout its freshwater life stage. This section describes many of these efforts.

Conservation Efforts

- The Eastern Klickitat Conservation District (EKCD), under a 1996 Memorandum of Agreement with the Washington Department of Ecology, implemented actions to contribute to the protection of water quality, speed riparian recovery, and potentially prevent future flood-related damage in the Rock Creek drainage. In accordance with the MOA, the EKCD monitors water temperatures other water quality parameters (e.g., dissolved oxygen, pH, nitrates). This MOA, however, lapsed in 2004 and has not been renewed, but the EKCD continues to implement its provisions. The EKCD monitors water temperatures other water quality parameters (e.g., dissolved oxygen, pH, nitrates) as well as plant vegetation throughout the watershed. Under a grant from the Washington Conservation Commission (WCC), the EKCD "cost-shares" with landowners for grassland/permanent cover plantings and for no-till seeding throughout the Rock Creek drainage. Under a different grant from the WCC, the EKCD is working with livestock growers throughout the basin to develop and implement BMPs (Best Management Practices) which target restoration and protection of riparian areas (pers. comm. Jim Hill, EKCD District Manager 2006).

- County governments, state and local agencies and other stakeholders/water resource interests are developing a watershed plan under chapter 90.82 RCW for the Rock Creek Basin and elsewhere in Water Resource Inventory Area 31 (WRIA 31). WRIA 31 encompasses the Rock Creek subbasin and other Columbia River tributary systems between the John Day Dam and Kennewick in Washington State. A Watershed Assessment in support of the planning process has been completed (http://klickitatcounty.org/Planning/). The watershed management plan is scheduled to be completed in early to mid-2007, and, upon approval, will guide water resources management. Upon approval of the Rock Creek Watershed (RCW) Plan, Chapter 90.82 RCW provides for plan implementation in the amounts of $100,000 for each of the first three years and $50,000 for two additional optional years.

- Washington's water quality and other water resource related funding programs administered by Washington Department of Ecology take local priorities and consistency with WRIA watershed plans into consideration when determining whether to fund proposed projects through grants and/or low interest loans. The WRIA 31 watershed planning unit serves as the body that develops the local statement of agreed priority for projects proposed within Rock Creek and other areas of WRIA 31.

- The U.S. Department of Agriculture's (USDA) Natural Resources Conservation Service (NRCS) works with landowners to conserve natural resources on private lands. The NRCS accomplishes this through various programs including, but not limited to, the Conservation Technical Assistance Program, Soil Survey Program, Conservation Reserve Enhancement Program, and the Wetlands Reserve Program. The NRCS works closely with local Conservation Districts; providing technical assistance and support.

- The Nature Conservancy has acquired land and conservations easements within the watershed. The Conservancy is working with Federal, state and private adjoining landowners to protect native habitats and significant plant and animal species, and to restore sites as functional ecosystems within the watershed.

- The Yakama Nation has provided basic monitoring and recently received a small grant to perform fencing and riparian plantings in lower Rock Creek. These actions will begin to address at a small scale the following limiting factors: loss of riparian vegetation, altered food web, altered channel morphology. A small grant was recently awarded the YN to conduct water quality/quantity measures, habitat surveys, and Ecosystem Diagnosis and Treatment (EDT) modeling in Rock Creek. Complementing this effort, the YN has proposed assessing Rock Creek's current and potential steelhead production by assessing the juvenile salmonid abundance, growth, life histories, and genetics. Data collected through assessment activities to determine steelhead distribution, diversity, relative abundance, and movement within or out of the watershed will help feed modeling efforts, which in turn will help prioritize restoration activities.

Regulatory Protection

Various state, tribal and county regulatory mechanisms are in place to protect riparian areas from current and future threats posed to listed species through habitat loss and degradation caused by human land uses and development. These mechanisms include Washington State forest and fish regulations, state and county shoreline development regulations and the Yakama Nation Forest Management Plan (citation?). In addition, some areas receive special protection through designation, such as Wild and Scenic River reaches, primitive areas, and wildlife refuges.

Forest and Fish Regulations (Washington State)

The Washington Forests & Fish Law (ESHB 2091) was signed into law in 1999 as part of The Washington State Forest Practices Act (Title 76.09 RCW), passed in 1974. The Forests & Fish Law, based on the Forests & Fish Report, resulted in changes to forest practices rules to protect riparian and aquatic resources on more than eight million acres of private forestland. It is intended to meet the provisions of the Federal Clean Water Act concerning nonpoint source silvicultural practices. Changes to the law included:

- Updates of the stream typing system in the state to improve mapping of fish-bearing waters,
- Increases in buffer widths along fish bearing and non fish bearing streams,
- Changes in forest practices to protect against landslides
- Mandatory requirements to update the forest road system to hydrologically disconnect roads from streams and minimize sediment delivered to streams,
- New regulations on pesticide applications to prevent or avoid drift of chemicals into streams,
- Increased protection of wetlands
- Changes in enforcement,
- Establishment of a scientifically based adaptive management and monitoring process for evaluating the impact of forest practices on aquatic resources,
- Establishment of a process for amending the forest practices rules to incorporate new information as it becomes available, and
- Establishment of a small landowner office to assist non-industrial landowners.

Additional information regarding the Forest Practices rules can be found at: http://www.dnr.wa.gov/forestpractices.

The Washington Department of Natural Resources, on behalf of the State of Washington, submitted applications to NMFS and the U.S. Fish and Wildlife Service for incidental take permits under section 10 of the Endangered Species Act. Issuance of these permits would provide assurances that all forest practices activities in compliance with the state forest practices rules and administrative program will satisfy ESA requirements for aquatic species. The two services released the final HCP, environmental impact statement (FEIS), and implementing agreement in a *Federal Register* notice on Jan. 27, 2006. This notice provides an opportunity for the public to review the final documents and the responses to public comments on the draft documents.

Timber, Fish and Wildlife (Washington State)

In 1975, the Washington Department of Natural Resources (WDNR) developed the process of classifying streams into one of five types, depending on their physical, biological, and human-use characteristics as part of the Forest Practices Rule (WAC 222-16-031). The Forest Practices Rules give directions on how to implement the Forest Practices Act (Title 76.09 RCW) to regulate forest practices that impact Washington's

surface waters. As of spring 2005, WDNR has changed the Types 1-5 designations to S-F-N water types on the westside of the state; the change will take effect in water typing maps as of March 2006 on the eastside.

Western and Eastern Washington
Type "S" – Shorelines
Type "F" – Fish
Type "Np" – Non-Fish Perennial
Type "Ns" – Non-Fish Seasonal
Letter "U" – Unknown

Accurate water typing is essential to protecting fish and their habitats because the type and proximity of human activities allowable in areas adjacent to streams and other surface waters is dictated by water type. For example, riparian buffer zones required on fish-bearing streams are greater than those required on non-fish-bearing streams.

Since 1997 WDNR has maintained a system for correcting water type designations in forestlands, but there is no comparable system to ensure timely updates in non-forestry areas subject to Growth Management Act (GMA) planning and regulations. Likewise, county and local planning and conservation ordinances rely on DNR water-type maps, often without adequate mechanisms for checking or correcting the data presented in the maps. Local jurisdictions are relying on inaccurate water-typing maps to regulate land and water use, and many streams and the fish they support are facing threats from development and associated practices because they are not receiving adequate protection.

The Forest Practices Rules prescribe how forest practices such as logging, road building, and applying chemicals are to be conducted in ways that protect public resources. When operators or landowners do not follow the rules, the WDNR issues enforcement orders and may also issue a civil (monetary) penalty. A civil penalty is most often issued when the violation caused significant environmental damage, when an operator or landowner does not comply with the department's enforcement orders, or when the operator or landowner has a history of repeated violations. All civil penalties become final orders of the department unless appealed. Although violators are notified and/or fined, the infractions are usually addressed after they have already been committed, and the fines are often relatively insignificant compared to the value of the timber harvested.

Klickitat County Shorelines Master Plan

The Klickitat County's Shorelines Master Plan (SMP) regulates "development" within the "shorelines" of Rock Creek and other water bodies in Klickitat County's jurisdiction. "Development" is broadly defined as: construction or exterior alteration of existing structures; dredging; drilling; dumping; filling; removal of any sand, gravel or minerals; bulkheading; driving of piling; placing of obstructions; or any project of a permanent or temporary nature which interferes with the normal public use of the surface of the waters overlying lands subject to the SMP regulations at any state of water level. "Shorelines"

are those lands extending landward for 200 feet in all directions as measured from the ordinary high water mark, floodways and contiguous floodplain areas landward 200 feet from such floodways, and all wetlands and river deltas associated with the streams and lakes. The SMP applies to the shorelines of the main stem of the Klickitat River as well as the shorelines of all tributaries with a mean annual flow of 20 cfs or more.

The SMP designates various shorelines as "environments", which determine the level of protection that is warranted. Rock Creek is designated "Conservancy Environment", which allows a limited scope of development, subject to conditions (i.e. shoreline conditional use permit).

Each development proposal is subject to review pursuant to the shoreline environment within which it is to be located. One or more shoreline permits must be secured prior to implementation: Substantial Development Permits (SDPs) are required for any development for which the total cost or fair market value exceeds $5,000, or any development which materially interferes with the normal public use of the water or shorelines; Shoreline Conditional Use Permits (CUPs) are required for development types that warrant conditions to ensure consistency with the SMP; and Variances (VARs) are issued to grant relief from specific bulk, dimensional, or performance standards of the SMP in order to avoid unnecessary hardship, provided that extraordinary circumstances are shown to exist and the public interest shall suffer no substantial detrimental effect. Some types of development, such as a single-family residence, normal maintenance and repair, or construction of a normal protective bulkhead for a single family residence, are exempt from the requirement of a substantial development permit, but are still subject to all other provisions of the SMP.

Klickitat County's SMP was first adopted in the mid-1970s pursuant to the Washington State Shoreline Management Act of 1971, and has been updated periodically since then. Existing structures and developments that were established prior to adoption of the SMP are considered legally established "nonconforming" uses. Since adoption of the SMP, all developments within shorelines, including modifications to nonconforming uses, have been reviewed by the County and Washington Department of Ecology (Ecology) to ensure compliance with the goals and requirements of the SMP.

The Department of Ecology reviews County permit decisions and has final authority to approve or deny conditional use permits and variances. Persons may appeal the final decision to the Shorelines Hearings Board.

Klickitat County Critical Areas Ordinance

Klickitat County adopted a Critical Areas Ordinance (CAO) in 2001 and, with the concurrence of Washington Departments of Fish and Wildlife, Community Trade and Economic Development, and Ecology, amended it in 2004. The CAO extends beyond the geographical scope of the County's SMP to protect wetlands, critical fish/wildlife habitat, geologically hazardous areas, aquifer recharge areas, and frequently flooded areas. The CAO is, in effect, an overlay on existing land use regulations. The CAO

provides for standard setbacks of 300' from Category I wetlands; 200' from Category II; and 75' from Category III and IV. The CAO provides for standard buffers of 200' from Type 1 & 2 waters; 150' from Type 3 waters; 50' from Type 4 waters; and 25' from Type 5 waters. A wildlife habitat management plan is required for new development that will likely impair habitat functions and values. As with the SMP, developments and uses that existed prior to the adoption of the CAO are considered legally established "nonconforming" uses.

Klickitat County Floodplain Management Ordinance

The Klickitat County Floodplain Management Ordinance (FPO) regulates all development and activities that may increase flood hazards. A permit is required for development within areas of special flood hazard (with at least 1 percent chance of flooding). The applicant for a non-residential structure must include a certification and flood analysis conducted by a professional engineer. In general, development that will does not meet the specific criteria in the ordinance for development in these areas, to protect public health and safety, will be denied.

Klickitat County Zoning Ordinance

The Klickitat County Zoning Ordinance (CZO) was adopted in 1979 and has been amended over time. Much of the Rock Creek watershed is zoned by the CZO as "extensive agriculture" which requires a 20-acre minimum lot size for the purpose of dividing properties, and new development/uses are restricted to resource management uses/activities and other compatible uses. One permanent residential dwelling is allowed per lot. Some areas of the watershed are zoned for residential development. The allowable minimum lot size for new lots is either 1 or 2 acres; and one residential dwelling is allowed per lot. Other than residential development, most new development/uses in these zones is either prohibited or allowed per a zoning conditional use permit.

Klickitat County Environmental Ordinance (CEO)

The Klickitat County Environmental Ordinance (CEO) was adopted pursuant to the State Environmental Policy Act (SEPA). The CEO and SEPA require an analysis of probable significant adverse environmental impacts that may result from a proposed development. The CEO and SEPA require a threshold determination for each proposed development that is not exempt. The threshold determination is a determination that a project will or will not have probable significant adverse environmental impacts. If a project has probable significant adverse impacts, and environmental impact statement (EIS) is prepared. Any proposed development/use that is not specifically exempt in SEPA, chapter 43.21C RCW, or the SEPA rules adopted by the Department of Ecology, chapter 197-11 WAC, is required to comply with SEPA. Klickitat County provides applicable state agencies and tribes, as well as the public, the opportunity to review threshold determinations and EISs.

Washington State Water Pollution Control Act (Chapter 90.48 RCW)

This act gives Ecology the authority to protect water quality in the state and to promulgate regulations as needed to achieve this goal. The Act makes discharges of pollutants into waters of the state unlawful and has provisions for enforcement of violations, including the authority and process for issuing compliance orders and civil penalties, and for seeking criminal penalties. The Act also provides for permitting processes, cooperation with other entities, water quality monitoring, grants, and numerous other subjects regarding management of water quality issues in the state.

Washington's Statewide Monitoring Program

In 2001, Substitute Senate Bill (SSB) 5637 was signed into law. This act related to monitoring of watershed health and salmon recovery. The Monitoring Oversight Committee developed a comprehensive statewide strategy that addresses the actions identified in SSB 5637 (Monitoring Oversight Committee 2002). Among other things, the Plan is intended to provide information regarding trends in fish, water, and habitat conditions and assess effectiveness of actions taken to improve watershed health and provide for salmon recovery. The strategy includes documentation of fish population trends in some areas of the state; however, the Rock Creek Subbasin is not one of the areas included to date in that monitoring effort. The strategy is also monitoring the effectiveness of habitat restoration efforts funded by the State. The monitoring of project effectiveness follows the Monitoring and Evaluation Strategy (Washington Salmon Recovery Funding Board 2003) that was developed in support of the Comprehensive Statewide Strategy. The Monitoring and Evaluation Strategy specified methods to assess a wide range of restoration and protection projects.

On-Site Sewage Systems

Chapter 246-272 of the Washington Administrative Code (WAC) regulates the on site disposal of sewage in the state. The law is applicable to septic systems as well as larger on-site systems. The rule addresses location of systems, site evaluations, design, installation, inspection, operation and maintenance, repair, abandonment, and other areas of concern. The rule helps to prevent the discharge of sewage into fish-bearing streams.

Hydraulic Code

Chapter 75.20 RCW governs construction projects within the waters of the state. The law requires hydraulic project approvals from the Department of Fish and Wildlife for wharves, bulkheads, bridges, culverts, fish habitat restoration projects, and other construction activities within the ordinary high water mark. This regulation helps to protect fish and fish habitat during construction.

Regulation of Dairy Farms

Chapter 90.64 RCW, the Dairy Nutrient Management Act, includes a number of requirements designed to protect water quality from dairy operations. These are in addition to NPDES requirements in the Federal and State Clear Water Acts for concentrated animal feeding operations. The Act requires inspection of all dairy farms,

implementation of dairy nutrient management plans, technical assistance and enforcement (including civil penalties) against significant polluters. The intent of the regulation is to protect water quality and, subsequently, fish habitat. Ecology is the primary regulatory authority under this Act.

Other Rules and Regulations

There are over 100 additional rules and regulations applicable to the protection of water quality and fish habitat in the State of Washington. These rules cover a broad range of subjects such as groundwater quality standards, application of pesticides, well construction, motor oil disposal, utilities, solid waste disposal and recycling, water supply facilities, mining, energy facilities, dikes and levies, aquiculture, etcetera. Lists of applicable laws and rules and links to the specific requirements of those laws and rules can be found at www.ecy.wa.gov/laws-rules.

Voluntary Programs

A number of voluntary programs have been developed to encourage landowners to implement conservation programs on their lands and to assist landowners with habitat improvement actions. Some of these programs are described below. The list includes only the larger programs. Other programs exist and new programs may be developed in the future that can be used to assist with conservation actions on private lands.

Lead Entity Process

In 1998 the Washington State Legislature enacted chapter 77.85 RCW to empower citizens at the community level to engage in salmon recovery through a locally driven habitat protection and restoration program. The legislation recognized that active local participation is the key to ensuring public participation in, and support for, salmon recovery. Through this legislation, local "Lead Entities" were identified and funded to implement chapter 77.85 RCW. Lead Entities prioritize projects for PCSRF funding administered by Washington State's Salmon Recovery Funding Board. A lead entity has not been established for the Rock Creek subbasin, therefore PCSRF funds are not accessible at this time for habitat protection or restoration projects in the subbasin.

Conservation Reserve Enhancement Program (CREP)

The Conservation Reserve Enhancement Program is a voluntary program designed to establish forested buffers along streams where riparian habitat is poorly developed. Land enrolled in CREP is removed from production and grazing under 10 to 15-year contracts. In return, landowners receive annual rental, incentive, maintenance and cost share payments. The CREP program is administered by the Farm Service Agency and the State of Washington.

Conservation Reserve Program (CRP)

The Conservation Reserve Program provides technical and financial assistance to eligible farmers and ranchers to address soil, water, and related natural resource concerns on their lands. The program encourages farmers to convert highly erodible cropland or other environmentally sensitive acreage to vegetative cover such as native grasses, wildlife

plantings, trees, filter strips, or riparian buffers. Farmers receive an annual rental payment for the term of a multi-year contract. The program is funded by the Farm Service Agency with technical assistance from the National Resource Conservation Service (NRCS).

Continuous Conservation Reserve Program (CCRP)

The Continuous Conservation Reserve Program is a voluntary program that protects soil, improves air and water quality, and enhances fish and wildlife habitat through the use of buffers, filter strips, and wind breaks. Contract periods range from 10 to 15 years. Cost shares and yearly payments are provided as incentives for participation in the program. The program is run by the Farm Services Agency.

The Grassland Reserve Program (GRP)

The Grassland Reserve Program is a voluntary program that helps landowners and operators restore and protect grassland, including rangeland, pastureland, shrubland, and certain other lands, while maintaining the areas as grazing lands. The program includes options for permanent or 30-year easements. Landowners receive payment for the easements. The Natural Resources Conservation Service (NRCS) administers the program in cooperation with the Forest Service.

Environmental Quality Incentives Program (EQIP)

The Environmental Quality Incentives Program was re-authorized by the 2002 Farm Bill to promote agricultural production and environmental quality as compatible national goals. The program is administered by NRCS. Management incentive payments and cost share benefits are available to support implementation of practices directly affecting the health of soils, water, animals, plants, and air.

The Conservation Security Program (CSP)

The Conservation Security Program is a voluntary program that provides financial and technical assistance to producers who practice good stewardship on their agricultural lands and incentive to those that want to improve or expand their conservation measures. Lands that can be placed into the program include cropland, pastureland, prairie, rangeland, and incidental forested land. The contract period and cost-share payments are based on a three-tier approach, with increasing compensation associated with increased natural resource protection. The program is run by the NRCS.

Wildlife Habitat Incentive Program (WHIP)

The Wildlife Habitat Incentive Program is a voluntary program that encourages creation of high quality wildlife habitats that support populations of National, State, tribal, and local significance. Through WHIP, the NRCS provides technical and financial assistance to landowners to develop upland, wetland, riparian, and aquatic habitat areas on their properties. Participants voluntarily limit future use of the land for a period of time, but retain private ownership. Agreements are usually five to ten years in duration.

The Healthy Forest Reserve Program (HFRP)

The Healthy Forest Reserve Program is a voluntary program established for the purpose of restoring and enhancing forest ecosystems to promote the recovery of threatened and endangered species, improve biodiversity, and enhance carbon sequestrations. The program offers three enrollment options including a 10-year agreement, a 30-year easement, and a longer term easement. The compensation to landowners increases with the term of the easement agreement. The program is administered by the U.S. Department of Agriculture and through the Conservation District.

Wetlands Reserve Program (WRP)

The Wetlands Reserve Program is a voluntary program that provides technical and financial assistance to landowners to address wetland, wildlife habitat, soil, water, and related natural resource concerns on private lands. The landowner receives financial incentives to restore, protect, and enhance wetlands or lands that have been historically modified for agricultural production in exchange for retiring marginal land from agriculture. Easements are either permanent or 30-year agreements. The NRCS administers the program.

Forestry Riparian Easement Program (FREP)

The Forestry Riparian Easement Program was developed to partially compensate eligible small forest landowners in exchange for a 50-year easement on timber that is required to be left under the forest practices rules. The landowner still owns the property and retains full access, but has "leased" the trees and their associated riparian function to the State. WDNR administers this program.

Yakama Nation Forest Management Plan

The Yakama Nation has voluntarily adopted the Yakama Nation Forest Management Plan which is used to guide management of timber harvest and road construction and maintenance on tribal land.

Conservation Designations

Badger Gulch Natural Area Preserve

The Washington Department of Natural Resources (WDNR) established the 180-acre Badger Gulch Natural Area Preserve in 1982 to protect four important native plant communities and three rare plants. The Natural Area Preserve lies within Klickitat County about 6.8 miles north of the Columbia River and 13 miles east of Goldendale on the Goldendale-Bickleton road. The preserve includes a 2-mile long portion of Badger Gulch, a narrow, steep-walled canyon that contains Badger Creek, which empties into Rock Creek near RM 15. The four protected native plant communities (Idaho fescue, houndstongue hawkweed, Oregon white oak-ponderosa pine, bluebunch wheatgrass-Sandberg's bluegrass and white alder riparian) and three rare plant species (porcupine sedge, shining flatsedge, and beaked cryptantha) play an important ecological role in protecting the subbasin's water quality and many vertebrate and invertebrate species (WDNR 1998).

In 1998, Washington Department of Natural Resources' Southeast Region developed the "Badger Gulch Natural Area Preserve Management Plan." The purpose of the management plan is "to permit natural ecological and physical processes to predominate, while controlling activities that directly or indirectly modify these processes" on the preserve. The WDNR 1998 'Plan' defines all aspects of management for the site from public use to monitoring and research activities (WDNR 1998).

Klickitat Oaks Preserve

Adjoining the Badger Gulch Natural Area Preserve is The Nature Conservancy (TNC) of Washington's Klickitat Oaks Preserve. The current TNC Klickitat Oaks Preserve 414-acre site conserves/preserves native habitats and significant plant and animal species as a functional ecosystem within the upper Rock Creek watershed. This area has been a major conservation site for the TNC since the ecological significance of the area was identified in the 1980s. The Conservancy is currently negotiating the purchase of an additional 120-acre plot and, with another private landowner, a 1,500-acre limited development conservation easement. Working with Federal, state and private adjoining landowners, the TNC's purpose is to protect all of the native habitats and significant plant and animal species of the site as a functional ecosystem within the upper Rock Creek watershed.

The Nature Conservancy has developed an initial preserve design and an in-depth Site Conservation Plan for the area. The Nature Conservancy's conservation plan is a cooperative management strategy for the upper Rock Creek watershed involving the U.S. Bureau of Land Management, WDNR, and resident private landowners. The Nature Conservancy has made a long-term commitment to the site and is currently involved in restoration and management work on the ground, including exotic species control, plant and animal inventory and assessment, and long-term restoration planning.