State of Washington
DEPARTMENT OF FISH AND WILDLIFE
Mailing Address: P.O. Box 43200, Olympia, WA 98504-3200 • (360) 902-2200 • TDD (360) 902-2207
Main Office Location: Natural Resources Building, 1111 Washington Street SE, Olympia, WA

May 16, 2018

TO: Riparian Stakeholders and All Interested Members of the Public

FROM: Terra Rentz, Ecosystem Services Division Manager

SUBJECT: *Riparian Ecosystems, Volume 2: Management Recommendations*

We are pleased to provide our draft Priority Habitats and Species (PHS) guidance on riparian ecosystems in Washington and ask for your review and **comments by July 17, 2018**. We are taking comments at https://wdfw.wa.gov/conservation/phs/mgmt_recommendations/comments.html.

Specifically, we are seeking comments on the attached *Riparian Ecosystems, Volume 2: Management Recommendations*. This volume is an implementation manual for how to protect functions and values of riparian ecosystems and surrounding watersheds. Its recommendations represent our best professional judgement as to how local governments and other stakeholders can use best available science in policies, plans and regulations designed to conserve riparian ecosystems for the protection of fish and wildlife species, and in particular salmon species.

The science this document is based upon is in *Riparian Ecosystems, Volume 1: Science Synthesis and Management Implications,* available at https://wdfw.wa.gov/publications/01987/. We are not seeking your review of volume 1. Volume 1 has been reviewed, edited and re-reviewed by the Washington State Academy of Science (WSAS). This review process produced a document that met WSAS standards for a synthesis of current science across the range of topics we covered. We provide Volume 1 here for reviewers of Volume 2 who want to better understand the scientific underpinnings of our recommendations.

Together, Volume 1 and Volume 2 update and expand information provided in our 1997 PHS Riparian Management Recommendations. We look forward to receiving your comments by July 17, 2018 at the website above. Thank you for your assistance making this a useful document.

Attachment: *Riparian Ecosystems, Volume 2: Management Recommendations*

RIPARIAN ECOSYSTEMS, VOLUME 2: MANAGEMENT RECOMMENDATIONS

A PRIORITY HABITATS AND SPECIES DOCUMENT OF THE WASHINGTON DEPARTMENT OF FISH AND WILDLIFE

Public Review Draft

May 2018

This document should be cited as follows:

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We appreciatively acknowledge the participation of our Technical Advisory Group:

Name	**Affiliation**
Nichole Embertson, PhD	Whatcom Conservation District
Martin Fox, PhD	Muckleshoot Tribe
Aimee Fullerton, PhD	NOAA Fisheries
Marc Hayes, PhD	WA Department of Fish and Wildlife
Tim Hyatt, PhD	Skagit River System Cooperative
Jack Janisch	WA Department of Ecology
Peter Leinenbach	US Environmental Protection Agency
Chris May, PhD	Kitsap County
Michael Pollock, PhD	NOAA Fisheries
Jeremy Sikes	WA Department of Ecology
Carol Smith, PhD	WA State Conservation Commission
Steve Wondzell, PhD	US Forest Service

The scientific rigor of this document was improved through the peer review provided by the Washington State Academy of Sciences, with coordination provided by Dr. Robert Bates.

Draft versions of this document were reviewed by numerous staff in state agencies, including the Department of Ecology, Department of Natural Resources, Department of Commerce, Recreation and Conservation Office, State Conservation Commission, and Puget Sound Partnership. These reviews improved the document and we are appreciative of the helpful input we received from the state family.

We also appreciate the review by federal and tribal entities including EPA, NOAA Fisheries, Northwest Indian Fisheries Commission, Columbia River Inter-Tribal Fish Commission, Upper Columbia United Tribes, and individual tribes.

Finally, we acknowledge and express our appreciation for all local governments and individuals who provided feedback to us during our public comment period.

While we acknowledge and have deep appreciation for all the review and comments provided, WDFW bears sole responsibility for this document and any errors contained in it.

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PREFACE

This Priority Habitats and Species (PHS) document of the Washington Department of Fish and Wildlife (WDFW) is provided in support of the agency's mission to protect fish and wildlife—public resources the agency is charged with managing and perpetuating. WDFW works cooperatively with land use decision makers and landowners to facilitate land use solutions that accommodate local needs *and* needs of fish and wildlife. WDFW's role in land use decision making is that of technical advisor: we provide information about the habitat needs of fish and wildlife and the likely implications of various land use decisions for fish and wildlife.

The five chapters of Volume 2 are a partial update of an earlier document entitled *Management Recommendations for Washington's Priority Habitats: Riparian* (Knutson and Naef, 1997). This document, called *Protecting Riparian Ecosystems, Volume 2: Management Recommendations* is a partial update because it addresses only aquatic species. Riparian needs of terrestrial species will be updated later. Until the terrestrial species update is completed, readers can consult the 1997 document, available at http://wdfw.wa.gov/publications/00029/ for information about riparian ecosystems and terrestrial species.

Priority Habitats are places that warrant special consideration for protection when land use decisions are made. To qualify as a "Priority Habitat" in WDFW's PHS program a habitat must provide unique or significant value to many species. It must meet at least one of the following criteria (WDFW, 2008):

- Comparatively high fish and wildlife density
- Comparatively high fish and wildlife species diversity
- Important fish and wildlife breeding habitat
- Important fish and wildlife seasonal ranges
- Important fish and wildlife movement corridors
- Limited availability
- High vulnerability to habitat alteration
- Unique or dependent species

Riparian areas meet all of these criteria. Because of the many important ecosystem services (hydrologic, geomorphic, and biological) riparian areas provide, they were among the first PHS Priority Habitats identified and described by WDFW.

The PHS program provides land use decision support to clients such as local governments, developers, agencies, tribes, and landowners. PHS consists of PHS List, PHS Maps (available online at http://wdfw.wa.gov/mapping/phs/), PHS Management Recommendations, Technical Assistance (available from our Regional Habitat Biologists), Customer Service, and the newest component PHS Adaptive Management Support.

This PHS riparian document compliments a family of PHS document including *Landscape Planning For Washington's Wildlife: Managing for Biodiversity in Developing Areas* and *Land Use Planning for Salmon, Steelhead and Trout: A land use planner's guide to salmonid habitat protection and recovery* available at http://wdfw.wa.gov/conservation/phs/mgmt_recommendations/)

List of Acronyms

ACS	Aquatic Conservation Strategy
BAS	Best Available Science
BLM	(US) Bureau of Land Management
BFW	Bankfull width
BMP	Best Management Practice
CAO	Critical Areas Ordinance
CMER	Cooperative Monitoring, Evaluation, and Research
CMZ	Channel Migration Zone
DBH	Diameter at breast height
DNR	(Washington) Department of Natural Resources
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
FEMAT	Forest Ecosystem Management Assessment Team
GIS	Geographic Information System
GMA	Growth Management Act
GMHB	Growth Management Hearings Board
HCP	Habitat Conservation Plan
NEPA	National Environmental Policy Act
NFMA	National Forestry Management Act
NOAA	National Oceanographic and Atmospheric Administration
NNL	No Net Loss
NRC	National Research Council
NRCS	Natural Resources Conservation Service
PHS	Priority Habitats and Species
PSMEP	Puget Sound Ecosystem Monitoring Program
RCW	Revised Code of Washington
RMZ	Riparian Management Zone
SMA	Shoreline Management Act
SMP	Shoreline Master Program
SPTH	Site-Potential Tree Height
$SPTH_{200}$	Site-Potential Tree Height (200-year-old tallest dominant trees)

TAG	Technical Advisory Group
TFW	Timber/Fish/Wildlife
USFWS	United States Fish and Wildlife Service
VSP	Voluntary Stewardship Program
WAC	Washington Administrative Code
WDFW	Washington Department of Fish and Wildlife
WSAS	Washington State Academy of Sciences

GLOSSARY

Adaptive management: The systematic acquisition and application of reliable information to improve management over time. It treats management decisions as experiments in order to address critical *uncertainties* and learn more quickly from experience. It involves setting targets, monitoring benchmarks, and adjusting management decisions based on results. The hallmarks of a sound adaptive management program are: 1) adequate funding for research, 2) a willingness to change course when pre-established triggers are reached, and 3) a commitment to gather and evaluate conditions at appropriate spatial extents for necessary time scales. See Ecosystem-based management.

Anthropogenic: Related to human activity.

Aquatic species: Wildlife species that live in freshwater including fish, shellfish (clams, snails, mussels), amphibians (e.g., frogs, salamanders), turtles, crustaceans (e.g., crayfish), insects (e.g., larval mayflies, stoneflies, caddisflies, dragonflies) and various other invertebrates.

Bias (scientific): The phenomenon of gathering information that is not representative of the system as a whole. It can result from study design, conscious decisions (e.g., selecting sites for an experiment that hold some variables constant to study the effects of the variable of interest), or unconscious actions (e.g., assuming a theory is true or false without evidence).

Channel confinement: An indicator of how much a channel can move within its valley determine by the ratio of valley width (distance between toe of hillslopes on both sides of a stream) to active channel width. Typically, a segment is considered confined if the ratio is less than 2 and unconfined if greater than 4.

Channel migration zone: The area within which a river channel is likely to move over a period of time (e.g., 100 years).

Channel reach (stream): A specific portion of a channel that has similar physical features, such as gradient and confinement.

Channel slope or gradient: The average steepness of a stream segment measured as its change in elevation divided by its length. Typically, a segment's gradient is considered low if less than 2%, moderate between 2% and 4%, and high if greater than 4%.

Complexity: The complicated state seen in dynamic environments that contain multiple components and *processes* that interact with one another in a complex web of interactions whose outcomes are often unpredictable. Complexity can be described with conceptual models; outcomes of well-understood complex phenomena can be partially predicted using computer models.

Composition: A term describing the all parts of an ecosystem that include both living (biotic) and nonliving (abiotic) elements. Ecosystem composition is an important consideration in conservation.

Disturbance regime: The frequency, magnitude, and duration of *disturbance* events.

Disturbance: A temporary change in environmental conditions (*composition*, *structure*, and *function*) within an ecosystem.

Dynamic equilibrium: An ecological system's long-term state of relative stability which is brought about through opposing, dynamic forces and continual states of flux. Activities such as urbanization, forestry, windthrow, landslides and forest fire can compromise dynamic equilibrium in riparian–stream systems. Protecting a *watershed's* dynamic behavior (rather than any specific feature) is an overarching goal of ecosystem-based *riparian* management.

Ecological integrity: The *structure*, *composition*, and *function* of an ecosystem operating within the bounds of natural or historical *disturbance regimes*. See Historical condition and Range of natural variability.

Ecosystem composition: All living (biotic) and nonliving parts of an ecosystem.

Ecosystem function(ing): 1) The *process* or the cause-effect-relationship underlying two or more interacting components, e.g., terrestrial plant material as food/substrate for aquatic invertebrates, 2) The sum of *processes* that sustain the system, and 3) the capacity of natural processes and components to provide goods and services that satisfy human needs, either directly or indirectly. Ecosystem functions can be conceived as a subset of ecological processes and ecosystem components and structure (see ecosystem process).

Ecosystem process (or ecological process): Complex interactions between biotic (living organisms) and abiotic (chemical and physical) components of ecosystems through the universal driving forces of matter and energy (see ecosystem functioning).

Ecosystem structure: The arrangement of and relations among the parts or elements (components) of an ecosystem.

Ecosystem: A spatially explicit unit of the Earth that includes all of the organisms, along with all components of the abiotic environment. Ecosystems have *composition*, *structure*, and *functions*.

Ecosystem-based management: Management driven by explicit goals, executed by policies, protocols, and practices, and made adaptable by monitoring and research based on our best understanding of the ecological interactions and *processes* necessary to sustain ecosystem *composition*, *structure*, and *function*. EMB acknowledges that humans are an important ecosystem component and focuses on managing human activities within ecosystems. EMB often involves balancing ecological, economic, and social objectives within the context of existing laws and policies.

Erosion: The loosening and transport of soil particles and other sediment by water. Terrestrial erosion includes raindrop splash erosion, overland flow sheet erosion, surface flow rill (shallow) and gully (deeper) erosion. Channel erosion includes streambank erosion and channel *incision*. Rill and gully erosion in *riparian areas* diminishes its ability to trap sediment and pollutants and often can be avoided with intact *riparian* vegetation.

FEMAT curve: A conceptual model that describes the relationship between various *riparian ecosystem functions* and distance from channel. The model consists of generalized curves that show the cumulative effectiveness of litter fall, root strength, shading, and coarse wood debris to stream as a function of distance from channel (measured in fraction of a *Site-Potential Tree Height*).

Flow regime (stream): The distribution of stream flow through space and time. Flow regimes can be described by their magnitude (e.g., mean annual, hourly maximum), timing, frequency or return periodicity, duration, spatial distribution, and rate of change. The pathways that water takes to reach a stream (e.g., surface runoff) and within a stream exert a strong influence on the flow regime.

Function: Discrete *ecosystem processes* used to define the ecosystem. See Ecosystem Function(ing) and Ecosystem process.

Historical condition: The dynamic state of a place prior to the arrival of non-indigenous peoples. It is the conditions under which native species evolved, and therefore, represents conditions that should most reliably maintain resilient self-sustaining native fish and wildlife populations. It is useful as a reference point (or conceptual model) for understanding how managed an area such that it moves in the direction of greater *ecological integrity*. See Ecological integrity and Range of natural variability.

Hot moments (*nutrient cycling*): Periods of elevated denitrification rates. Hot moments can occur during a rainfall event.

Hot spots (*nutrient cycling*): Areas that exhibit high denitrification rates. Hot spots often occur in floodplains and other *riparian areas* with oscillating groundwater levels and/or higher *hyporheic* flows; locations of hot spots can vary through time.

Hydrology: The longitudinal, lateral, and horizontal movement and storage of water.

Hyporheic zone: The area beneath and alongside a stream channel where surface water *infiltrates* and exchanges with subsurface flow.

Impervious surface: Ground surfaces that resist or prevent water *infiltration*, e.g., roofs of houses and roadways.

Incision: The *process* of downcutting into a stream channel leading to a decrease in the channel bed elevation. Incision is often caused by a decrease in sediment supply or increase flows capable of transporting (scouring) sediment.

Infiltration: The rate or *process* by which water on the ground surface enters the soil.

Keystone species: A species whose ecological effect are disproportionate to their abundance and biomass, e.g., salmon and beaver.

Keystone ecosystem: An ecosystem whose effect on the broader ecosystem is disproportionate to their size, e.g., *riparian ecosystem*.

Keystone processes: *Ecological processes* that have widespread impacts throughout an ecosystem, e.g. *riparian* forest succession, *riparian* nutrient uptake, flood flows.

Macroinvertebrates (benthic): Animals, including insects, mollusks, crustaceans, and worms, that live within streams, do not have a backbone, and are large enough to be seen without a microscope. They are important components of the ecosystem and are commonly used as an indicator of habitat and *water quality*.

Mass wasting: The down slope movement of material due to gravity (rather than water, wind, or ice, for example).

Monitoring and adaptive management: See Adaptive management

Morphology (stream channel, aka fluvial geomorphology): A stream channel's shape and how it changes over time as a result of the interplay of *hydrology*, vegetation, sediment movement, and its position within the landscape. Channel morphology is influenced by the abundance and variation in sediment sources, the ability to transport sediment downstream, and interactions of sediment with *riparian* and instream vegetation.

Novel (or engineered) **solutions**: Solutions that are not found in nature. Examples: *vegetative filter strips* designed to capture excess nutrients; dams designed to provide flood control; engineered logjams designed to provide streambank channel roughness and complexity.

Novel conditions or ecosystems: Conditions (ecosystems) that are without historical precedent. Examples: wetlands created in arid regions by leakage from irrigation canals, presence of manmade chemicals in the environment, and climate change due to anthropogenic greenhouse gas emissions.

Nutrient cycling: The movement, uptake, transformation, storage, and release of nutrients, especially carbon, nitrogen, and phosphorus. *Riparian* characteristics that affect nutrient cycling include flow path, vegetation *composition* and quality, topography, groundwater level, and soil type. Excess nitrogen and phosphorus—used extensively in fertilizers—can create significant problems such as eutrophication, harmful algal blooms, fish kills, and contamination of drinking water supplies.

Nutrient spiraling length: The distance nutrients move downstream during a complete cycle; a measure of nutrient utilization to nutrient supply. Long spiraling lengths indicate that the system is saturated with nutrients and organisms can no longer use the incoming nutrient loads. Washington forests typically have relatively tight N and P cycles, with low rates of inputs and outputs, but high rates of internal cycling.

Population viability (local): The likelihood that a population of a species will persist for some length of time.

Precautionary principle: Erring on the side of not harming resources when faced with *uncertainty*, especially for harm that is essentially irreversible. Utilizing a precautionary approach involves: 1) taking preventive action (avoiding impacts); 2) shifting the burden of proof to the project proponents; 3) exploring a wide range of potential alternatives; and/or 4) including multiple stakeholders and disciplines in decision making.

Process: See Ecosystem process

Range of natural variability (or Historical range of natural variability): natural variability refers to two intertwined concepts: 1) that past conditions and processes provide context and guidance for managing ecological systems today, and 2) that disturbance-driven spatial and temporal variability is a vital attribute of nearly all ecological systems.

Recruitment (wood): The *process* of wood moving from a *riparian area* to the stream channel. Sources of recruitment include bank erosion, windthrow, landslides, debris flows, snow avalanches, and tree mortality due to fire, ice storms, beavers, insects, or disease. Dominant factors include

channel width, slope steepness, slope stability, forest *composition* and *structure*, and local wind patterns.

Riparian area: The area in alongside a stream or river.

Riparian corridor: See Riparian area.

Riparian ecosystem: The area alongside a river or stream that significantly influences exchanges of energy and matter with the aquatic ecosystem. It includes the active channel, the active floodplain and terraces, and portions of the adjacent uplands that contribute organic matter and energy to the active channel or floodplain. It is a zone of influence; a transitional ecotone between terrestrial and aquatic ecosystems that is distinguished by gradients in biophysical conditions, *ecological processes*, and biota.

Riparian habitat: see Riparian area

Riparian Management Zone: A delineable area defined in a land use regulation. RMZs are often used to protect *riparian ecosystems* and can be subdivided (e.g., core/inner/ outer RMZ) to provide varying levels of protection.

Riparian zone: See Riparian area

Riparian: An adjective meaning "alongside a stream or river."

Risk: A situation involving exposure to danger, harm, or loss. Risk reflects the magnitude of the adverse impact and its probability of occurring. Risk is appropriately managed by applying *the precautionary principle* (especially for irreversible losses) and through *adaptive management*.

Riverscape: The landscape in which *riparian ecosystems* interact. It includes the river network and contributing *watershed* along with other components that are not organized by *watershed* boundaries such as wildfire, mobile organisms, and wind-borne seeds. Distinct from uplands, it is primarily organized in a downstream direction, but also contains lateral elements (e.g., floodplain interaction), vertical elements (e.g., interaction of surface and *hyporheic* flow), and upstream elements (e.g., migrating salmon).

Salmonid: A family of fish of which salmon and trout are members. Salmonids in Washington include Chinook salmon, chum salmon, coho salmon, pink salmon, sockeye salmon/kokanee, steelhead/rainbow trout, cutthroat trout, and bull trout/Dolly Varden.

Shifting baseline syndrome: A gradual lowering of standards or expectations for what constitutes a "degraded" ecosystem. The shifting baseline syndrome may be the result of each new generation perceiving what they experience as "normal" or "natural."

Site class: The classification of a site based on the productivity of its dominant tree. Site classes vary based on local differences in soil nutrients and moisture, light and temperature regimes, and topography. Site classes are typically described as most productive (i) through least productive (v).

Site-Potential Tree Height: The average maximum height of the tallest dominant trees (200 years or more) for a given site class.

Stochastic event: An event which is randomly determined (e.g., landslide, flood). Stochastic events may have patterns that can be analyzed statistically but cannot be precisely predicted.

Stream order: A hierarchical stream classification system in which headwater tributaries are classified as first order; when two first order tributaries meet they form a second order tributary, when two second order tributaries meet they form a third order tributary, and so on. Low order (1st-3rd) streams make up 88% of the state's stream miles; below the Tri-Cities the Columbia River is a 10th order river.

Structure: See Ecosystem structure.

Thermal loading potential: The potential amount of solar radiation (sunlight) available at a given location. Primary factors include shading (topographic and vegetative), latitude, elevation, and date.

Thermal regime (stream): The distribution of stream temperatures through space and time. Thermal regimes can be described by their magnitude (e.g., monthly mean, hourly maximum), timing, frequency, duration, spatial distribution, and rate of change.

Thermal sensitivity (stream reach): The susceptibility of a stream reach to changes in temperature. Thermal sensitivity typically increases with less stream flow, less groundwater input, and a wider channel to depth ratio.

Uncertainty (scientific): The absence of information about the state of something or a relevant variable. Uncertainty can be the result of natural variation (i.e., because outcomes vary in difficult-to-predict ways through time and space), model uncertainty (i.e., we do not understand how things interact with each other), systematic error (e.g., poorly designed experiments or calibrated instruments), or measurement error. Appropriate management responses to scientific uncertainty include gathering site-scale information, monitoring and *adaptive management*, applying the *precautionary principle*, and applying robust solutions (e.g., solutions that are likely to perform well over a range of conditions). See Risk.

Vegetative filter strips: *Novel solutions* designed to capture water transported nutrients, contaminants compounds and sediment.

Water quality (riparian): Physical, chemical, and biological characteristics of water that describe its suitability to meet human needs or habitat requirements for fish and wildlife. *Riparian areas* affect water quality by intercepting, accumulating and cycling fine sediments, excessive nutrients, and contaminants in overland and shallow subsurface flows.

Watershed processes: The fluxes of energy (e.g., sunlight, wildfire) and materials (particularly water and sediment) that interact with biota (e.g., vegetative cover, salmon, beavers, soil microbes) to form a watershed's physical features and characteristics, which give rise to its instream physical and ecological conditions. These processes occur within a context that reflects the watershed's climate, geology, topography, and existing human land use. Also see Ecosystem process.

Watershed: A landmass that drains to a common waterbody.

CHAPTER 1. INTRODUCTION

1.1 DOCUMENT DESCRIPTION

This Priority Habitats and Species (PHS) document is the second of a two-volume set. The first volume, *Protecting Riparian Ecosystems, Volume 1: Science Synthesis and Management Implications* is a synthesis of the current state of science that provides the basis for Washington Department of Fish and Wildlife's (WDFW) management recommendations described in Volume 2. Volume 2 is an implementation manual for how to protect functions and values of riparian ecosystems and surrounding watersheds. Although the primary audience is local governments, Volume 2 should be useful to anyone with an interest in protection and management of rivers and streams in Washington State. Together, Volume 1 and Volume 2 update and expand information provided in WDFW's 1997 PHS Riparian Management Recommendations (Knutson and Naef, 1997; available at http://wdfw.wa.gov/publications/00029/).

This document focuses on providing guidance on how to protect the functions and values of riparian areas for the benefit of all species that depend on this ecosystem, including humans and salmon. Recovering salmon in Washington State requires improvements through an all–H approach (Habitat, Hatcheries, Harvest, and Hydro-systems). For salmon, we must protect and restore riparian habitat functions while maintaining ecological connectivity throughout the watershed. Riparian protection occurs through voluntary actions by farmers, forest owners, and other landowners and through regulations. Protection is the focus of the guidance provided in this document—how to protect what remains of historical riparian habitat and functions. While recognizing its critical role, comprehensive restoration guidance was beyond the scope of our work here: Chapter 4 provides limited guidance on restoration.

In addition to being important to fish and other aquatic species, riparian ecosystems are essential to terrestrial species. More than 85% of all species on the landscape use riparian ecosystems during some phase of their life. Of these, about 170 species including 134 mollusks, 11 amphibians, 3 reptiles, 10 birds, and 9 mammals are likely riparian obligates—requiring riparian habitat to complete their life cycle[1].

Functions are defined as the process, or the cause-effect-relationships underlying two or more interacting parts of the riparian ecosystem (see Volume 1). The functions that riparian systems provide—such as stream temperature moderation, water purification, floodwater storage, stream channel stabilization, provisioning of woody debris into aquatic systems, and facilitating fish and wildlife movement—are widely acknowledged in the scientific literature. Maintaining functions requires that we maintain both the important parts of the system (components) and the organization of those parts relative to each other (structures). Riparian values refer to the benefits that riparian systems provide to society—also known as ecosystem goods and services. These benefits include the ability to reduce flood damage, improve water quality, support harvestable

[1] Quinn, T. and others. 1998. Habitat Associations of the riparian-dependent amphibian, reptile, mammals, and mollusks in commercial forest lands of Washington State: a report to the TFW policy committee.

surpluses of salmon, and provide recreational opportunities; and have direct economic consequences to local communities through recreational and commercial fishing opportunities, and flood and water quality protection.

WDFW's legislative mandate (RCW 77.04) and our synthesis of scientific knowledge related to best achieving those mandates is the basis for guidance presented in Volume 2. WDFW's mandate is a statement of values approved by the state legislature and reads in part "…wildlife, fish, and shellfish are the property of the state and that WDFW…shall conserve the wildlife and food fish, game fish, and shellfish resources in a manner that does not impair the resource." The recommendations in Volume 2 represent WDFW's best professional judgement as to how local governments can use best available science in policies, plans and regulations designed to conserve riparian ecosystems for the protection of fish and wildlife species, and in particular salmon species. Community values and science play complimentary but distinct roles in the creation of public policy. In Appendix 4, we describe the role of science and values as reflected in policy choices during the creation of three large-scale aquatic species conservation plans in Washington State. We provide this appendix to demonstrate how riparian science informed policy choices and how the same science resulted in different policy outcomes.

The Growth Management Act (GMA) was adopted in 1990, and WDFW recognizes that cities and counties have existing approaches for resource protection that have been approved by elected officials and, in some cases, through a Growth Management Hearings Board process. This guidance provides refinements and recommends changes to improve protection as informed by new scientific knowledge gained since publication of the 1997 PHS Riparian Management Recommendations. Some key changes from previous recommendations include:

1. Consideration of the Channel Migration Zone as important to protect for maintaining riparian functions on some streams.
2. Riparian Management Zones (RMZ), rather than buffers, as the area within which to achieve No Net Loss. The RMZ provides a framework for assessing, planning and managing for the full range of riparian functions. RMZ protections can be adapted to meet local needs, reflect current conditions and can address multiple goals of GMA and SMA.
3. Watershed-scale considerations that contribute to effectiveness of riparian ecosystems protections and provide for lateral, longitudinal and vertical connectivity vital to movement of water, wood, sediments and species.
4. A framework for incorporating monitoring and adaptive management to improve local permit implementation and compliance, and to increase effectiveness of actions to protect aquatic species.

1.2 Purpose and Goals of Volume 2

This document provides guidance on how to implement the best available science provided in Volume 1 and to assist local governments in complying with GMA, Voluntary Stewardship Program (VSP) and SMA requirements. The guidance is statewide in its applicability and intended for all land uses, excluding public forests and private industrial forestlands covered under existing land use agreements.

Federal, state and tribal government riparian management programs of have specific requirements and policies. We do not discuss how these programs comport with the guidance provided as it is outside the purview of WDFW to set policy for federal agencies or tribal governments. For instance, we do not discuss protection of floodplains under Federal Emergency Management Agency (FEMA) nor do we discuss specific Endangered Species Act requirements relative to listed salmon and other species. We also do not address Forest Practice Act (FPA) activities on lands that fall within the jurisdiction of the FPA or the Department of Ecology's Clean Water regulations.

We believe that this document will be useful to watershed managers, salmon recovery managers, and restoration managers interested in restoring riparian and watershed conditions in support of improving habitat for aquatic species over time. Volume 2 provides information to:

- Meet local government's regulatory requirements under GMA
- Assist local groups in designing and implementing the VSP for agricultural lands
- Protect existing, and restore degraded riparian functions in support of recovering salmon.
- Incorporate implementation, compliance and effectiveness monitoring to understand how well regulations protect riparian functions and values.

Through the PHS Library, WDFW provides several related documents of use to local governments: *Land Use Planning for Salmon, Steelhead, and Trout*[2], *Protection of Marine Riparian Functions in Puget Sound, Washington*[3], species- and habitat-specific management recommendations, and maps of Priority Habitat and Species.

Restoration of degraded riparian ecosystems is necessary for the recovery of riparian functions in many locations. Although Volume 2 is not a restoration guide, it is applicable to restoration practitioners in that it provides management actions protective of riparian functions and values. While we do not address restoration project design or standards, we provide links to resources that do. The scale of this document is statewide and does not address issues specific to a particular community or unusual environmental conditions; we recommend such matters be addressed locally with input from tribal biologists, stakeholders, and WDFW Habitat Biologists.

The recommendations in Volume 2 are advisory only. Local governments are not required to use this guidance. The information presented in this document is not, in and of itself, the "best available science." Rather, it represents recommendations as to how a local government could incorporate the best available science in policies, plans and regulations.

1.3 Definition and Overarching Riparian Management Recommendations

Volume 1 provides the definition and science for the basis of WDFW's riparian management recommendations. In an attempt to make field delineation of riparian ecosystems easier, we operationalized the definition (Figure 1-1). The most important change made was to recognize the contribution of the channel migration zone (CMZ) to riparian ecosystem function. Generally, the

[2] Knight, K. 2009. Land Use Planning for Salmon, Steelhead and Trout: A land use planner's guide to salmonid habitat protection and recovery. Washington Department of Fish and Wildlife, Olympia, Washington.
[3] Washington Sea Grant. 2009. Protection of Marine Riparian Functions in Puget Sound, Washington. Washington Department of Fish and Wildlife, Olympia, Washington.

CMZ is defined as the area that a stream channel has historically occupied and is reasonably likely to move over some period.

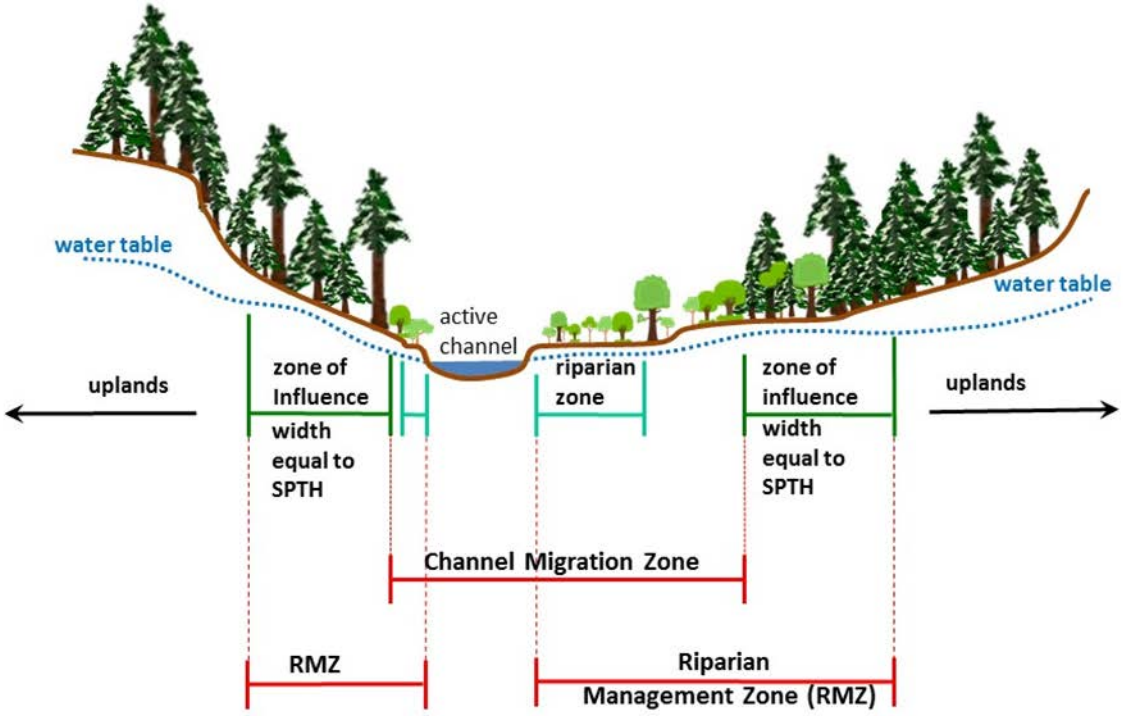


Figure 1-1. Generalize diagram of the riparian ecosystem as defined in Chapter 1 Volume 1. The zone of influence—portions of terrestrial ecosystems that significantly influence exchanges of energy and matter with aquatic ecosystems—starts at the edge of the stream channel or CMZ. The width of the zone of influence is equal to the Site-Potential Tree Height

Our inclusive definition of riparian ecosystems is integral to development of management recommendations. Riparian ecosystems include areas through which surface and subsurface hydrology connect waterbodies with uplands and portions of terrestrial ecosystems that significantly influence exchanges of energy and matter with aquatic ecosystems. Key conclusions from Chapter 9, Volume 1, supported by literature cited, are as follows:

1. Protection and restoration of riparian ecosystems continues to be critically important because: a) they are disproportionately important, relative to area, for aquatic species, e.g., salmon, and terrestrial wildlife; b) they provide ecosystem services such as water purification and fisheries-related economic activity; and c) they respond to and interact with watershed-scale processes to create and maintain aquatic habitats.
2. Stream riparian ecosystems include CMZ, riverine wetlands, and terraces, and the adjacent uplands that contribute matter and energy to the active channel or CMZ.
3. One Site-Potential Tree Height (SPTH) measured from each edge of the active channel or each edge of the channel migration zone is the estimated width of the riparian ecosystem. Protecting functions within at least one SPTH is a scientifically supported approach if the goal is to protect and maintain high function of the riparian ecosystem.

4. A near consensus of scientific opinion holds that the most effective and reliable means of maintaining viable self-sustaining fish, especially salmon, and wildlife populations is to maintain/restore ecosystems to conditions that resemble or emulate their historical range of natural variability.
5. Watershed connectivity is primarily related to maintaining flows of water, wood and sediment (and species) primarily in downstream direction, but also in the cross-stream direction between the stream channel and the riparian ecosystem. Protection of the active channel, CMZ and the zones of influence helps maintain connectivity in the lateral and horizontal direction at least in areas without levees or extensive floodplain development. In addition to riparian ecosystem protection, the protection and restoration of the watershed-scale processes, especially hydrology and water quality, are important for aquatic system function, and help maximize the value of riparian protections.
6. Riparian areas and surrounding watersheds are complex and dynamic systems comprised of many interacting components. These interactions across the watershed and through time create the mosaic of conditions necessary for self-sustaining populations of fish, especially salmon, and other aquatic organisms.
7. Impending changes to aquatic systems because of climate change increases risk to species already threatened by human activities. The warming effects of climate change on rivers and streams threaten to drastically reduce fish distribution and viability throughout the Pacific Northwest.
8. The use of the precautionary principle and adaptive management are particularly appropriate when dealing with complex and dynamic systems, and when addressing uncertainty regarding the effect of management activities on functioning ecosystems.

1.4 Ecosystem Based Management and WDFW Conservation Principles

Historical and ongoing changes to ecosystems present numerous challenges to managing riparian areas effectively, requiring a more holistic and integrated approach. Trends in land use and human population limit our ability to predict the future state of ecosystems over the long term. Climate change will add additional challenges, including altered flows and elevated water temperatures in rivers and streams. Ecosystem Based Management (EBM) is an integrated, science-based approach to natural resource management that aims to sustain the ability of ecosystems to provide goods and services upon which humans and other species depend. Acknowledging the human component of ecosystem management is an integral part of EMB. It explicitly recognizes the magnitude of humans as change agents and the composite role of social, economic, and ecological factors in managing complex and dynamic systems. Due to the sheer complexity and magnitude faced by riparian managers, EMB is the best approach to address changes from human land use, population growth and climate change.

This document reflects WDFW's perspective consistent with WDFW's mandate: to preserve, protect, perpetuate, and manage Washington's fish and wildlife (RCW 77.04.012). We believe that durable conservation is best achieved through employing the following ecosystem based management principles adopted into WDFW policy in 2013:

1. Practice conservation by managing, protecting and restoring ecosystems for the long-term benefit of people and for fish, wildlife and their habitat.
2. Improve effective conservation when we manage fish, wildlife and their habitats by supporting well-functioning ecosystems.
3. Work across disciplines to solve problems because of the connections among organisms, species and habitats.
4. Integrate ecological, social, economic, and institutional perspectives into decision-making.
5. Embrace new knowledge and apply best science to address changing conditions through adaptive management.
6. Collaborate with conservation and community partners to help us achieve our shared goals.

1.5 Organization of Volume 2

Volume 2 consists of five chapters. Chapter 2 contains a brief discussion of policy and legal contexts for protection of riparian ecosystems, meaning No Net Loss, role of mitigation and application of best available science.

In Chapter 3, we redefining Riparian Management Zones for aquatic species based on SPTH and CMZ, with additional information in Appendices 1 and 2. WDFW recognizes that counties and cities have the responsibility of including science in developing Critical Areas Ordinances (CAOs) and have a long history of implementing riparian protections. The regulatory recommendations described in Chapter 3 will assist counties and cities in reviewing and implementing their CAOs. Chapter 3 also contains an alternative approach for non-forested regions of Washington (i.e., Columbia Plateau Ecoregion). This new guidance can be used to review existing approaches, or incorporated into implementation of existing regulations.

Chapter 4 describes voluntary protection and approaches for counties participating in VSP and for salmon recovery restoration. Although voluntary actions vary by county, the area within which a county should consider protection and restoration for agricultural lands is also one SPTH.

Chapter 5 will assist with developing implementation and effectiveness monitoring programs. Cities and counties should develop monitoring programs to ensure fair and transparent protection programs that deliver consistent protection to critical areas. We also provide information to assist VSP enrolled counties with designing benchmarks and implementing monitoring to ensure protection of riparian functions relative to 2011 levels as described in the VSP legislation.

This volume contains five appendices:

- Appendix 1: Determining Site-Potential Tree Height
- Appendix 2: Site-Potential Tree Height Histograms by County
- Appendix 3: Voluntary Stewardship Program Adaptive Management Matrix
- Appendix 4: Ecosystem Based Management Case Studies
- Appendix 5: Determining Extent of Riparian Ecosystem in the Columbia Plateau Ecoregion

CHAPTER 2. THE GROWTH MANAGEMENT ACT, THE SHORELINE MANAGEMENT ACT, AND PROTECTION OF CRITICAL AREAS

2.1 INTRODUCTION

This chapter provides background on several recent Growth Management Hearings Board's decisions, court cases, and updates to the Washington Administrative Code related to implementation of the Washington State Growth Management Act (GMA) from 2005 through 2016. For a comprehensive summary of all case law and Growth Management Hearing Board (GMHB) decisions, please refer to Appendix 1.B of Department of Commerce's Critical Areas Ordinance Guidelines available at https://www.ezview.wa.gov/site/alias__1949/library_draft_documents/36886/draft_documents.aspx. The following summary addresses court cases and GMHB decisions in five areas of importance to implementation of GMA requirements: 1) defining Best Available Science, 2) ensuring No Net Loss, 3) mitigation, 4) adaptive management and 5) special consideration for anadromous fisheries.

In 1990, the Washington State Legislature passed the Growth Management Act (RCW 36.70A) to guide local jurisdictions in their decisions regarding land use. The GMA establishes a framework for managing land use consistent with 14 goals (RCW 36.70A.020). These goals include conserving fish and wildlife habitat and protecting the environment. GMA requires that local governments' policies and development regulations protect critical areas, include best available science, and give special consideration to anadromous fisheries (RCW 36.70A.172). The GMA directs local jurisdictions to protect functions and values of five types of critical areas, including Fish and Wildlife Habitat Conservation Areas (FWHCA).

Department of Commerce rules state that FWHCA include areas where endangered, threatened, and sensitive species have a primary association; habitats and species of local importance; naturally occurring ponds under twenty acres and associated submerged aquatic beds that provide fish or wildlife habitat; and lakes, ponds, streams, and rivers planted with game fish by a governmental or tribal entity. In addition, the rules identify "waters of the state" as a FWHCA area, which overlaps with all these other areas.

Considerations for classifying and designating these areas include protecting riparian ecosystems including salmon habitat, which also includes marine nearshore areas, and establishing buffer zones to separate incompatible uses from habitat areas. Commerce's rule identifies sources and methods (WAC 365-190-130(4)) for designating FWHCAs that include WDFW habitats listed as Priority Habitat and Species (PHS).

2.2 CONNECTION TO THE SHORELINE MANAGEMENT ACT

The Shoreline Management Act (SMA) applies to all marine waters along the Pacific Ocean and Puget Sound, streams and rivers with an annual mean flow of more than 20 cubic ft per second, lakes greater than 20 acres in size, shore lands adjacent to these water bodies (typically within 200 ft of the water body with some exceptions), and associated wetlands.

The Legislature has adopted the goals and policies of SMA as a fourteenth goal of GMA. Department of Ecology (Ecology) writes rules to implement SMA and administers the Act in partnership with local governments. In contrast with CAOs, which are locally developed, Shoreline Master Programs (SMPs) are the product of state regulation, constitute land use regulations for various shorelines of the state, and approved by Ecology.[1]

The Legislature created deadlines for cities, counties and towns to complete a comprehensive SMP update consistent with Ecology's 2003 Guidelines, which included a requirement to ensure "no net loss of ecological functions" (described below). The phased deadlines in statute began in 2005 and all completed comprehensive updates are expected by 2019.

Critical areas regulations adopted under GMA apply in shoreline jurisdiction until Ecology approves a comprehensive SMP update consistent with Ecology's 2003 SMP Guidelines. After a comprehensive SMP update is approved by Ecology, critical areas within shoreline jurisdiction are regulated by the SMP [RCW 36.70A.480(3)(b)].

Ecology rules provide local governments options for addressing critical areas, including integrating relevant CAO provisions directly into SMPs, or adopting a specific version of the CAO by reference. Ecology is an active partner in protecting critical areas in shoreline jurisdiction. Unlike for other critical areas, in shoreline jurisdiction the state has an obligation to conclude affirmatively that local regulations are consistent with all statutory and regulatory requirements. Ecology solely bases approval of each SMP on consistency with the SMA and the SMP guidelines. Ecology also has ongoing oversight of SMPs, including issuing the final decision to approve, deny or condition locally issued Conditional Use Permits and Variances.

The GMA created Growth Management Hearings Boards (GMHB) to handle appeals of local government legislative actions and determine compliance with GMA's requirements (RCW 36.70A.250-280). SMP approval appeals in jurisdictions that are "fully planning" under the GMA are heard by the GMHB, while appeals of "partially planning" jurisdictions are directed to the Shorelines Hearings Board.

2.3 Defining Best Available Science

Best Available Science (BAS) is required to be included in CAO updates. In 1990, WDFW created the PHS program to identify fish and wildlife areas of particular importance for protection. Over time, PHS has come to include a list of habitats and species, a suite of management recommendations, mapping tools, and technical assistance to local governments. Under GMA rules, PHS is a source of Best Available Science to consult for endangered, threatened and sensitive species, and as a source of information in determining what habitats and species of local importance to consider.[2] WDFW has applied PHS criteria to the riparian ecosystem and has found ample reason to include it as a Priority Habitat.[3] Thus, the science summary on riparian functions may be included in a

[1] Citizens for Rational Shoreline Planning, et al. v. Whatcom County, 155 Wn. App. 937, 943 (2010).
[2] Commerce WAC 365-190-130(4)
[3] WAC 365-190-130(2)(f) and (4)(f).

jurisdiction's update of their CAO as BAS, and the management recommendations contained within Volume 2 aid in implementation of BAS.

The initial round of GMA periodic reviews in 2004 was the first time local governments were required to include BAS. While critical areas designation and protection had been the subject of appeals to the GMHBs and courts, the requirement to include BAS in the first round of updates resulted in numerous challenges to local CAOs. The state joined multiple appeals, many of which involved riparian buffers to protect salmon habitat.

At the time of this writing, local governments are partway through the second round of GMA updates—due between 2015 and 2019. To date, three challenges have been brought before the Growth Management Hearings Board regarding the inclusion of BAS and new science.

In 2014, the Court of Appeals reviewed Ferry County's use of BAS to designate habitats and species of local importance in its CAO.[4] The Court concluded that Ferry County "failed to develop or obtain any valid scientific information supporting its refusal to designate any habitats or species as locally important. … [T]he county failed to include BAS in its designation of species and habitats of local importance. The county may depart from BAS, but must do so using a reasoned process."[5] Although the Court recognizes a county may "disagree with or ignore scientific recommendations and resources provided by state agencies or Indian tribes … the county must unilaterally develop and obtain valid scientific information. The GMA does not require a county to follow BAS; rather it is required to 'include' BAS in the record. A county may depart from BAS if it provides a *reasoned justification* for such departure."[6]

In 2017, the Central Puget Sound Region Growth Management Hearings Board issued a decision based on a challenge to an ordinance adopted by Snohomish County amending portions of its critical areas ordinance.[7] Although the Board found that petitioners failed to meet their burden of proof or were time-barred on 14 of their 15 issues, it found the County failed to follow Department of Commerce's minimum guidelines in WAC 365-190-130.[8] The Board remanded for compliance, and subsequently closed the case on October 12, 2017. The decision also notes that challenges to local codes are untimely unless filed within 60 days, as required by RCW 36.70A.290(2).[9] However, when amending a code, new or changed BAS must be considered.[10]

The SMA has closely related requirements for use of information when developing SMPs that protect ecological functions. Local governments must use a systematic interdisciplinary approach; consult with relevant agencies; and use all available information regarding hydrology, geography, topography, ecology, economics, and other pertinent data.[11] The SMP Guidelines require use of "the most current, accurate and complete scientific and technical information available."[12] The

[4] *Ferry County v. Growth Management Hearings Board,* 184 Wn. App. 685 (2014)
[5] *Id.* at 739, ¶89-90
[6] *Id.* at 717, ¶43; *see also Id.* at 733-39, ¶68-90)
[7] *Futurewise v. Snohomish County,* CPSR GMHB No. 15-3-0012c (February 17, 2017)
[8] *Id.* at 16-19 (Issue A-7).
[9] *Id.* at 4.
[10] *Id.* at 6.
[11] RCW 90.58.100.
[12] WAC 173-26-201(2)(a)

Legislature provided significant state resources to inform the use of scientific information for SMP updates (including approximately $34 million in grants to local governments). Inventory and Characterization of shorelines was the basis for every SMP update, which in many cases enabled tailored approaches to the application of scientific information specific to local conditions. The GMHB has recognized the differences in application of use of information to inform SMPs because it is a specific state overlay on local land use process where certain statewide interests apply. As clarified by the GMHB, "The SMA process does incorporate the use of scientific information, but it does so as part of the process of balancing a range of considerations such as public access, priority uses, and the development goals and aspirations of the community."[13]

2.4 No Net Loss

Development regulations must preserve the existing functions and values of critical areas within certain limits described by the *No Net Loss* provisions of Chapter 365-196 WAC, Part 8. Development regulations apply to all counties and cities, not just those that are planning under GMA. The relevant portions of WAC 365-196-830 are:

> *(2) Critical areas that must be protected include…(c) Fish and wildlife habitat conservation areas…*
> *(3) "Protection" in this context means preservation of the functions and values of the natural environment...*
> *(4) Although counties and cities may protect critical areas in different ways or may allow some localized impacts to critical areas, or even [may allow] the potential loss of some critical areas, development regulations must preserve the existing functions and values of critical areas. If development regulations allow harm to critical areas, they must require compensatory mitigation of the harm. Development regulations may not allow a net loss of the functions and values of the ecosystem that includes the impacted or lost critical areas.*

The court has found that protection of functions and values of an ecosystem includes all as opposed to just some functions and values of the designated areas.[14] The court has also concluded that the "no harm" standard protects critical areas by maintaining *existing* conditions and does not require enhancement or restoration of lost habitat functions that no longer exist.[15] In addition, the GMHB found that the GMA requires protection of the critical area ecosystem, not just the species contained within the ecosystem.[16]

For these reasons, Volume 1 and 2 focus on defining the functions necessary to protect within the ecosystem for benefit of aquatic and riparian obligate terrestrial species.

The SMA requires local governments to plan for preferred uses of shoreline (e.g., water-dependent uses, single-family homes, and public access) while also protecting the environment. Ecology adopted rules in 2003 based on a negotiated settlement requiring SMP regulations to assure "no net

[13] *Lake Burien Neighborhood, et al., v City of Burien and Department of Ecology*, GMHB 13,3-0012 (6/16/2014)
[14] *Yakama County v. Eastern WAGMHB*, 168 Wn. App. 680 (2012)
[15] *Swinomish Indian Tribal Community v. Western Washington Growth Management Hearings Board*, 161 Wn.2d 415 (2007)
[16] *Whidbey Environmental Action Network v. Island County*, 14-2-0009

loss of ecological functions necessary to sustain shoreline natural resources." Each SMP accomplishes this through a complex combination of environment designations (shoreline-specific zoning overlays), detailed regulations for specific uses and shoreline modifications, careful mitigation sequencing, and critical area protections (either adopted by reference or developed for unique circumstances). Ecology's rule includes guidance specific to vegetation management that ensure local governments focus on applicable functions within their jurisdiction. Just like under the GMA "no harm" standard, the intent of "No Net Loss" requirements is to halt introduction of impacts from new development.

Ecology's rules recognize shoreline development can impact ecological functions. However, the recognition that future development will occur is basic to the No Net Loss standard. The challenge is in maintaining shoreline ecological functions while allowing appropriate new development, ensuring adequate land for preferred shoreline uses and promoting public access to shorelines.

Ecology rules clarify that regulations may not require mitigation in excess of that required to achieve No Net Loss. The regulations acknowledge the degradation ecological functions in many areas. To achieve restoration of functions above the baseline of current conditions, local governments prepare restoration plans that identify voluntary opportunities. SMPs may also include incentive-based approaches to accomplish restoration. Ecology rules acknowledge local governments may consider the indirect restoration effects from shoreline development regulations and mitigation standards. For example, all SMPs include requirements to avoid new impacts by retaining existing riparian vegetation in defined buffer areas. Over time, trees will grow in these buffer areas, improving ecological functions. In addition, mitigation requirements for replacement structures such as docks will lead to improvements in ecological function, as newer more fish-friendly materials and practices are used. In some cases, Ecology's review of CAO regulations results in changes to how the CAOs are applied in shoreline areas to ensure they meet SMA No Net Loss requirements for critical area protection.

2.5 MITIGATION

Mitigation, as a concept, is common to natural resource management and generally means those measures taken to offset an action's adverse impacts on a natural resource. Under the State Environmental Policy Act (WAC 197-11-768) and Ecology SMP rules (WAC 173-26-201(2)), mitigation consists of sequential steps:

1. Avoiding the impact altogether by not taking a certain action or parts of an action;
2. Minimizing impacts by limiting the degree or magnitude of the action;
3. Rectifying the impact by repairing, rehabilitating, or restoring the affected environment;
4. Reducing or eliminating the impact over time through preservation and maintenance operations during the life of the action;
5. Compensating for the impact by replacing, enhancing or providing substitute resources or environments; and
6. Monitoring the impact and compensation projects and taking appropriate corrective measures.

Steps 2, 3, and 4 are often consolidated under one step—"minimize." Ecology SMP guidelines clarify that mitigation measures be applied in sequence in order of priority, with avoidance as the top

priority. The GMHB has reinforced mitigation sequencing to ensure No Net Loss and has stated that one can only consider compensatory mitigation after first avoiding and minimizing.[17] In addition, the San Juan County case found that if development regulations allow harm to critical areas, they must require compensatory mitigation of the harm.

For these reasons, we recommend counties develop guidance for mitigating harm to riparian areas that reflects the science of Volume 1.

2.6 Adaptive Management

Achieving No Net Loss of critical areas functions and values is a central goal of all locally adopted CAOs as discussed earlier in this document. Under SMA, Ecology certifies that approved SMPs will achieve No Net Loss of ecological functions necessary to sustain shoreline natural resources. Monitoring implementation and effectiveness of riparian protections helps ensure the achievement of No Net Loss as implementation of regulations occurs under GMA or SMA.

The GMHB and courts have provided some guidance on when adaptive management would be required. For instance, Skagit County adopted a less-than-precautionary approach, premised on the county's use of an adaptive management program. The State Supreme Court affirmed the GMHB's acknowledgment that a local government can rely on an evaluation of effectiveness through monitoring and adaptive management but those programs would need to include benchmarks and triggers for corrective action and the ability to detect the cause of any deterioration in existing functions and values.[18] Regardless of whether local governments have adopted regulations that establish specific adaptive management triggers, it is essential to have a feedback loop to ensure regulations are efficient and effective. To assist counties in developing monitoring and adaptive management programs, WDFW provides Chapter 5 in this volume.

2.7 Special Consideration for Anadromous Fish

The GMA requires special consideration be given to conservation or protection measures necessary to preserve or enhance critical anadromous fish resources. Healthy and harvestable salmon populations are a central goal of WDFW and the guidance of Volume 2 furthers this goal by protecting critical habitat for salmon. Special consideration for anadromous resources includes measures of protection or enhancement for all life stages of anadromous fish including habitat related to spawning and incubation, juvenile rearing and adult residence, juvenile migration downstream to the sea, and adult migration upstream to spawning areas (WAC 365-195-925(3)).

In addition to the special consideration that must be given to anadromous fisheries, there are significant tribal interests in the protection of salmon habitat. Most of Washington's tribes reserved off-reservation fishing rights in treaties signed with the federal government. In 2007, a federal district court ruled that these treaty rights impose a duty upon the State of Washington to refrain from building or operating culverts that block fish passage and reduce the number of fish available for treaty harvest. The court found that the State had violated its obligations under the treaties and

[17] *Friends of the San Juans, et al. v. San Juan County*, 13-2-0012©
[18] *Swinomish Indian Tribal Community et al. v. Skagit County*; 2-2-0012c; Compliance Order, 12-8-03

ordered the State to remove fish passage barriers.[19] In 2016, a federal appellate court affirmed this decision. In 2011, Western Washington treaty tribes produced a document called *Treaty Rights at Risk*, in which they called on the federal government to protect treaty fishing rights through federal laws such as the Endangered Species Act and the Clean Water Act.

Due in part to aforementioned legal developments, local jurisdictions are encouraged to consider treaty fishing rights when developing CAOs and making other land use planning decisions.

2.8 Shoreline Master Program Hearings Board and Court Decisions

A number of challenges have occurred to Ecology's SMP approvals on issues related to riparian ecosystem protection. The challenges have originated from many different land use perspectives.

Citizen groups concerned about diminished property rights have challenged several SMPs. For example, many features of the Bainbridge Island SMP were challenged for exceeding government authority. The SMP was challenged for its two-zone Riparian Protection Zone with buffer widths that varied by environment designation, vegetation standards, shoreline modification standards, non-conforming use provisions, and regulations for piers and docks. The Board upheld all the city's environmental protections and clarified that "where a jurisdiction is confronted by scientific recommendations consisting of ranges, buffer widths are ultimately a policy decision. But the SMP decision requires weighing of interests while assuring no net loss."

Similarly, the Jefferson County SMP was challenged by an organization concerned the County's SMP went "too far" in regulating land use, for a variety of reasons. The GMHB upheld the SMP and the Court of Appeals affirmed the Board decision. The Court upheld the county's incorporation of their CAO into their SMP and found proper evidence supported adoption of 150 ft buffers in shoreline jurisdiction. The Court recognized that the Guidelines authorize a SMP to include buffers, and the record was replete with evidence indicating how they were established. The Court cited recommendations from WDFW for buffer widths of 288 ft, acknowledging that local governments and Ecology must select buffers based on science but are not expected to follow any one single recommendation.

By contrast, organizations that advocated for protections that are more stringent have challenged other SMPs. Such a challenge occurred with City of Burien's shoreline provisions for providing inadequate buffer widths, vegetation conservation standards, and mitigation sequencing requirements. The City had used existing development in part to establish buffers. The Board upheld the SMP, finding "the SMA process does incorporate the use of scientific information, but it does so as part of the process of balancing a range of considerations such as public access, priority uses, and the development goals and aspirations of the community."

The Board also upheld the Spokane County SMP adoption of Critical Areas Regulations including provisions authorizing public trail construction. The Board found that "promoting public access to shorelines is a key policy goal of the SMA, and the statute contemplates striking a balance between facilitating access and protecting the ecology."

[19] *U.S. v. Washington*, Sub proceeding 01-01

There have been a few cases where Boards identified an issue that needed to be addressed. For example, the Board upheld the Yakima County's SMP riparian buffers, but found the county had not adequately addressed potential cumulative impacts of channel migration. The County prepared a channel migration study, which demonstrated the SMP had adequate protections in place and was compliant.

CHAPTER 3. REGULATORY TOOLS

3.1 INTRODUCTION

The purpose of this chapter is to provide guidance that will assist local governments in reviewing and implementing regulatory tools to protect riparian habitats with special consideration for maintaining important watershed processes. Developing specific guidance and regulations based on policies is a key step to developing effective protection programs consistent with natural resource goals of Growth Management Act (GMA) and Shoreline Management Act (SMA). Parcel-scale regulations are foundational to land use regulatory approaches for protecting rivers and streams, and most local governments rely solely upon regulation at the parcel or site scale for protecting rivers and streams. However, sole reliance upon a regulatory approach at the site scale, especially in combination with frequent exemptions and a lack of adaptive management is likely to result in loss of aquatic system function over the long term (see Volume 1). We believe that site-scale regulations are most effective when those regulations work in a coordinated way with watershed-scale planning and with a monitoring and adaptive management approach designed to meet explicit riparian protection goals and objectives through time.

WDFW recognizes that all cities and counties have existing approaches for protecting riparian ecosystem functions. Local ordinances vary in details but all include 1) vegetative buffers to avoid and minimize new impacts, 2) requirements for compensatory mitigation for unavoidable impacts, and 3) provisions defining allowed uses, exceptions, and/or variances. Riparian areas are typically covered by several different types of critical areas regulations. In addition to Fish and Wildlife Habitat Conservation Areas, riparian areas may also be protected by regulations for Frequently Flooded Areas, Geologically Hazardous Areas, and Wetlands.

We encourage local jurisdictions to analyze their current approaches (e.g., regulations, guidance, exemptions, databases, inspection process, and monitoring) for gaps in protection. In addition, some regulations outside the SMA and CAO portions of the local codes can either support or negatively impact riparian areas, for example clearing and grading, firewise, and tree protection ordinances. We strongly encourage counties to consider ordinances across their regulatory purview that may inadvertently create loopholes (e.g., clearing and grading allowances prior to development permit issuance) in riparian protection efforts.

Volume 1 describes how riparian ecosystems are critically important for aquatic species particularly in managed landscapes. It also refers to other elements (watershed connectivity, floodplains, stormwater, etc.) that contribute directly to watershed function, which, in turn, supports riparian function. Protection of watersheds commonly falls under the purview of agencies other than WDFW. Nonetheless, we encourage local jurisdictions to consider how the overall pattern of land use, in combination with all SMA and GMA protection measures, can collectively contribute to maintaining fish and wildlife and other important ecosystem services. To that end, we suggest considering the following questions when counties begin reviewing their CAOs:

1. Are there existing strategies (salmon recovery plans, reach-scale assessments, incentive-based riparian protection plans) to maintain, protect and restore riparian areas? If so, how

are they integrated with regulatory protections? Could actions identified in existing strategies be useful in satisfying mitigation obligations, or focusing restoration activities? For instance, are there stretches of river that have been identified as priority for a suite of restoration actions or protection? How are these protected in existing regulations or through voluntary actions?

2. Are current buffer widths based on Site-Potential Tree Height (SPTH)? We recommend comparing the current buffer widths with riparian management zone (RMZ) approaches described herein. If a CAO or SMP has adopted a different approach to setting buffer widths, can our recommended RMZ be used during implementation to identify areas for mitigation when there are unavoidable impacts within the buffer? Alternatively, can the RMZ be used to identify restoration opportunities under incentive-based riparian protection plans, salmon recovery plans, or reach-scale assessments?

3. Are provisions clear for ensuring No Net Loss within the buffer or RMZ, or are there opportunities to clarify requirements? Do you have a monitoring and adaptive management program for improving permit implementation? If so, have you identified improvements in your permit program you can implement to ensure No Net Loss within the buffer or RMZ? If you already have implementation and compliance information, are you collecting information on effectiveness of protecting riparian areas? If there is information on effectiveness of protection, what changes would improve regulations or where are you being successful?

4. Are current regulations written and mitigation approaches designed to protect and restore areas closest to the stream?

5. What other regulations may negatively impact riparian areas even though they may not be within the CAO (e.g., clearing and grading regulations)?

6. Do you have opportunities to connect riparian areas with other protected areas such as geologically hazardous areas, green belts, and parklands?

7. Given the importance of maintaining watershed connectivity, how do current regulations and land use plans ensure protection of aquifer recharge areas and floodplains? Is low impact development already required or encouraged within the watershed?

8. Are CAOs for ensuring No Net Loss within the buffer or RMZ clear, or are there opportunities to clarify requirements? Do you have a monitoring and adaptive management program for improving permit implementation? If so, have you identified improvements in your permit program that will lead to better compliance with regulations? If you are satisfied with implementation and compliance of CAOs, are you collecting information on effectiveness of protecting riparian areas? If there were information on effectiveness of protection, what changes would improve regulations such that No Net Loss in functions can be achieved?

Specifically, jurisdictions should use this guidance to improve on-the-ground outcomes, increase consistency, ensure transparency and deliver a fair and effective program. By transparency, we mean that the public can readily understand the reasons and the outcomes of land use decisions.

Refer to Chapter 5 to explore additional guidance for how monitoring of existing protections could be achieved in your community.

3.2 No Net Loss

No Net Loss (underpinnings are described more fully in Chapter 2) should be achieved over time by establishing policies and regulations that protect the riparian ecosystem. Much of the potential impact from human activity is based on the specific type of land use and exactly where that land use occurs. The recognition that future development will occur is fundamental to SMA, the goals and requirements of GMA, and the No Net Loss standard. The challenge is in maintaining riparian and targeted watershed functions while allowing appropriate types of development. A county or city must provide a detailed and reasoned justification for any designated critical area not protected.

Where local jurisdictions have comprehensively updated their Shoreline Master Program (SMP), the SMP provides protection of riparian conditions consistent with the No Net Loss standard embodied in WAC 173-26-186(8). Each SMP contains policies and regulations that assure "no net loss of ecological functions necessary to sustain existing shoreline natural resources." As Ecology guidelines explain, the concept of "net" recognizes that any development has potential or actual, short-term or long-term impacts. Further, through application of appropriate development standards based on a careful mitigation sequence, those impacts will not diminish the shoreline resources and values, as they currently exist.

To achieve the No Net Loss standard while accommodating preferred uses and development, SMPs establish and apply:

- Environment designations with appropriate use and development standards;
- Provisions to address the impacts of specific common shoreline uses, development activities and modification actions;
- Provisions for the protection of critical areas within the shoreline; and
- Provisions for mitigation measures and methods to address unanticipated impacts.

Each comprehensively updated SMP is supported by a shoreline characterization report, and a cumulative impact analysis that evaluates the overall effect of these components to reach a conclusion that the standard is met. Ecology's guidelines also require local governments plan for overall improvements ("net gain" in functions) through voluntary restoration programs. Many SMPs also incorporate incentive approaches for restoration into regulations.

Under the GMA, local governments are required to adopt critical areas regulations to protect critical areas functions and values.[1] The Supreme Court has interpreted this requirement to be protection of existing functions and values, and the "no harm" standard.[2] Local governments are required every eight years to review and, if necessary, update their critical areas regulations to incorporate changes in statutory requirements, or to include new sources of best available science. Department of Commerce recommends that jurisdictions review any new sources of best available science, as

[1] RCW 36.70A.172
[2] *Swinomish Indian Tribal Community v. Western Washington Growth Management Hearings Board*, 161 Wn.2d 415 (2007).

well as any management recommendations associated with the new science, for applicability to their regulations. Commerce also encourages local governments adopt incentive programs to protect critical areas and provide opportunities for restoration of critical areas.

No Net Loss provisions incorporate the following concepts:

- Regulatory approaches ensure that existing riparian ecosystem functions should not decrease due to permitted development.
- Potential adverse impacts to the riparian functions that result from planned development should be viewed through the lens of mitigation sequencing. This sequence begins with avoiding impact wherever possible, minimizing impacts that cannot be avoided, and fully mitigating all impacts.
- Riparian functions can be improved through incentive programs and voluntary restoration. Incentive programs and voluntary restoration will be necessary to improve aquatic system functions in many areas.
- Achieving the No Net Loss standard alone is unlikely to recover listed salmon. Restoration will be a critical piece of recovering salmon in many watersheds.

3.3 Balancing Predictability with Flexibility

The following paragraphs have been modified from Ecology's Wetland Guidance, 2006, Volume 2.

Regulations are often characterized by their predictability and flexibility. A predictable (prescriptive) approach provides clear, consistent standards that all applicants can rely on. A prescriptive approach may not allow flexibility to address site-specific or unique situations from the perspective of the regulatory agency or from that of the landowner. On the other hand, a more flexible approach may fail to provide the degree of specificity that allows the public agency or the applicant to have some certainty of the outcome early in the process.

In reviewing regulations, local governments may consider how their regulations balance these two distinct and sometimes competing approaches. A balanced approach may set "sideboards" with criteria for selecting an alternative from a range of allowable options or a general standard with criteria for deviating from the standard. A more flexible approach implies more discretion on the part of county or city staff and applicants. Flexible approaches can be helpful in ensuring regulations address actual habitat needs on a given site, but may also introduce more uncertainty about the efficacy of outcomes if less well-tested alternatives are authorized. This flexibility increases the importance and value of permit tracking and monitoring. See discussion in Chapter 5 and Chapter 2 for further details.

3.4 Site-Potential Tree Height Background

Before we move into recommendations, we provide background information on the origin, applicability, and usefulness of a conceptual framework based on Site-Potential Tree Height (SPTH; for more information, please refer to Volume 1, Chapter 9). In 1993, a group of experts (the Forest Ecosystem Management Assessment Team, FEMAT) was convened to determine how to protect riparian areas in forested landscapes. They developed a framework (also referred to as a model) that has come to be known as the "FEMAT Curves" (FEMAT, 1993) to describe important riparian

functions of old forests (at least 200 years old) and how they change with distance from the stream channel (Figure 3-3Figure 3-3 and Figure 3-4). Though this foundational work is more than 30 years old, it continues to provide one of the most applicable and useful conceptual frameworks for informing riparian management. The model (Figure 3-1) conveys two important points: 1) four of the five riparian ecosystem functions or processes occur within one $SPTH_{200}$ and 2) the marginal return for each function or process decreases as distance from the stream channel increases. Although not shown on the FEMAT Curves below, a $SPTH_{200}$ of at least 150 ft will likely provide full pollutant removal function based on our literature review (Volume 1, Chapter 5). Importantly, FEMAT curves generally acknowledge site-specific differences in riparian function among stream reaches, i.e., riparian ecosystems is wider at sites with taller trees.

FEMAT (1993, p. V-34) defined SPTH as "the average maximum height of the tallest dominant trees (200 years or more) for a given site class." The key phrase in this definition is "200 years or more" which refers to the approximate minimum age of old-growth forests. This reflects FEMAT's underlying assumption that old-growth forest conditions are needed for full riparian ecosystem functions. Because Douglas fir can continue height growth at a substantial rate for more than 200 years, site-potential height based on age 200 years is the minimum width for full riparian ecosystem functions according to FEMAT.

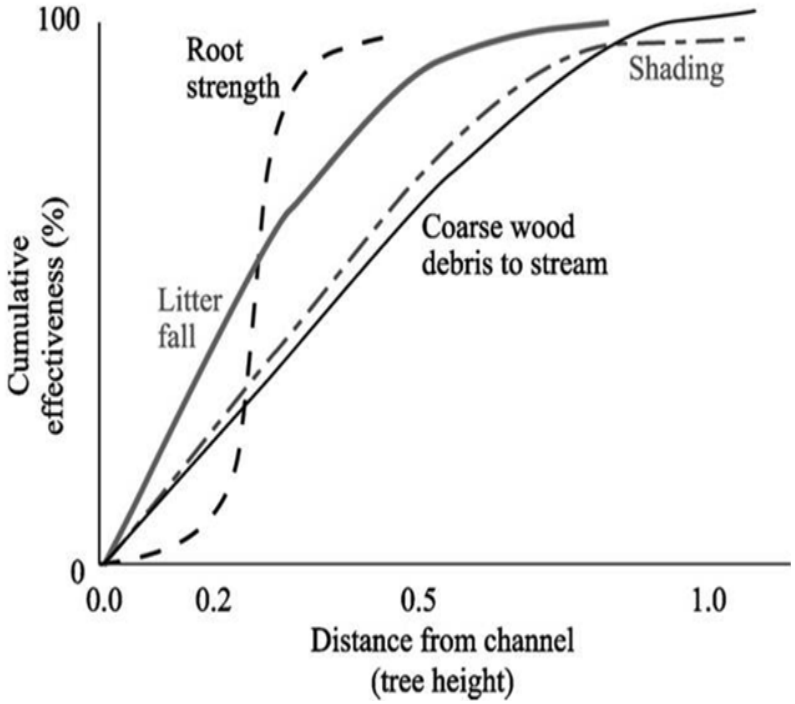


Figure 3-1. The "FEMAT Curves" (FEMAT, 1993): generalized conceptual models describing some riparian forest contributions to riparian ecosystem functions and processes as distance from a stream channel or Channel Migration Zone increases. Not shown here is the pollutant removal function. "Tree height" refers to average maximum height of the tallest dominant trees (200 years old or greater) and is referred to as Site-Potential Tree Height ($SPTH_{200}$).

FEMAT Curves define the relationship between riparian functions and distance, where distance is measured as height of the dominant tree species at least 200 years of age. Consequently, SPTH has often been used to define the extent of the riparian ecosystem in forested (or historically forested)

areas. Given its utility, the site-potential height of trees has been described for a wide variety of forest types and can be readily found in silviculture literature. Mean heights of dominant trees in riparian old-growth forest of Washington range from 100 to 240 ft (Fox, 2003). The wide range of heights reflects differences in site productivity, i.e., local differences in soil nutrients and moisture, light and temperature regimes, and topography. Site productivity is described quantitatively through a site index, which is the average height, that dominant trees of a particular species are expected to obtain at a specified tree age. Tables (e.g., King 1966) have been developed to predict the future average height of dominant trees on a site.

Riparian areas may lack trees for a variety of reasons, 1) they occur in areas of the state that do not support forest (in a traditional sense) such as the Columbian Plateau Ecoregion (see Volume 1, Chapter 7), 2) they occur in small areas where local soil or other site specific growing conditions prevent tree growth, or 3) they occur in areas where forests have been converted to other land uses such as development or agriculture. FEMAT curves based on SPTH may not apply, or must be applied differently to areas in the Columbia Plateau and in small, localized areas of other ecoregions that do not support tree growth. We provide guidance below on how to address riparian ecosystems protection in the Columbia Plateau Ecoregion. Addressing riparian protection in localized treeless areas will likely require site-specific information. However, FEMAT curves are appropriately applied to areas that have been converted from forest to other land uses.

3.5 Delineating Riparian Management Zones

The first step to providing management recommendations is to define the area to be protected. Riparian protections should be focused within the area defined as the Riparian Management Zone or RMZ. The RMZ is the area in which full riparian function can potentially occur, and is thus not synonymous with buffers as used in previous guidance or existing regulations. The RMZ differs from buffers in one important way. Buffers are established through policy, whereas the RMZ is a scientifically based description of the area adjacent to rivers and streams that has the potential to provide full function based on the $SPTH_{200}$ conceptual framework.

3.5.1 *RMZs in Forested Ecoregions of the State*

We use the term RMZ to define the stream riparian ecosystem. To operationalize the definition of the RMZ in areas of the state that currently or historically supported forests, we define the RMZ as the distance of one $SPTH_{200}$ where the $SPTH_{200}$ is the average maximum height attained by dominant trees at 200 years of age, measured from the edge of the active channel or Channel Migration Zone (CMZ; whichever is wider). Measuring the RMZ width at the outer edge of the CMZ ensures that when the stream migrates, it will still be adjacent to the zone of influence that can provide riparian function. We recognize that determining the CMZ may be technically challenging and require additional resources. WDFW can provide technical assistance and work cooperatively with local jurisdictions to delineate CMZs.

3.5.2 *RMZs in the Columbia Plateau Ecoregion*

The conceptual framework for identifying RMZs of the Columbia Plateau Ecoregion (also referred to as the dryland portion of the state, Figure 3-2) is similar in certain ways to the RMZ in non-forested regions. In both cases, the RMZ is based on a historic template of conditions found in those ecosystems (see Volume 1, Chapter 8, and Figure 3-4). However, in contrast to forested areas, vegetation within riparian ecosystems of dryland areas often exhibits an abrupt demarcation between the riparian zone and the zone of influence. Trees, shrubs, and herbaceous plants are confined to moist streamside areas, but the upland zone of influence may consist of sagebrush or bunchgrass communities. Consequently, the processes and functions of the two zones of drylands may be quite different from forested areas. Along some reaches, the riparian zone and zone of influence may both reside within a floodplain. Further, the variety of riparian plant communities is greater in drylands than those of the forested ecoregions. In drylands, differences in hydrology and geomorphology manifest substantial site-level differences in composition and structure of riparian vegetation. These difference have important implications on the defining the RMZ on dryland area.

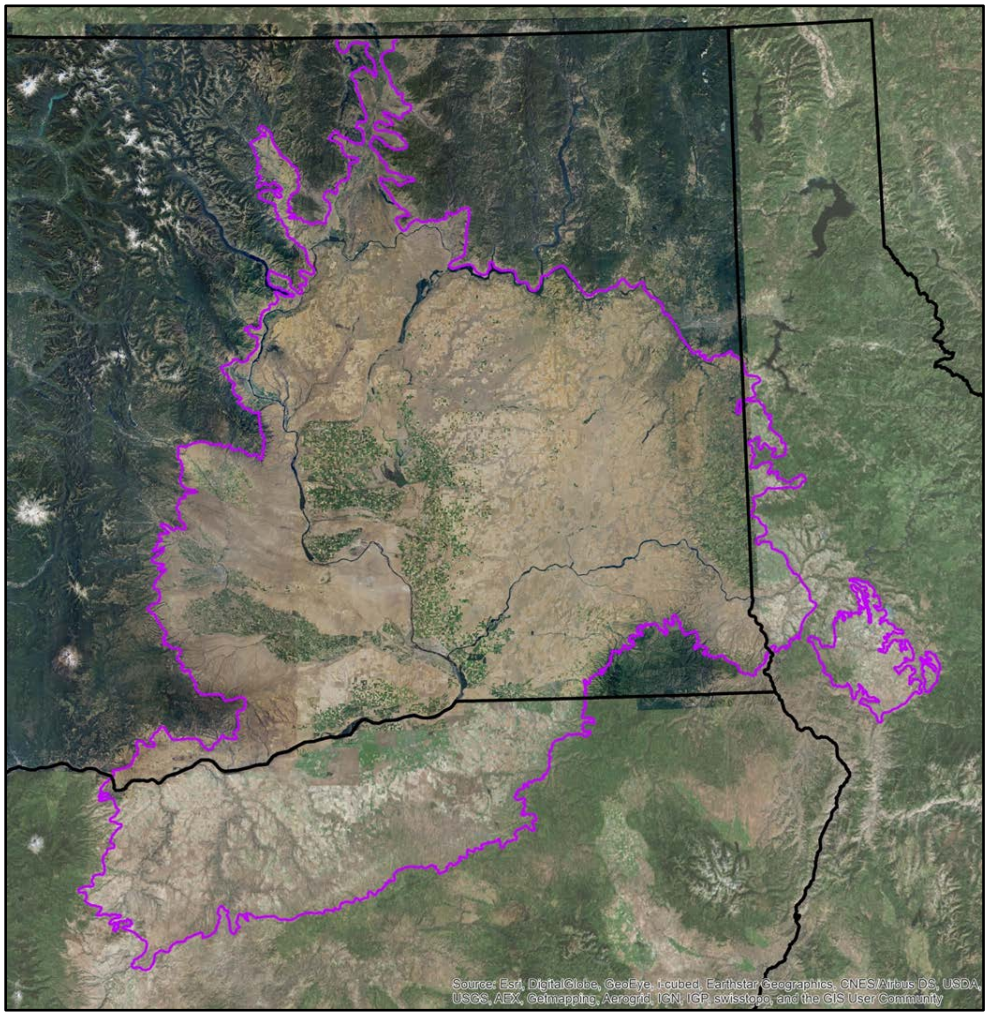


Figure 3-2. Boundary (in purple) of the Columbia Plateau Ecoregion. State boundaries are black. Aerial photography for Washington State done in 2015 by the National Agriculture Imagery Program

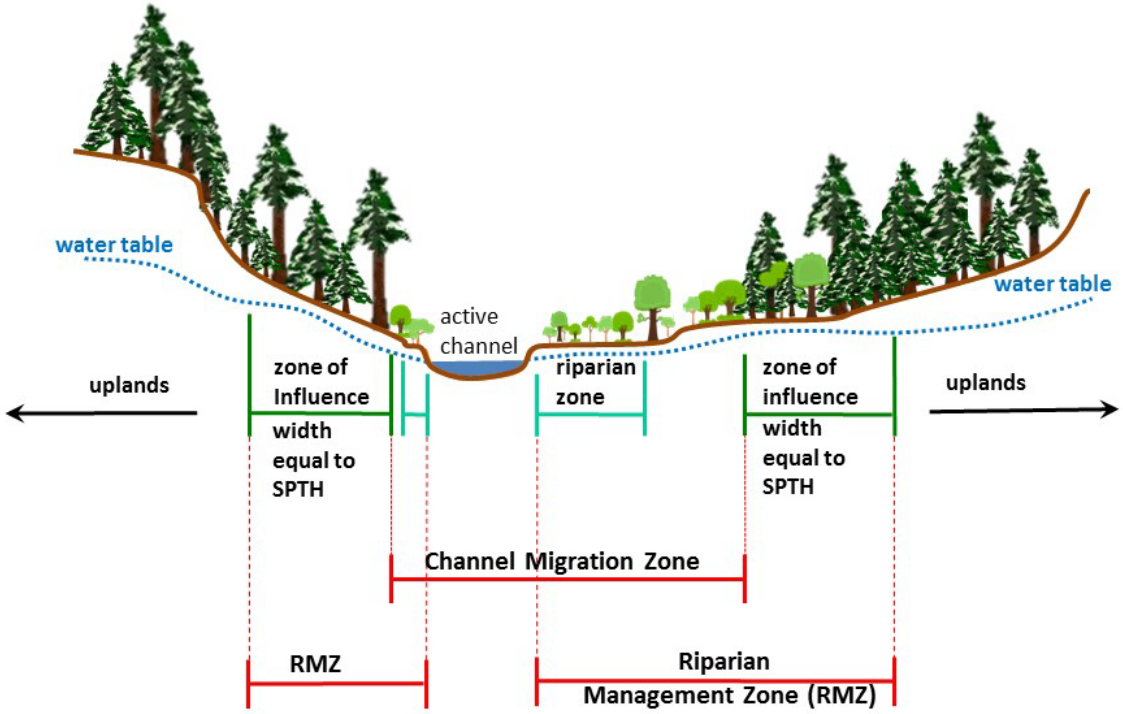


Figure 3-3. A generalized diagram of the riparian ecosystem based on the definition in Chapter 1, Volume 1. The RMZ includes the riparian zone, the channel migration zone (if one exists) and the zone of influence. The zone of influence starts at the outer edge of the stream channel or CMZ. The width of the zone of influence in equal to one $SPTH_{200}$.

WDFW recommends the width of RMZs in the Columbia Plateau ecoregion be based on the widest of three riparian functions: shade, wood (large and small), or pollutant removal. One of those three functions will determine the outer extent of the zone of influence and thus the extent of the riparian ecosystem. For grass, herb, shrub, and small tree riparian vegetation types, the zone of influence based on shade or wood, which depend on vegetation height, will be narrower than the zone of influence based on pollutant removal. If a site's current and anticipated future land uses are not likely to generate pollutants, including sediments due to ground disturbance, then the RMZ width should be based on site-potential vegetation height (i.e., trees or shrubs), which should provide maximum shade and wood for aquatic habitats. If pollutant removal is a concern, then RMZ width should be based on the desired removal efficacy for pollutants created at that site. If, for instance, runoff containing excess nitrogen is a concern and a 95% removal efficacy is desired, then a 220 ft wide RMZ may be needed. See Chapter 6, Volume 1 for more information about pollutant removal. As with RMZs in forested ecoregions, we recommend protecting all riparian ecosystem functions within RMZs in drylands and we recommend local jurisdictions provide No Net Loss of ecosystem functions within this area.

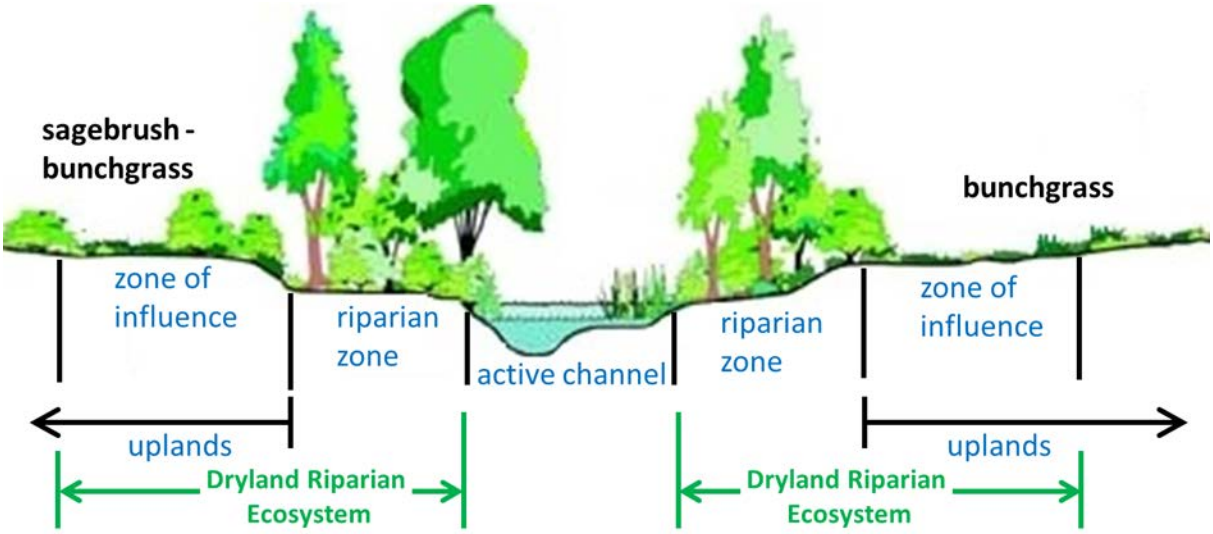


Figure 3-4. Dryland Riparian Ecosystem. The riparian ecosystem consists of two zones: riparian and zone of influence. The riparian zone extends from the edge of the active channel or channel migration zone towards the uplands. This zone includes areas where vegetation is influenced by groundwater or, at least periodically, by overbank floodwaters. Beyond this is the riparian "zone of influence." This includes areas where ecological processes significantly influence the stream, at least periodically. Note that many dryland riparian areas are treeless (Chapter 7, Volume 1).

3.6 Desired Conditions within the RMZ

3.6.1 *Within Washington State Forested Ecoregions*

Our management goal is to protect and restore, full riparian function, wherever feasible, across the stream network. Achieving full riparian function depends on the conditions of the riparian ecosystem. Specifically, full function occurs when riparian areas are unaltered by human uses and development and vegetation in the zone of influence represent mature or relatively undisturbed vegetative conditions (See Figure 3-3). Many rivers, streams, and associated riparian ecosystems throughout Washington have been altered and we recognize that the current conditions do not provide full function. In this section, we articulate the desired future condition if we are able to protect what remains and restore what we can. This vision is based on understanding and protecting riparian functions within the RMZ to meet desired future conditions that are provided by mature/old conifer forests at age 200 years or older.

Forests are complex and dynamic environments, particularly when they occur in riparian areas. Differences in topography, soil type, stream size and other conditions affect the characteristics of the riparian plant communities. Forest community characteristic include the type of vegetation (e.g., species of trees, shrubs, and ground vegetation), vegetation density (number of shrubs or trees per acre), growth characteristics (growth rates, tree size and height, etc.), and standing dead and downed trees.

The structure and composition of old forest varies with forest type, climate, site characteristics, and disturbance regime. Old forests, beginning at about 200 year of age, can be distinguished from younger growth forests by large, physiologically old (for the species and local site conditions) trees

as stand dominants, relatively large range of tree size and spacing, accumulations of dead standing and fallen trees, multiple canopy layers, gaps in the forest, and understory vegetation patchiness.

Along streams where we currently have young forests we recommend avoiding and minimizing activities within the RMZ—a recommendation based on the idea that many young forests will develop toward desired conditions with minimal human intervention. Sometimes forest growth towards desired future conditions can benefit from active management. Active management can include planting trees, thinning overstocked forests to facilitate tree growth, fertilizing forest stands, removing aggressive invasive species like blackberry among other activities. Washington State University (http://forestry.wsu.edu/) provides education and information about forest management to private forest landowners as well as the public.

Meeting desired future conditions in some areas of the state, such as intensively built environments, might be impossible at least in the near term. Where reestablishing a functional forest is currently impossible, we suggest protecting and restoring existing riparian functions wherever possible. In cases where redevelopment is occurring within an RMZ, we encourage both moving structures and roads out of the RMZ and facilitating the establishment of native riparian vegetation, or incorporating targeted restoration to improve ecological functions in other parts of the watershed.

3.6.2 *Within the Columbia Plateau Ecoregion*

The goal for riparian areas of the Columbia Plateau Ecoregion is the same as the goal for forested ecoregions—protect and ideally restore full riparian ecosystem function within the RMZ. As described for forested regions of the state, full function in dryland areas occurs when conditions within the RMZ are relatively unaltered by human use and development (See Figure 3-4). However, management to achieve that goal is more complicated in dryland riparian areas for three reasons. First, there is a greater variety of plant communities within riparian ecosystems of the Columbia Plateau than in the surrounding forested ecoregions. Consequently, the vegetation heights of dryland riparian ecosystems range from grasses and sedges to tall trees such as cottonwoods. Several key ecological functions of riparian areas—namely, shade, wood, and detrital nutrients for aquatic habitats—are dependent on vegetation height. The other two functions—bank stability and pollutant removal—are largely dependent on processes occurring at or below the soil surface.

The second reason management of dryland riparian areas is more complicated is related to water. The existence of riparian areas in drylands depends on soil moisture and water table elevations. Many dryland riparian plant communities evolved under an annual hydrological cycle of flooding followed by gradual recession of stream flows. Dams and water diversions have disrupted this cycle. Water management is likely to have caused adverse changes to riparian plant communities along other rivers and streams in the Columbia Plateau while creating wetlands and riparian areas in places they did not previously exist.

Third, management will be more complicated because many riparian areas in the Columbia Plateau have been badly damaged by human activities, and we do not know their historical conditions. At many sites, we do not even know which human activities—beaver trapping, open-range grazing, timber harvest, water management, or some combination—led to current degraded conditions.

Lacking such information will hamper success of site-scale riparian protection and restoration projects and regional restoration plans. An initial step toward grappling with this issue might be a sub region or Water Resource Inventory Area (WRIA)-level mapping of potential riparian vegetation types. Mapping would incorporate the likelihood of historical beaver habitat and the potential vegetation that could have existed in the presence of beaver. The map would serve three purposes: 1) a vegetation guide for riparian restoration projects, 2) a historical baseline for fish habitat conditions in the Columbia Plateau, and 3) habitat restoration objectives for the recovery of salmon and other aquatic species.

3.6.3 *Riparian Management Zone Recommendations*

Protecting functions within the RMZ is a scientifically supported approach if the goal is to protect and maintain high or full function of the riparian ecosystem for aquatic habitat and species, including salmon. During our review of the literature, we found no scientific evidence to suggest that full riparian function can be met with anything less than protection of the riparian ecosystem. Furthermore, science has not yet identified exactly when reductions in riparian functions will begin to negatively affect fish and wildlife, thus we recommend a precautionary approach that limits risk to fish and wildlife, consistent with WDFW's mandate to protect, preserve and perpetuate Washington's fish and wildlife.

We recommend protecting all riparian ecosystem functions within the RMZ. In forested regions of the state, this translates into the area within one $SPTH_{200}$ from the edge of the stream or Channel migration zone (CMZ). For dryland riparian areas, the width of RMZs should be based on the shade, wood (large and small), or pollutant removal functions (see section 3.5.2; for details see Volume 1, section 5.5). Recall that the RMZ describes the area that has the potential to provide full riparian function, regardless of its current conditions, and thus is the area within which local jurisdictions should provide for No Net Loss. We offer some recommendations in Section 3.10 for how to address RMZ protections in highly altered landscapes.

Using the FEMAT framework, we know that areas closer to the stream have potential to provide a higher level of function than those areas further from the stream on a per area basis. This generally means that the same disturbance to an outer portion of the RMZ reduces riparian function less than disturbance to the inner portion of the RMZ, all else being equal. Likewise, removing a disturbance within an inner RMZ has a larger positive effect on riparian ecosystem functions than removing the same disturbance from an outer portion of the RMZ. The FEMAT Curves provide a useful framework for determining compensatory mitigation for impacts occurring in the RMZ. The FEMAT Curves also can also provide a general accounting system for the relative impacts of management depending on proximity to the stream.

Under the GMA, counties and cities have the responsibility to include scientific information to inform their critical areas regulations. Within the shoreline jurisdiction, that responsibility is shared with Ecology. These regulations, which typically employ standardized numeric vegetative buffer widths, rather than SPTH, have been tested in a number of court decisions, and have been approved by Ecology in shoreline jurisdiction.

WDFW's 1997 riparian habitat recommendations included buffer width recommendations based on stream type (Table 3-1) suggesting that some stream types may be more resilient to reductions in riparian function than others.

Table 3-1. WDFW 1997 recommended buffer widths (called riparian habitat area) to protect riparian functions and associated fish and wildlife, provided as background and context for current recommendations.

Fish Presence	Stream Type	1997 Recommended Buffer Widths (ft)
Fish	Type 1 and 2	250
Fish	Type 3 (5-20 ft wide)	200
Fish	Type 3 (less than 5 ft wide)	150
No Fish	Type 4 and 5 (low mass wasting potential)	150
No Fish	Type 4 and 5 (high mass wasting potential)	225

We recognize that land cover and land use has changed in many riparian ecosystems. In other words, protecting riparian forests from development may no longer be an option available to local governments. In some cases, the RMZ may be largely converted from a naturally vegetated state to homes, industrial uses, roads, dikes, or agriculture, thus reducing riparian functions. Critical areas regulations already incorporate consideration of current conditions. Despite changes to the condition of the RMZ, it is important to remember that the RMZ defines the area within which riparian functions occur and therefore is the area within which protection and restoration can still have a positive impact on aquatic function. For instance, some of the most intensively managed areas such as industrial zones can continue to provide some level of riparian function (e.g., stream bank stability, pollution removal) or could benefit from targeted restoration to restore function relatively compatible with existing land uses.

3.6.4 *Protection for Seasonal and Non-Fish Bearing Streams*

In 1997, WDFW provided recommendations for protection of riparian functions based on DNR's then-current stream classification system, a system that is used less often today than in the past. Table 3-2 includes a comparison between 1997 stream typing system and DNR's current system. We provide this table to assist jurisdictions in updating their CAOs to reflect DNR's current system.

Table 3-2. Stream typing comparison between the old and current DNR classification systems.

Stream Type	Current System	Old System
Shorelines of the State	Type S	Type 1
Fish Bearing	Type F	Type 2 and Type 3
Not Fish Bearing, Perennial	Type Np	Type 4 or 5
Not Fish Bearing, Seasonal	Type Ns	Type 5 or 5

Protecting all existing functions within the areas described within the RMZ across all stream types is the most conservative approach and ensures No Net Loss of functions. WDFW recognizes the challenge of meeting multiple goals as part of the Growth Management Act, where tradeoffs in land use are made to address different stakeholder values. For example, one tradeoff, consistent with some other riparian protection strategies for aquatic species is to reduce the area within the riparian ecosystem that is protected along non-fish bearing perennial and seasonal streams to approximately 60% of a site's SPTH (Table 3-1). As guidance presented here is not tailored to reflect site-specific conditions and needs of the local jurisdiction, we encourage consultation and guidance from regional WDFW Habitat Biologists to assist with site-specific RMZ distances for non-fish bearing and season streams.

3.6.5 *RMZ Delineation*

There are multiple methods for using the information we provide to define the extent of the riparian ecosystem: 1) a parcel-specific approach and 2) a countywide approach. The parcel-specific approach is because each parcel within a county can have a unique $SPTH_{200}$ that must be determined by consulting the NRCS database and would result in a range of $SPTH_{200}$ values across the county. The countywide approach is based on local governments choosing a distance within the riparian ecosystem in which all landowners are expected to protect riparian functions. A countywide RMZ distance raises concerns about over- and under-protection that a parcel-specific approach does not. For these reasons, we encourage local jurisdictions to consider carefully prior to refining their existing approach or in choosing a new approach based on these two options.

The parcel-specific approach more accurately defines the riparian ecosystem and ensures that there is minimal over- or under-protection. We know of several ways that one can obtain a parcel-specific SPTH. The Washington Department of Natural Resources (DNR) provides online interactive maps of site productivity classes for much of the nonfederal and nontribal forestlands in Washington (http://www.dnr.wa.gov/). Because much of much of the landscape outside forests is not mapped by DNR, you can also consult the Web Soil Survey (WSS) provided by the Natural Resources Conservation Service (NRCS) (http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm) that describes site class associated with other riparian areas. Appendix 1 provides guidance on how to use these websites and how to translate site productivity classes to $SPTH_{200}$. Please note that despite the large area covered by these maps, they do not provide universal coverage for all riparian areas. In other words, site productivity classes are not mapped for some areas of the state.

If site-specific information on forest productivity (i.e., site index) in unavailable, then we recommend use of SPTH equal to the third quartile of the SPTH histogram for your county. We explored the idea of determining missing site class information for a site using site productivity information from adjacent areas. However, we found no scientifically credible and practical methodology for determining site productivity class for an area based on information from adjacent areas and therefore have not pursued this strategy further. The other strategy for determining site productivity class requires fieldwork that identifies soil type and, potentially, information on tree growth at that site. Trained foresters may be able to provide this service. The site-specific

approaches are more complicated and expensive for property owners but they do resolve concerns of over- and under-protection raised by a countywide RMZ method that we describe below.

For greater predictability and a less arduous process for property owners, WDFW provides county-specific SPTH for most counties in Washington State in Appendix 2. We provide two examples of RMZ distances for Snohomish (Figure 3-5) and Spokane (Figure 3-6) counties here. In each example, we plotted the percent of stream miles in that county by $SPTH_{200}$ category. These plots or histograms were created by analyzing $SPTH_{200}$ along all streams in Snohomish and Spokane counties using the methods described in Appendix 2. Means, medians, and quartiles were calculated using stream miles. The mean 200-year SPTH of a county, for instance, was calculated as a stream-length weighted mean. The median represents the 200-year SPTH that is greater than the SPTHs along half the stream miles in a county and less than the SPTHs along the other half of stream miles. The third quartile splits the bottom 75% of the stream miles from the top 25%.

Snohomish County is generally representative of RMZs found on the west side of the Cascades while Spokane County is representative of east side forests. Note that the $SPTH_{200}$ in Spokane County is smaller than Snohomish County, which reflects the different growing conditions and tree species between different regions.

Recall the definition of RMZ as the area that can provide full riparian function and thus should be assessed for improved protection, restoration, or mitigation to achieve No Net Loss. Buffers, which are often vegetated, protect the stream from the impact of adjacent land uses and should be established within the RMZ. The best buffer provides riparian functions similar to old forest conditions.

Local jurisdictions have adopted a variety of approaches to establishing buffer widths. One approach is to designate inner- and outer- buffer zone definitions within the RMZ to reflect varying levels of protection or of current conditions. This approach may help communicate the important idea that relatively undisturbed vegetated areas closer to the stream provide a greater percentage of the functions than those areas further from the stream. The inner zone should have strict restrictions on any development while minimizing and mitigating any incursion into the outer zone. The exact distance for the inner and outer zone would be determined for each county based on current conditions and the goal of achieving No Net Loss within the RMZ.

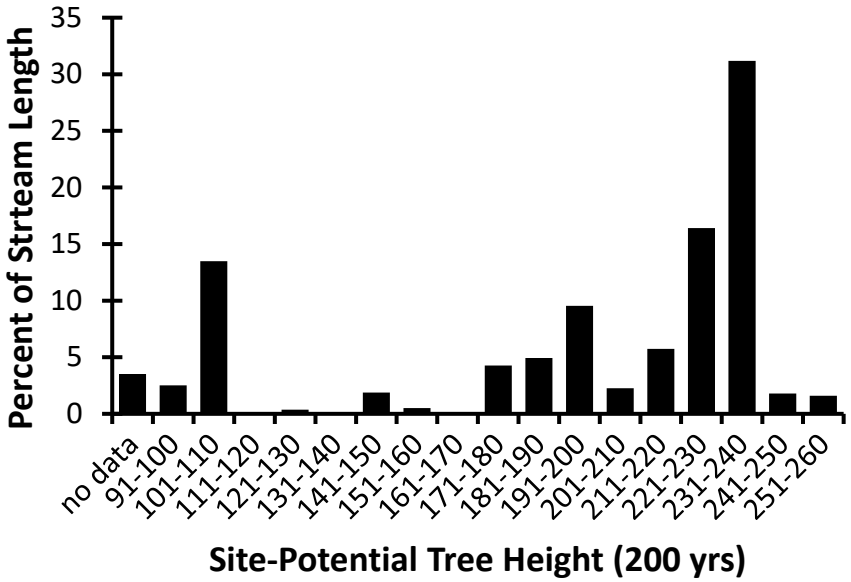


Figure 3-5. SPTH by percent of the total stream length in Snohomish County. The third quartile is 235 ft and is the middle value between the median and the highest value of the data set of SPTH for the county. Stream miles roughly correspond to the amount of riparian area in a county, and no "no data" indicates that the soil-type polygon did not provide a site index value. See Appendix 2 for more information.

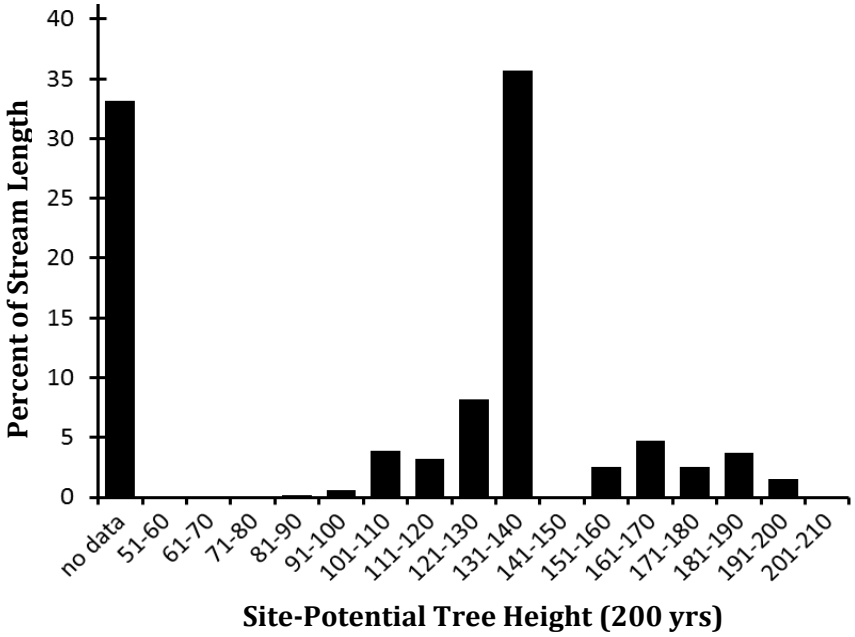


Figure 3-6. SPTH by percent of the total stream length in Spokane County. The third quartile is 137 ft and is the middle value between the median and the highest value of the data set of SPTH for the county. Stream miles roughly correspond to the amount of riparian area in a county, and no "no data" indicates that the soil-type polygon did not provide a site index value. See Appendix 2 for more information. Parts of southern Spokane County are in the Columbia Plateau ecoregion. We provide different riparian protection recommendations for those dryland areas (see below).

3.7 Channel Migration Zones and Floodplains

Protecting the Channel Migration Zone from incompatible human uses (e.g., development, impervious surfaces) is important for providing riparian ecosystem function. Human alterations to river channels that limit channel migration and bank erosion can degrade aquatic and riparian habitats. However, lateral channel migration and related streambank erosion can leave human communities at risk along river systems. For these reasons, geomorphologists have developed protocols for determining the CMZ. A channel migration zone includes the outer extent of known historical channels, plus potential future migration over the next 100 years, and they typically encompass floodplains and some portion of terraces (landform remnants of the former floodplain). CMZ delineation considers the historical migration zone, which is the collective area that the channel has migrated through in the historical record, the avulsion hazard zone, or areas not in the historical record that are at risk of avulsion, and also the erosion hazard area, which is the area at risk of bank erosion from stream flow or mass wasting over the timeline of the CMZ. The CMZ also includes channels and terrace banks that are at risk of mass wasting due to erosion of the toe.

Some counties and cities have defined the CMZs and incorporated protections for these areas (Table 3-3). We recognize the additional costs associated with efforts to delineate CMZs but note migrating river channels present substantial, yet avoidable, risk of catastrophic damages to private property and public infrastructure, and a threat to human safety. Many jurisdictions map the general location of CMZs during periodic Shoreline Master Program updates (WAC 173-26-221 (2)(c)(iv)(A)).

We rely on Washington State Forest Practices Board Manual[3] to operationalize the description, definition, and methods to delineate the CMZ for local governments. The manual defines the CMZ as "the area where the active channel of a stream is prone to move and this results in a potential near-term loss of riparian function and associated habitat adjacent to the stream, except as modified by a permanent levee or dike. For this purpose, near-term means the time scale required to grow a mature forest." In this definition, "mature" refers generally to a forest 140 years of age. Conceptually, this means that the CMZ would be based on where the active channel had been over the last 140 years.

Smaller streams, not part of the SMP, may also have CMZs. In cases where the SMP does not apply, jurisdictions should still analyze and identify the CMZ to protect the riparian ecosystem but also public health and safety. WDFW also recognizes that in many urban, agricultural, and suburban environments, rivers have been confined by infrastructure, dikes and levees that restrict channel migration. These structures are part of the current landscape and have fundamentally changed the ability of the RMZ to contribute to the functions of the aquatic system. In these cases, non-regulatory multi-benefit floodplain restoration programs such as Floodplains by Design are the most effective approaches to bringing back channel migration and floodplain functions.

[3] https://www.dnr.wa.gov/about/boards-and-councils/forest-practices-board/rules-and-guidelines/forest-practices-board-manual

1341 **Table 3-3. Examples of approaches by local government taken to incorporate protections for the channel**
1342 **migration zone.**

Jurisdiction	How CMZs are protected	Reference	Standard
Jefferson County	CAO: Critical Areas: Geologically Hazardous Areas (Rivers for which CMZs have not been mapped are not regulated). SMP: Within shoreline jurisdiction CMZs impact residential development, transportation facilities and flood control structures.	CAO: JCC 18.22.160 SMP: 18.25.380, 18.25.500, 18.25.520	CAO: Buildings are required to be outside the full extent of high risk CMZs. SMP: Residential development within a CMZ is prohibited. New transportation facilities shall be designed to avoid impacts to CMZs. New shoreline uses (including subdivision) would likely require flood control structures in the CMZ should be prohibited. The County's GIS shall show the limits of the CMZ.
King County	Critical Areas: Geologically Hazardous Areas and Frequently Flooded Areas Shoreline Management Program	KCC 21A.24.045 21A.24.275 21A.24.358 21A.25.200 21A.06.475	Alterations within CMZs are subject to several requirements to limit impacts. Many rivers' CMZs are mapped per local criteria; site-specific maps can be prepared if there is a site-specific discrepancy. Recorded subdivisions and binding site plans shall show CMZ boundaries. Aquatic buffers extend to the outer edge of a severe CMZ, if mapped. In CMZs, development shall be located and designed to avoid the need for future shoreline stabilization
Whatcom County	CAO: Erosion Hazard Areas	WCC 16.16.355 16.16.740	New residences shall be located outside identified channel migration hazard areas. Stream buffers for streams with identified CMZs shall extend outward from the outer edge of the CMZ.

1343 Floodplain protection is largely addressed through provisions for Frequently Flooded Areas (FFA)
1344 in CAOs. Floodplains are already mapped by jurisdictions as part of the FEMA flood insurance
1345 programs. The Department of Commerce recommends that classifications of FFAs should include, at
1346 a minimum, the 100-year floodplain designations of the FEMA National Flood Insurance Program
1347 (NFIP). Final updated FEMA maps must be adopted into the local floodplain management ordinance
1348 in order for properties in a jurisdiction to retain flood insurance coverage. CAOs should reference
1349 FEMA's final updated maps. Final (effective) and many preliminary Flood Insurance Rate Maps can
1350 be found at https://msc.fema.gov/portal.

1351 Jurisdictions in the Puget Sound basin must meet the procedural and substantive requirements of
1352 the National Marine Fisheries Service's (NMFS) Biological Opinion on the NFIP. FEMA has the

ultimate authority for determining the adequacy of Endangered Species Act (ESA) Biological Opinion (BiOp) compliance. Implementing the FEMA guidance will assist local governments in addressing compliance with the BiOp. CAO updates provide an opportunity for local governments to include or reference procedures for BiOp implementation in their Floodplain Management Regulations or combined Floodplain Management Regulations/Critical Areas Ordinances. This will help ensure that all staff and other parties are aware of these procedures required to comply with the BiOp. The primary source of guidance for BiOp implementation is FEMA's web site at https://www.fema.gov/national-flood-insurance-program-endangered-species-act.

Ecology provides technical assistance to local governments that need to comply with FEMA NFIP regulations and GMA requirements.

Recommendations:

- Prohibit new development in the 100-year floodplain.
- Prohibit new dikes, levees, tide-gates, floodgates, pump stations, culverts, dams, water diversions, and other alterations to the floodplain, excepting habitat improvements such as a wider culvert for fish passage.
- Develop flood hazard reduction plans and ordinances.
- Identify opportunities for and encourage restoration of side channel habitat for salmonids as mitigation for modifying existing floodplain structures where feasible.
- Increase opportunities for land exchanges that retain or restore floodplain and delta habitats.
- Develop accurate floodplain mapping, using lidar mapping and parcel information to help determine local areas of flood hazard.

Find additional resources at:
http://www.ecy.wa.gov/programs/sea/floods/FloodedAreaGuidance.html.

3.8 Project-Specific Riparian Habitat Management Plans

When reviewing proposed projects near streams, local governments typically require applicants to provide site-specific, detailed Habitat Management Plans (HMP, some jurisdictions and state agencies refer to this as a Critical Area Report). This section describes our recommendations for six aspects of Riparian HMPs that we recommend local government address in their CAOs:

1. When HMPs are required
2. Critical areas delineated
3. Land use actions identified
4. Mitigation
5. Monitoring and Adaptive Management
6. Who prepares and reviews them

When required: We recommend a Riparian HMP be prepared whenever a land use action (including subsequent impacts such as stormwater runoff or removal of danger trees) has the potential to impact the riparian functions or aquatic habitat. Regardless of the jurisdiction's regulatory stream buffer, an HMP should be required whenever there is potential impact to the *riparian ecosystem, i.e., the RMZ*. The distance between stream and area of impact at which a Riparian HMP is required can be smaller (e.g., within 1.5 times the width of the RMZ) when the location of all streams, floodplains,

CMZs, steep slopes, wetlands, etc. is reliably known. Conversely, in cases where there is less confidence in the spatial accuracy of such features, a Riparian HMP should be required when impacts occur at larger distances (e.g., within 1,000 ft). Maps are important tools for triggering Riparian HMPs. Local jurisdictions should require a Riparian HMP whenever a reliable map indicates a stream is present. Stream location data that should be consulted include DNR's stream typing (available at http://data-wadnr.opendata. arcgis.com/datasets/wa-hydrography-watercourses) and Ecology's National Hydrography Dataset (available at http://www.ecy.wa.gov/services/gis/data/inlandWaters/nhd/NHDdownload.htm), and, if available, stream channels identified via lidar. Land use actions that should be informed by a Riparian HMP include subdivisions (plats, short plats, and large lot subdivisions), land/vegetation disturbing activities (e.g., clearing and grading, septic drain field siting), stormwater routing, and development activities.

We recommend an HMP be prepared whenever disturbances occur within the RMZ (Figure 3-3 and Figure 3-4). Because of the inaccuracy of mapping tools, local jurisdictions will typically require an HMP if land disturbing activities occur within 1,000 ft of a potential critical area.

Critical Area Delineation: HMPs should delineate the extent of the critical area and identify ecosystem functions and values that should be protected as land use changes. A Riparian HMP should map the inner edge of the RMZ by identifying the Ordinary High Water Mark, CMZ (if available), and floodway and using either the county-specific RMZ or use a site-specific methodology described previously. Riparian HMPs should include delineations of wetlands, geologic hazards, frequently flooded areas, and critical aquifer recharge areas. They should identify the salmon and other aquatic species that use the stream network in the immediate vicinity as well as up- and downstream. Likewise, HMPs should identify terrestrial Priority Species that use the riparian corridor and larger blocks of habitat to which the corridor is connected. HMPs should discuss relevant management recommendations for Priority Habitats and Species found on or near the site. Finally, these delineations are valuable information that should be 1) attached to the property's title to inform future owners of the property's critical areas, and 2) used to update the jurisdiction's critical area maps.

Land Use Action Identification: HMPs should discuss relevant management recommendations for Priority Habitats and Species found on or near the site. The HMP should depict the location of proposed land use actions, including the management of stormwater. It should quantify the area within the RMZ (and other critical areas and their buffers) that are impacted by the proposed land use action. It should also identify current disturbances to the RMZ and other critical areas.

Mitigation: The HMP should describe how the mitigation sequence has been followed for the proposed project. It should describe measures taken to avoid impacts and minimize unavoidable impacts through clustering, conservation easements, signage, seasonal construction restrictions, etc. It should propose compensatory mitigation to offset any degradation to ecosystem functions. Mitigation ratios should be used that reflect proximity to stream (high credits/debits for activities in the inner RMZ) and duration of impact (higher for perpetual impacts). The HMP should identify ways that ecosystem function could be improved by enhancing riparian corridor connectivity (e.g., removal of stream barriers) and by improving the quality of the riparian area (e.g., replacing invasive vegetation with native).

Monitoring and Adaptive Management: The HMP should recommend requirements regarding compliance and potentially, effectiveness monitoring. It should identify specific standards the project is expected to provide (e.g., aerial extent of vegetative cover, composition of riparian tree species, extent of invasive vegetation, water quality). It should identify the periodicity of monitoring (e.g., at year 1, 2, 3, 5, 8, and 10). The HMP should also specify triggers at which additional actions are required (e.g., replanting, removal of invasive vegetation, installation of water quality treatment facilities). It should specify who is responsible for preparing, reviewing, and submitting reports. Finally, the report should contain an estimate of the costs of implementing the monitoring; the project proponent should post a bond for this amount.

Preparer and Reviewer: Riparian HMPs should be prepared by a qualified professional biologist, botanist, or ecologist; additional expertise related to CMZs, unstable slopes, and wetlands may also be necessary. The Riparian HMP should be reviewed by an independent professional with similar qualifications. WDFW's Regional Habitat Biologists can often serve in this role, especially for larger projects. If federally listed species are involved, the HMP should also be reviewed by the USFWS or NOAA Fisheries.

3.9 Recommendations for Common Activities in the RMZ

Critical Area Ordinances are adopted to protect functions of riparian ecosystems from the many types of land use activities that can adversely affect them as described in Volume 1. The Shoreline Master Program will have specific allowances, exemptions and exceptions within SMA jurisdiction, as required by Ecology SMP guidelines (WAC 173-26). For CAOs, local governments should regulate all land use activities that are likely to impact the functions of a riparian ecosystem found within the RMZ. At a minimum, it is important to establish provisions and standards that ensure No Net Loss of ecological function and values for any activity that directly impacts or is likely to impact riparian functions.

We provide information and recommendations for each of the following activities:

1. On-site Sewage Systems
2. Bank hardening
3. Clearing, grading, and placement of fill
4. Removal of noxious weeds
5. Forest practices and conversions
6. Firewise and fire hazard reduction
7. Removal of hazard trees
8. Non-compensatory restoration and enhancement
9. Emergency activities
10. Educational or Recreational Areas

3.9.1 *On-site Sewage Systems (OSS)*

A properly sited and maintained OSS provides effective replenishment of shallow aquifers, contributing to summer base flows. Historically, many OSS have been constructed in low elevation areas that border streams, lakes and wetlands in order to take advantage of the passive gravity flow. However, we have known for a long time that drainfields associated with water features can

deliver high loads of both fertilizer and toxic pollutants resulting in significant cumulative impacts to the flora, fauna and water quality. Fortunately, modern on-site sewage systems depend less on gravity and more on pump systems that move water from tank to drainfield thereby delivering and processing effluents at higher elevations and away from streams, lakes and wetlands. The State Department of Health has adopted rules implemented in part by local health offices that establish public health standards for location, design, installation, operation, maintenance, and monitoring of on-site sewage systems, including requiring setbacks from waterbodies (WAC 246-272A). If public health standards allow for an OSS within a RMZ, local jurisdictions should exercise their authority to ensure critical area protection goals are also met, as informed by a HMP.

3.9.2 *Bank Hardening*

Avoid permitting development that will require bank protection. Allow new bank stabilization of shorelines only after an imminent threat to existing residential or business structures or critical public facilities has been demonstrated by a geotechnical or hydrologic analysis and reviewed by a qualified third party. Structure relocations and bioengineering alternatives to hard armoring should always be considered first. Require proposed bulkhead rebuild projects to evaluate the effectiveness of bioengineering alternatives and current need. If bank protection cannot be avoided, follow bank protection recommendations in the Washington State Integrated Streambank Protection Guidelines (http://wdfw.wa.gov/publications/00046/).

3.9.3 *Clearing, Grading, and Placement of Fill*

There are direct and cumulative effects of clearing, grading, and placement of fill activities. We recommend that CAOs address these activities due to significant and direct impacts to riparian ecosystems. Require a habitat management plan, prepared by a qualified professional, for any vegetation clearing within the RMZ. Consideration should also be given to assessing the temporal loss of function(s) from such clearing. Although functions recover over time through plant community succession, interim measures to enhance recovery times and trajectories should be implemented. Preferably, some measures (e.g., replacement plantings) should be conducted prior to or concurrent with clearing activities to minimize overall temporal losses. A qualified professional must prepare the plan (e.g., arborist).

If a local jurisdiction exempts small areas from filling or grading ordinances in riparian ecosystems, they should analyze and document potential cumulative impacts of such exemptions and mitigate the expected cumulative impacts. This could include an in-lieu fee, mitigation, and/or restoration programs to improve riparian functions, provided that restoration programs are evaluated to ensure the No Net Loss goal is likely to be met. Ensuring mitigation implementation effectively provides expected benefits would require the establishment of short- and long-term monitoring.

3.9.4 *Removal of Invasive Plants and Noxious Weeds*

Many CAOs do not require a permit for control and removal of noxious weeds within riparian ecosystem (as well as other critical areas). We support this if the weed control is 1) done by hand with light equipment, or using Ecology-approved aquatic herbicides and adjuvants, 2) does not involve the use of hazardous substances, and 3) does not result in compacted soils. Local

governments should retain some oversight authority when more extensive control methods are proposed to make sure that riparian functions, especially water quality, are adequately protected. Most communities issue an exemption letter or permit which could be conditioned to ensure impacts are minimal.

In certain circumstances, plants that are native and not typically considered invasive can nonetheless be detrimental to the habitat. An example is conifer species that—in the absence of fire—outcompete native deciduous species (primarily Oregon white oak) in Puget Sound Prairies. The removal of conifers and the re-establishment of historical conditions in such ecological systems within the RMZ should be guided by a Habitat Management Plan prepared by a qualified professional. WDFW Area Habitat Biologists can assist with preparing and reviewing such actions.

3.9.5 *Forest Practices and Conversions*

The state's Forest Practices Act (RCW 76.09 and WAC 222) regulates forest practice activities on forestland. When conducting commercial forest practice activities, the forest practice rules apply for the protection of the resources on site and not the critical areas ordinances. Lands converted from forestry to another use require a special forest practice permit. The local jurisdiction or the DNR may be the lead on that permit depending on the status of jurisdiction. When converting the land, the critical areas protections are applied. We suggest that the proponent always contact DNR prior to conducting such activities.

3.9.6 *Firewise and Fire Hazard Reduction*

Fire is a concern in forested areas of Washington though the threat of fires varies across the state and among watersheds. Local regulations should require that fire hazard reduction is accomplished in coordination with a Firewise program and that the removal of trees within the riparian area is done under consultation with a Firewise professional (http://www.dnr.wa.gov/firewise). Due to the change in fire regimes throughout Washington, current forest stands do not necessarily reflect historic conditions. For instance, in southwest Washington, many riparian areas have transitioned from a mixed hardwood/conifer to Douglas-fir dominated stands. Understanding the composition of historical forest stands can help ensure retention of riparian functions. When fuel reduction efforts involve the removal of merchantable trees, the proponent should check with the local jurisdiction and DNR, who may require a permit for tree removal.

3.9.7 *Removing Hazard Trees*

Trimming or removal of hazard trees in riparian areas should be considered in light of the change to riparian function and balanced with public safety. "Hazard" trees should be defined as a threat to life, property or public safety, and removing the tree should not adversely affect the functions of the riparian ecosystem. We recommend that the local government involve a qualified arborist to evaluate requests to remove a hazard tree. The qualified arborist should have an understanding of the functions of riparian ecosystems and an ability to establish that the hazard tree presents an imminent threat to life, property or public safety.

Some local governments use Forest Practice Rules (WAC 222-21-010(4)) which define a hazard tree as "any qualifying timber reasonably perceived to pose an imminent danger to life or improved

property." This applies to any tree within 1.5 tree-lengths of the structure. A DNR forester can provide a site visit to verify that the timber being removed is, by DNR definition, a hazard tree and not subject to forest practice jurisdiction. This allows tree removal without a Forest Practice permit. We also recommend referring to Department of Commerce's definition for hazard trees.

We recommend local jurisdictions include conditions that limit impacts to riparian areas, including:

- Minimal compaction of soils within the RMZ
- Replacement of tree either in-kind or with native species that are underrepresented in the community
- Revegetation with native species, and
- Leaving the wood in or adjacent to the stream for fish habitat if it does not create a hazard

Creation of "view corridors" and the removal of healthy trees in a riparian ecosystem under the pretext of control of hazard trees should be limited. When trees are removed, a restoration plan should be required. In some instances, pruning (not topping) of trees for a view corridor may be considered by a jurisdiction as appropriate. A management plan for maintaining a view corridor, prepared by a certified arborist, should be required by the jurisdiction. The plan should also be reviewed by qualified staff or an arborist. This approach is recommended to reduce the cases of illegal clearing to create a view, leaving the jurisdiction to deal with an enforcement action. Finally, it is important that when homes are being sited, that the riparian ecosystem is considered and that the home is not placed such that hazard tree removal is foreseeable.

3.9.8 *Restoration and Enhancement*

Restoration and/or enhancement of riparian ecosystem, including in channel or streamside work, should be encouraged in critical areas regulations, especially on lands set aside for conservation. There are significant resources available to cities and counties that identify limiting factors or high priority restoration activities to benefit salmon and terrestrial organisms and ecosystems. Refer to Chapter 4 for additional information on restoration and other voluntary actions. Re-planting activities should promote native vegetation with species consistent with historical conditions of ecological systems native to the local area. Restoring riparian areas within agricultural lands is discussed in Chapter 4.

It may be appropriate for a local government to set up a separate streamlined review process for restoration or enhancement projects. Streamlined review processes should focus on facilitating projects while still complying with requirements of the local protection program under the assumption that short-term impacts will be compensated by long-term benefits. This assumption should be evaluated as part of an adaptive management program.

3.9.9 *Emergency Activities*

Local codes typically include provisions for emergency activities. These are intended to provide relief from procedural requirements of the code, namely from time delays associated with obtaining a permit prior to responding to an emergency. Local regulations should clearly differentiate between the need to quickly permit the emergency activity and providing any compensation needed for the emergency activity after-the-fact. There is rarely a practical justification for

exempting emergency activities from having to provide compensatory mitigation after-the-fact when the emergency action results in adverse impacts to the riparian ecosystem (or other critical areas).

3.9.10 *Educational or Recreational Areas*

It may be desirable to allow some focused use of the RMZ for educational and recreational activities while still preventing widespread disturbance. Most CAOs include allowances for unpaved access to a stream for aesthetic or recreational enjoyment with defined limits on clearing to avoid impacts and minimize disturbance of the soil, vegetation, and habitat. Additionally, providing educational or recreational developments such as trails, viewing platforms, or similar facilities may enhance the public's understanding and appreciation of riparian areas, streams and their functions and values. Public access to shoreline is a priority use under the Shoreline Management Act. Construction of trails can allow greater access for pets and may increase predation on fish and wildlife species. Regulations should minimize the impacts from trails and interpretive facilities to the extent practicable.

3.10 Riparian Management Zones in Urban Areas

A frequent concern about RMZs is their applicability to urban and urbanizing areas. The concerns generally fall into two categories: 1) the science on RMZs comes largely from agricultural and forestry settings and is perceived to be irrelevant to urban areas; and 2) the need to maximize density of development in urban areas is in direct conflict with the protection of riparian areas.

The concern over the relevancy of the literature on riparian functions to urban areas is largely unfounded. While most of the studies of riparian ecosystems and their impact on aquatic systems are in non-urban settings, the principles are the same. The same functions of shade, large wood recruitment, nutrient inputs, sediment filtration, nutrient, and pollutant removal operate similarly in urban areas as they do in rural settings. However, these riparian ecosystem functions are often not present or are greatly diminished in urban areas. Lawns that drain into streams rather than into stormwater collection areas are providing virtually no riparian ecosystem functions and should be discouraged. A good stormwater management systems may be needed to replace the riparian ecosystem's lost capacity to perform filtration and pollutant removal functions.

The role of the RMZ in providing needed habitat for aquatic species and many terrestrial species is performed similarly. In fact, a case can be made that RMZs in urban areas are even more important from a habitat standpoint because there may be less upland habitat available. The factors that may be different in urban areas are that urban riparian ecosystems may perform some functions at a lower level because of degradation and development of the watershed. However, intact RMZs in urban areas function as habitat corridors and are critical to many species. A key element to maintain in the RMZ is connectivity along the stream, both in the water and streamside portion.

Many populations of Puget Sound salmon move from the ocean through channelized streams, traversing heavily urbanized areas prior to reaching spawning grounds. Salmon must pass through a wide spectrum of development from the urban core (e.g., downtown Seattle) where streams are often channelized, either above or below ground, through areas with small lots and high urban density, into suburban creeks where larger lots allow for more protection of the riparian

ecosystem, and finally to rural lots with lower levels of development and better habitat. Therefore, it is critical that the urban environment maintain and enhance the ability of salmon to survive through these disturbed areas. With changes in urban infrastructure, there may be opportunity to improve functions in the urban environment. In these urban settings, it is critical to maintain connectivity through properly sized culverts such that fish can pass through at all relevant life stages. A landscape analysis can help identify existing connections that should be protected as well as areas where connectivity can be restored. Combined with standards for low impact development and state-of-the-art stormwater management, this kind of approach is practical and may result in positive outcomes for salmon and other aquatic species.

Recommendations for urban riparian ecosystems:

1. Delineate the RMZ in urban areas as described above. This is where the historical riparian functions would have occurred and may be used to identify areas for restoration.
2. Consider current conditions when reviewing regulations with the ultimate goal of maintaining remaining functions through regulations and improving functions through voluntary restoration.
3. Maintaining and enhancing connectivity laterally along the stream is critical. Prioritize in-stream connectivity and connectivity of riparian vegetation along the stream.
4. Areas closer to the stream provide the greatest conservation benefit and should be prioritized for replanting or restoration.
5. Adopt a stormwater design manual equivalent to Ecology's most current version of "Stormwater Management Manual for Western Washington" or "Stormwater Management Manual for Eastern Washington." The minimum requirements of these Ecology manuals for new and redevelopment should be used, including the flow control and treatment standards.
6. Use the Low Impact Development (LID) approach and techniques to better manage stormwater for new development, redevelopment and retrofit projects. This includes: limit land clearing, retain and, where necessary, restore native vegetation and soils, minimize site disturbance and development footprints, limit impervious surfaces through use of permeable pavement or other techniques, create graded swales and rain gardens to disperse and infiltrate stormwater runoff on site, and utilize rainwater catchment for landscaping irrigation.
   http://www.ecy.wa.gov/programs/wq/stormwater/municipal/index.html
7. Protect riparian functions that remain, especially in places that are relatively high functioning; implement actions that enhance degraded functions:
   a. Plant trees and native shrubs, especially along the stream edge.
   b. Avoid operating equipment and disturbing soil near the stream.
   c. Avoid using chemicals (fertilizers, herbicides) within the RMZ.
8. When replacing or removing existing infrastructure within a SPTH of a stream
   a. Begin by mapping the SPTH such that there is an understanding of where restoration would be best for improving riparian functions.
   b. Consider daylighting streams, improving connectivity through culvert replacement.
   c. Shift development away from streams.
   d. Enhance the riparian area closest to the stream with native vegetation.

e. Consider limiting access or concentrating access such that soil compaction is limited to viewing or access areas.
f. Avoid operating equipment and disturbing soil to avoid erosion or loss of vegetation near the stream.
g. Avoid use of chemicals (fertilizers, pesticides) within the riparian zone.

3.11 MANAGING WATERSHEDS

In the remainder of this chapter, we highlight key elements of watershed management that are important to protecting functions of aquatic systems. Many of these approaches are non-regulatory and will complement regulatory efforts undertaken by jurisdictions. A watershed can be defined as an area of land where all of the water that falls on it ultimately drains off to a common outlet. WDFW recognizes that protecting and restoring the riparian ecosystem alone will not necessarily ensure that the functions and values of the aquatic systems are maintained due to the influence from the watershed. As described in Chapter 8 of Volume 1, land use activities in a watershed can negatively impact the stream system even when the riparian ecosystem is relatively undisturbed. "Watershed management" is a land management approach that seeks to minimize upland land uses that can negatively affect the aquatic system (streams, wetlands and groundwater) in that watershed.

Local jurisdictions have been managing land use—with special provisions for riparian areas—for a quarter century under the GMA. Shoreline areas have been managed for nearly half a century under SMA. The importance of watersheds and their management is not a new concept, and we recognize that many communities have existing watershed-scale plans to recover salmon, manage growth, address water pollution and water resources, provide for wildlife habitat, and connectivity of landscape and aquatic systems. Below we provide a brief summary of recent science and overarching watershed management recommendations in support of the aquatic ecosystem. We also provide a few examples of watershed planning tools available to communities.

Fully functional riparian ecosystems, in combination with targeted watersheds protections provide significant benefits to humans. These benefits, often described in terms of ecosystem goods and services, include provisioning services such as food and water; regulating services such as decreasing flood flows; supporting services such as nutrient cycling, sediment and pollutant filtering, and carbon sequestration; and cultural services such as recreational, spiritual, and other nonmaterial benefits. These services provide real but often unquantified economic benefits to individuals and society; benefits that largely go unnoticed until they are lacking.

3.11.1 *Scientific Foundation for Watershed Management*

Key concepts from Volume 1 that form the foundation for this section are summarized below:

- *Watershed processes* are defined as the dynamic physical and chemical interactions that form and maintain the landscape and ecosystems on a scale of watershed to small basins. Watershed processes include the movement of water, wood, sediment, organic matter and nutrients.

- *Connectivity* is a key watershed attribute affecting the functionality of a watershed (how watersheds work). Watershed are strongly organized by the downhill movement of water, sediment and wood, and so rivers commonly display systematic patterns in the downstream direction. They also display systematic cross-stream flow or horizontal patterns between the stream channel and its adjacent floodplain; and to a less visible but still significant degree in the vertical dimension as well, particularly the interaction of shallow groundwater (hyporheic) flow with streamflow.
- Watershed connectivity is primarily related to maintaining these flows. Protected riparian areas are generally successful at maintaining connectivity in the longitudinal dimension although the consequences of "limited" interruptions in stream network connectivity (e.g., for example by road crossings not designed to accommodate passage of fish, sediment and wood) remain an important management issue. Protection of the riparian area zone of influence (beginning at the CMZ edge) also serves to maintain connectivity in the lateral and horizontal direction at least in areas without levees or extensive floodplain development. We recognize the multiple services that floodplains provide including the maintenance of connectivity and rely on local governments' and state agencies' regulatory as well as non-regulatory mechanism to provide for their conservation.
- *Longitudinal and lateral connectivity* can be enhanced by restoring hydrology on flood-suppressed (i.e., dammed) rivers and by increasing the amount of water retained in rivers after water diversions and withdrawals, thereby increasing habitat and species diversity. Restoring links between surface and groundwater flow enhances vertical connectivity and biotic communities associated with the hyporheic zone.
- *Watershed processes interact with riparian areas* to create and maintain instream habitat. The nature and intensity of these processes are strongly influenced by prevailing (and past) watershed land uses.
- *Riparian areas* are disproportionately important to watershed function and to the needs of terrestrial and aquatic species; maintaining ecosystem processes within riparian areas is an especially important part of watershed management, as is maintaining connectivity of riparian ecosystems across the watershed.
- *Hydrology* is directly linked to conditions within the watershed. The character and extent of vegetative cover will greatly mediate the effects of topography, climate, and geology on the movement of runoff. While human activities can dramatically affect the movement of water, these effects can be minimized through careful watershed planning and implementation of low impact development.
- *Cumulative effects*: Small streams typically empty into progressively larger streams throughout a stream network. Thus, the negative effects of upstream disturbances (e.g., routing of stormwater and inputs of fine sediments or pollutants) tends to be multiplied in the downstream direction. Watershed management requires understanding this (mostly) one-way flow of materials and energy in order to protect aquatic systems and associated riparian areas.
- *Pollution avoidance*: Pollutants from upland portions of the watershed make their way to streams via overland flow or drainage systems that route stormwater directly to stream channels. Reducing instream pollution requires actions across the watershed such as low

impact development practices and RMZs that can help provide the pollution removal function.

- *Watershed change and complexity*: Watersheds are in a constant state of change as they respond to disturbances (natural and human-caused) such as floods and droughts, landslides, fire, disease and development. Watershed conditions are the outcome of a complex variety of interacting physical, chemical and biological processes that take place within seconds (e.g., landslide) and over thousands of years (e.g., forest succession, rock weathering/erosion), as well as processes that occur at spatial scales ranging from microscopic to global. Maintaining the ability of a watershed to adjust to disturbances is important.
- *Disturbance:* Fluvial disturbances create, maintain and destroy habitat that allow species to complete their life histories. If future watershed conditions do not allow for these types of changes to occur over time then populations of aquatic organisms may not persist.
- *Adaptive, ecosystem-based management* is crucial for maintaining ecosystem services (e.g., salmon populations) because those services depend on maintaining the complex interplay among watershed component and processes. Given uncertainty about exactly how to manage for these conditions, especially in a changing climate we strongly encourage an adaptive approach to watershed management.

3.11.2 *Watershed-Scale Recommendations to Protect Aquatic Systems*

To achieve desired ecosystem goods and services—including clean water, flood control, and healthy fisheries—watershed managers should focus on influencing the watershed processes that act upon water, wood, sediment, nutrients, vegetation, and pollutants at the site and watershed scale. This section focuses on watershed-scale management.

Restore and Protect Watershed Processes: In general, efforts to improve watershed conditions should first focus on protecting and restoring the watershed *processes* that create, maintain and destroy habitat. The natural frequencies, magnitudes, and durations of natural disturbances (flood and fire being the most common) need to be better understood and then maintained to the greatest extent that surrounding land uses can tolerate—habitats have not only spatial but also temporal dimensions to their creation and support, and they cannot retain their functions if they remain static.

Manage Land for Stormwater: Stormwater runoff can change the timing, quality, and quantity of water provided to the stream. Land use changes should individually and cumulatively avoid/minimize changes to surface water flows. Protection and restoration efforts should focus on attenuating peak flows and reducing pollutants, which are typically accomplished by maximizing infiltration. Primary tools available to local governments include land use designations/zoning code, stormwater regulations. See City of Redmond Watershed Management Plan.

Manage Land for Stream Temperatures. As noted in Chapter 4, Volume 1, increases in water temperature can result from reduction of riparian vegetation cover, decreased streamflow, and simplification of stream channels (e.g., increased width-to-depth ratio and reduced hyporheic and groundwater exchange). These modifications are often the consequence of land use activities such as riparian vegetation removal, water diversions, unmanaged livestock grazing, and stream

channelization associated with roads, levees, and other forms of human development. Maintaining a stream thermal regime is best accomplished by taking a watershed approach and prioritizing thermally sensitive reaches for protection and restoration.

Restore and Protect Connectivity: Manage watersheds to avoid creating interruptions in all aspects of connectivity: longitudinal (e.g., dams, road crossings), lateral (e.g., levees and roads/buildings that cutoff riparian areas and floodplains from their stream), and vertical (water withdrawals, reductions of floodplains). This is especially important for species that are highly mobile and require a variety of habitat types (such as salmon, although it is also important for amphibians, birds, and mammals) across large areas. Restoration efforts that correct existing barriers to movement of water, wood, sediment, and species (e.g., removing blocking culverts, setting back levees) is a high priority restoration action with proven benefits for salmon. Connectivity in the form of near or complete contiguous RMZs is important to water quality. For example, some models suggest that 80-90% shading along a given stream reach or a range of stream order is necessary to protect stream temperatures.

Support Fish and Wildlife: Management of watersheds must include an appreciation for the way that biota (plants and animals) support ecosystem function. The importance of large wood to stream structure and salmonid habitat, the role of root strength in mediating bank erosion are commonly understood. Less well appreciated is the role returning salmon in providing nutrients to the watershed, or the role of beavers in protecting against flooding, or erosion.

Plan for Climate Change: Protection of riparian ecosystems is one of the most useful responses a local jurisdiction can make to help ameliorate the impacts of climate change to freshwater systems. Impending changes to aquatic systems as a result of climate change increases risk to species already threatened by human activities. The warming effects of climate change on rivers and streams threaten to drastically reduce fish distribution and viability throughout the Pacific Northwest. Expected increased rainfall intensity is expected to cause streams to become wider, necessitating larger culverts to pass fish. WDFW, in collaboration with the University of Washington's Climate Impacts Group, has created an online tool that estimates how much a stream channel width will increase due to climate change in the years 2040 and 2080.

Conduct Monitoring and Adaptive Management: Monitoring and adaptive management are important elements of both riparian area and watershed management. Managing a watershed to achieve particular outcomes is difficult because 1) watersheds are complex and managing them includes uncertainty related to measuring and achieving No Net Loss of ecosystem functions, 2) the risk of management error could further jeopardize imperiled species like salmon, 3) in the face of climate change and as we further develop areas to accommodate growth, we put more stress on the system that both increases the likelihood of not achieving our goals and increasing uncertainty about how to provide No Net Loss , and 4) climate change will increase the challenge of meeting No Net Loss of ecosystem function.

3.11.3 *Tools and Key References for Assessing Current Watershed Conditions*

WDFW's High Resolution Change Detection (HRCD) is a spatial dataset that characterizes changes in land cover. This tool allows jurisdictions to evaluate how watersheds are changing at a sub-

parcel scale over 2- to 3-year intervals beginning in 2006. Jurisdictions can use HRCD to evaluate the effectiveness of their efforts to steer growth towards portions of the watershed that are most suitable for growth. HRCD provides a tool that spans jurisdictions, making it useful for evaluating effectiveness of various approaches across many jurisdictions. This dataset is currently available throughout the entire Puget Sound basin and in select Eastern Washington watersheds. HRCD data is available at www.pshrcd.com.

Ecology's Puget Sound Watershed Characterization is a Puget Sound-wide tool that compares areas based on their suitability and value for restoration and protection. This tool informs two fundamental questions: 1) where on the landscape should protection and restoration be focused first, and 2) what types of activities and actions (i.e., restoration, protection, conservation, or development) are most appropriate to that place. With insights gained by this tool, decision-makers can incorporate information regarding watershed processes to improve plans (e.g., comprehensive plans, subarea plans, critical area ordinances, stormwater plans) and conservation efforts (e.g., in-lieu fee programs, open space tax credits, open space land acquisitions).

WDFW's *Priority Habitats and Species* program has several resources of interest to watershed planners. In addition to this two-volume document on riparian ecosystems, readers will find useful ideas in *Land Use Planning for Salmon, Steelhead and Trout: A land use planner's guide to salmonid habitat protection and recovery* (Knight, 2009) and *Landscape Planning for Washington's Wildlife: Managing for Biodiversity in Developing Areas* (WDFW, 2009). To address connectivity issues, watershed planning efforts are encouraged to prioritize conservation efforts within PHS "Biodiversity Areas and Corridors"—a type of Priority Habitat.

Since 2004, the *Pacific Northwest Aquatic Monitoring Partnership* has been a collaborative effort among West Coast federal, state, and tribal agencies to coordinate monitoring activities and develop common monitoring approaches. This partnership provides best practices, mapping tools, and protocols, and serves as a voluntary clearinghouse for a wide variety of monitoring projects.

Since 2009, Ecology's *Watershed Health Monitoring Project* has been monitoring sites throughout the state to assess watershed health. This project's protocols can be adapted by jurisdictions and scaled to watersheds of various sizes (with help from Ecology, if requested). Data is stored in the *Environmental Information Management database*—a resource that is also available at no cost to local jurisdictions. This sophisticated database allows users to input and retrieve data via the web, reliably store it, and make it available for analysis. Quality assurance/quality control measures ensure data put into the database are of high quality.

In 2016, the Washington Department of Commerce published *Building Cities in the Rain* (Ballash, 2016) to help communities improve watersheds while redeveloping and revitalizing urban areas. The guidance describes an optional three-step process for prioritizing watersheds for stormwater retrofits in urban areas.

Commerce's *Puget Sound Mapping Project* uses an interactive map to help users develop insights about how current and expected development patterns might affect the region's environmental health. The tool is designed to help decision makers consider information from the aforementioned *Puget Sound Watershed Characterization* when making decisions regarding development projects, urban growth boundaries, and compensatory mitigation.

CHAPTER 4. RESTORING RIPARIAN ECOSYSTEMS AND PROTECTING THROUGH VOLUNTARY STEWARDSHIP

4.1 INTRODUCTION

This chapter provides guidance to cities, counties, and conservation partners to promote protection of riparian areas through voluntary approaches and restoration. The Voluntary Stewardship Program (VSP) is a new approach for riparian protection on agricultural lands and we provide recommendations that may be useful to Conservation Districts and others engaged in the VSP process. We also provide information on stream restoration opportunities. Based on current trends, habitat restoration actions will be required to recover federally listed salmon to healthy and harvestable levels. While our guidance is not exhaustive, we provide high-level guidance to encourage salmon restoration where possible.

4.2 RESTORATION ACTIONS

Although this section focuses on salmon restoration, restoring riparian areas to emulate historical conditions benefits many species in Washington. To recover salmon, we must protect the existing riparian and watershed function, while seeking opportunities to restore lost function through time. We provide the following information to assist the restoration community in understanding what is important to restore. Many watersheds in Washington have salmon recovery restoration goals that can be obtained from regional Salmon Recovery Boards or Lead Entities for Salmon Recovery. Lead Entities and Salmon Recovery Boards are in every region of the state, including those areas without anadromous fish (https://www.rco.wa.gov/salmon_recovery/regions/regional_orgs.shtml).

4.2.1 *Developing a Restoration Strategy*

Aquatic restoration strategies, created collaboratively with local citizens or local governments, typically start with a clear set of goals and objectives. The selection of appropriate restoration strategies is informed by the political, social, and ecological context of the watershed, and bounded by the extent of opportunities and constraints. At a watershed scale, restoration efforts should focus first on projects that offer the greatest potential for success. The Stream Habitat Restoration Guidelines (2012) suggest the following prioritization of stream habitat restoration strategies:

1. *Protect habitat*. Protect areas with healthy, high-quality habitat (strongholds, refugia, and key sub-watersheds) to prevent further degradation. Secure, expand, and link protected areas.
2. *Connect habitat*. Connect and provide access to isolated habitat, including instream, off-channel, and estuarine habitat made inaccessible by culverts, levees, or other man-made obstructions.
3. *Restore habitat-forming processes*. Employ land use recovery and watershed restoration techniques to restore processes that create, maintain, and connect habitats, including restoration of sediment dynamics, large wood dynamics, flow regimes, adequately sized

healthy riparian zones, floodplain connectivity, water quality, and channel evolutionary processes. Employ a combination of passive and active restoration techniques, as necessary.

4. *Create or enhance habitat*. Modify or create stream habitat by such measures as installing instream structures, reconfiguring channel planform, cross-section or profile, or constructing a new side channel.

We provide multiple technical guidance documents to help implement riparian restoration projects as part of Aquatic Habitat Guidelines that can be found at http://wdfw.wa.gov/conservation/habitat/planning/ahg/. They include:

- 2014 Marine Shoreline Design Guidelines
- 2016 Your Marine Waterfront
- 2013 Water Crossing Design Guidelines
- 2012 Stream Habitat Restoration Guidelines (SHRG)
- 2002 Integrated Streambank Protection Guidelines (ISPG)
- 2010 Protecting Nearshore Habitat and Functions in Puget Sound
- 2009 Land Use Planning for Salmon, Steelhead and Trout: A land use planner's guide to salmonid habitat protection and recovery
- 2000 Draft Fishway Guidelines For Washington State
- 2000 Draft Fish Protection Screen Guidelines for Washington State

4.3 Implementing Riparian Strategies Through Incentives

There are several types of conservation incentives available to individuals and local governments:

- *Financial assistance*: grant programs that provide funding for conservation actions
- *Tax adjustment*: tax reductions for landowners undertaking conservation actions
- *Technical assistance:* advice or hand-on help for landowners on conservation tools or techniques
- *Recognition*: promotion of landowners who undertake conservation actions

4.3.1 *Financial Incentives*

There are grant funds available for riparian habitat conservation and restoration projects on public and private lands through the Recreation and Conservation Office and Salmon Recovery Funding Board. To access these funds contact the Recreation and Conservation Office. Grant programs include:

- Aquatic Lands Enhancement Account (ALEA)
- Washington Wildlife and Recreation Program (WWRP; Riparian Protection, Critical Habitat, Natural Areas, and Urban Wildlife Habitat Categories)
- Salmon Recovery Funding Board (SRFB)
- Estuary and Salmon Restoration Program (ESRP)—a program of WDFW
- Land and Water Conservation Fund (LWCF)
- Puget Sound Acquisition and Restoration (PSAR)

To learn more about these grant programs and eligibility requirements, go to www.rco.wa.gov/grants/habitat_grants.shtml.

Local land trusts can also help land owners conserve habitat, often leveraging funds from foundations and other non-governmental sources; see www.walandtrusts.org for a county-by-county list of land trusts.

For agricultural operators, local conservation districts and the Washington State Conservation Commission can provide technical assistance to find an approach that works for the farmer and improves riparian ecosystem function. Technical assistance may also be available from the Natural Resources Conservation Service (NRCS), WDFW, and Washington State University Extension. Technical assistance for timber landowners may be available from the DNR's Forest Stewardship Program.

Agricultural property owners can take advantage of a host of financial incentives described below to expand and maintain riparian functions within the Riparian Management Zone. Contact your local conservation district or the Recreation and Conservation Office.

- Conservation Reserve Enhancement Program—CREP is the most successful riparian buffer program in Washington (over 630 miles and 11,400 acres of buffers planted)
- Environmental Quality Incentives Program (EQIP) and Conservation Stewardship Program (CSP)
- State Acres for Wildlife Enhancement (SAFE)
- Regional Conservation Partnership Program
- Agricultural Conservation Easement Program (ACEP)
- Agricultural Land Easements (ALE)
- American Farm Trust Farmland Protection Program
- Washington Wildlife and Recreation Program Farmland category (RCO)

Timber landowners also have a variety of conservation incentive programs available:

- Forestry Riparian Easement (DNR)
- Rivers and Habitat Open Space Program (DNR)
- Healthy Forests Reserve Program (HFRP)
- Family Forest Fish Passage Program (DNR)
- Forest Legacy (USFS)
- Washington Wildlife and Recreation Program Forestland category (RCO)

4.3.2 *Tax Reduction Incentives*

Landowners can receive a substantial tax reduction by converting land into "open space" status. Lands with riparian areas often qualify for this incentive; see your county assessor and local planning department for details.

4.3.3 *Technical Assistance*

Local governments and individual land owners who want to improve habitat can request land use advice from a variety of sources, including:

- WDFW Regional Habitat and District Wildlife Biologists. Go to http://arcg.is/1SgsHqk to find yours.
- Salmon recovery Lead Entities or Regional Fisheries Enhancement Groups
- Tribal natural resource departments

4.4 Voluntary Stewardship Program

The Voluntary Stewardship Program (VSP), RCW 36.70A.705 provides counties with an alternative approach from traditional development regulations to protect and enhance critical areas where agricultural activities are conducted, while maintaining and improving the long-term viability of agriculture. The program promotes agriculture and environmental stewardship through a voluntary collaborative planning process with local agricultural operators. It builds on existing state and federal programs, allowing counties the ability to leverage resources from previous work plans to successfully reach program goals.

The State Conservation Commission administers the program with guidance from a statewide advisory committee. Twenty-seven counties in Washington have chosen to participate in the program (Figure 4-1). Funding is provided for the counties to develop incentive-based strategies and local guidelines for watershed stewardship. Funding for the incentives depend largely on federal sources such as the U.S. Department of Agriculture. Watershed workgroups in each county comprised of farmers, tribes, and local environmental groups and government agencies, develop watershed work plans with goals and measurable benchmarks to determine progress and success of the program over time. Counties, together with agricultural landowners, develop individual stewardship plans that implement the county work plan, including best management practices specific to their property. The stewardship plans aim at protecting critical areas while maintaining

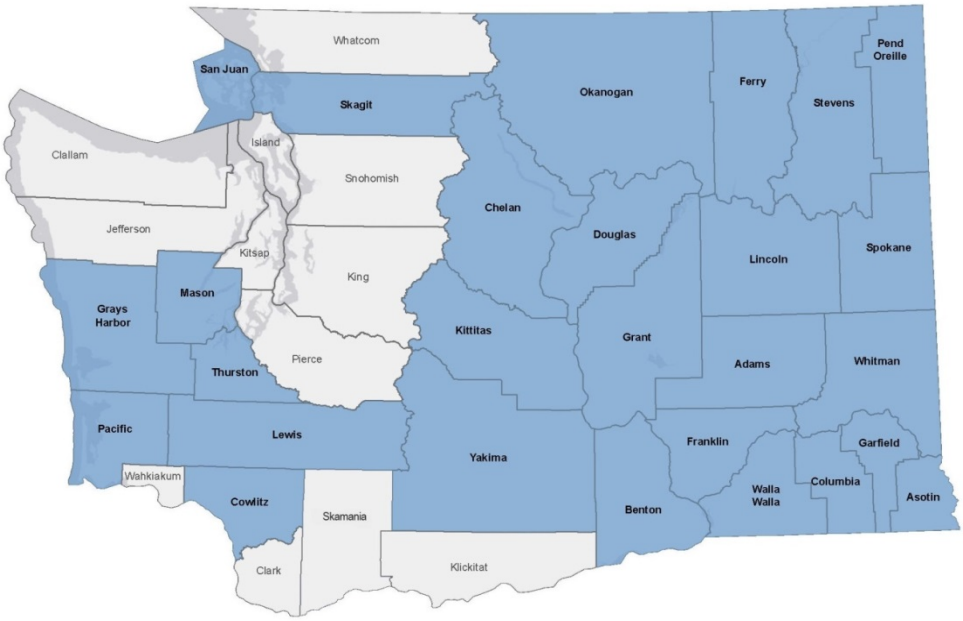


Figure 4-1. Washington State Conservation Commission Voluntary Stewardship County Participation map. Blue shaded counties are participating in the Voluntary Stewardship Program.

the viability of the landowner's agricultural operation. The VSP applies to all areas where agricultural activities are conducted and not just designated agricultural resource lands.

Counties not participating in the VSP are required to protect critical areas, following the traditional approach of using development regulations. If a VSP county develops a work plan that is not approved, or the work plan's goals and benchmarks have not been met as determined by the Conservation Commission, or the county has not received adequate funding, it will be required to adopt standard (non-VSP) development regulations to protect critical areas in areas used for agricultural activities (RCW 36.70A.735).

Local groups must create work plans that include benchmarks for the protection and enhancement of critical areas that at the end of 10 years will result in enhancement of critical area functions through voluntary and incentive-based actions. In addition, the work plan must establish baseline monitoring for the effects on critical areas and agriculture relevant to the protection and enhancement benchmarks developed for the watershed. There must also be periodic evaluations, adaptive management and a written report of status at the end of each biennium (RCW 36.70A.720). Critical area protection works in conjunction with efforts to maintain and enhance agricultural viability in each participating county. For more information, please visit http://scc.wa.gov/vsp/.

4.4.1 *VSP Goals and Benchmarks*

Volume 1 extensively explains the importance of riparian areas. Due to the importance of protecting the functions and values of these areas, WDFW recommends that counties participating in VSP have riparian specific protection and enhancement goals, benchmarks, monitoring and adaptive management actions outlined in their work plans.

Under VSP, *protection* means to maintain ecological function at the 2011 levels; *enhancement* means to improve above 2011 levels. Restoration is not a term used as part of VSP. We use the term *restoration* to refer to non-VSP voluntary actions. *Goals*, in VSP, are high-level statements of intent. *Benchmarks* are the specific activity or outcome that will be used to judge progress; benchmarks are tied directly to the high-level goals. WDFW also recommends identifying *performance metrics* that will measure the benchmark and a description of the monitoring method employed to determine if an adaptive management action is necessary. We also recommend describing what action will be taken if the monitoring demonstrates that the benchmark is not met.

Suggested VSP *protection* goals:

1. Maintain existing native vegetation along rivers and streams to at least 2011 levels…
    a. *For forested regions of Washington*: … to at least one Site-Potential Tree Height (SPTH) measured from the outer edge of the CMZ (if present).
    b. *For places within the Columbia Plateau Ecoregion:* … to at least the width that provides the desired level of sediment and other pollutant removal but no less than the width of the potential vegetation height; in all cases measured from the outer edge of the CMZ (if present).
2. Maintain existing floodplain processes that allows natural disturbance from periodic floods.

3. Maintain livestock management measures that reduce livestock access to riparian areas to at least 2011 levels.
4. Ensure that agricultural activities do not intensify within 1 SPTH of riparian ecosystem from that found in 2011
5. Maintain culverts to ensure fish connectivity upstream and downstream for fish
6. Maintain functional fish screens on instream withdrawal structures
7. Maintain all pervious surfaces/uncompacted soils and unditched/undrained areas to at least 2011 levels…
    a. *For forested regions of Washington*: … within one SPTH measured from the outer edge of the CMZ (if present).
    b. *For places within the Columbia Plateau Ecoregion:* … to at least the width that provides the desired level of sediment and other pollutant removal but no less than the width of the potential vegetation height; in all cases measured from the outer edge of the CMZ (if present).

Suggested VSP *enhancement* goals:

1. Improve quality of vegetation through the removal of invasive species and the planting of native riparian vegetation, with preference given to vegetation that provides needed ecosystem functions (e.g., shade, large wood, pollution removal)…
    a. *For forested regions of Washington*: … within one SPTH measured from the outer edge of the CMZ (if present).
    b. *For places within the Columbia Plateau Ecoregion:* … to at least the width that provides the desired level of sediment and other pollutant removal but no less than the width of the potential vegetation height; in all cases measured from the outer edge of the CMZ (if present).
2. Enhance riparian areas with a mix of native vegetation that will provide habitat for a diversity of species and multiple riparian functions (e.g., streambank stability, shade, wood recruitment, organic litter input, and pollutant removal). The specific mix of vegetation will vary by ecoregion and local needs, but will likely include conifers, grasses, and herbaceous plants.
3. Increase off channel habitat and improve natural flow regimes by removing dikes or levees and restoring access to the floodplain.
4. In areas of incised channels, reintroduce beaver or construct beaver dam surrogates to restore water table elevation and riparian vegetation.
5. Remove reed canary grass through increased management.
6. Increase large wood in streams and rivers to improve habitat for salmon and resident trout species.
7. Evaluate and implement, when feasible, low-till or no-till farming practices.
8. Increase connectivity through removal of non-fish passing culverts with adequately sized culverts.
9. Increase the acreage of riparian areas from which livestock have been excluded through increased fencing.
10. Reduce soil erosion through increased vegetation, exclusion of any soil compacting activities, and upland soil management techniques where applicable…

2094 a. *For forested regions of Washington*: … within one SPTH measured from the outer
2095 edge of the CMZ (if present).
2096 b. *For places within the Columbia Plateau Ecoregion:* … to at least the width that
2097 provides the desired level of sediment and other pollutant removal but no less than
2098 the width of the potential vegetation height; in all cases measured from the outer
2099 edge of the CMZ (if present).
2100 11. Remove ditching and drainage tiles that cause surface runoff to bypass riparian areas
2101 12. Consider replacing sheet and rill irrigation systems due to their tendency to exacerbate
2102 erosion problems.
2103 13. Increase efficiency of water use.
2104 14. Improve management of pastures (e.g., manure management) within floodplains
2105 15. Treat agricultural wastewater.

2106 In addition to setting goals and benchmarks, VSP requires monitoring and adaptive management to
2107 maintain and enhance critical areas, including riparian ecosystems. Monitoring under VSP does not
2108 occur at the parcel level, rather, VSP requires the workgroup to monitor at the watershed or sub-
2109 watershed scale. Key elements of the monitoring program:

2110 1. Establish a durable system to track and report goals, benchmarks, performance metrics, and
2111 agricultural activities.
2112 2. Develop implementation and effectiveness monitoring programs and then monitor on a 2-
2113 year and 5-year basis as required under VSP. Establish a process to review/update this
2114 system over time. (Refer to Chapter 5 for more information.)
2115 3. Establish "triggers" and actions to take when triggered through the adaptive management
2116 process. Establish a process to review/update these triggers and actions.

2117 To assist counties, we have included Appendix 3: Voluntary Stewardship Program Adaptive
2118 Management Matrix as a template for clearly connecting goals, benchmarks, performance metrics,
2119 monitoring and adaptive management. VSP counties currently use this matrix as a framework to
2120 identify specific elements of an adaptive management plan. We have also included an example from
2121 Chelan County. We discuss monitoring more fully in Chapter 5.

2122 Under VSP, the Conservation Districts largely provide technical assistance to ensure that individual
2123 stewardship plans contribute to the goals and benchmarks of the county. The riparian section of the
2124 individual stewardship plans should include elements such as:

2125 1. Designating the following as priority areas for protection or enhancement:
2126 a. For forested regions of Washington: … the area within one SPTH measured from the
2127 outer edge of the CMZ (if present).
2128 b. For places within the Columbia Plateau Ecoregion: … the area within the width that
2129 provides the desired level of sediment and other pollutant removal but no less than
2130 the width of the potential vegetation height; in all cases measured from the outer
2131 edge of the CMZ (if present).
2132 2. Identifying the location and extent of non-native vegetation, pervious/semi-pervious
2133 surfaces, and pollution-generating areas/activities within the riparian area.

3. Identifying the location and extent of instream structures (e.g., bank armoring, culverts, water diversions).
4. Identifying practices that increase the quality and quantity of riparian vegetation to improve riparian function. For example, identify the location of fencing and the acreage of fenced off riparian areas.
5. Identifying practices to improve water quality, reduce erosion or control fine sediments; map locations when possible.
6. Identifying practices to enhance use of the riparian area by terrestrial wildlife and birds, map locations when possible.
7. Identifying practices to enhance salmon habitat along and within the stream or river; map locations when possible.
8. Identifying watershed benchmarks and performance metrics that are applicable at the farm scale and that farm's "fair share" (e.g., based on acreage or stream length) of what is needed for the watershed to reliably achieve its benchmarks and performance metrics)

CHAPTER 5. IMPROVING PROTECTION THROUGH MONITORING AND ADAPTIVE MANAGEMENT

5.1 INTRODUCTION

As mentioned in Chapter 1, all cities and counties are currently protecting critical areas, including the riparian ecosystem, through a variety of regulatory and non-regulatory mechanisms. The challenge now is to understand how well those mechanisms meet their intent of protecting ecosystem functions and values. Government regulation is one part of a multi-component system of ensuring functional ecosystems that includes acquisitions, conservation easements, voluntary incentives, and restoration. We will focus this chapter on monitoring actions relative to critical area regulation. This chapter was written in collaboration with the Department of Commerce and relies heavily on the Department of Commerce's update of the Critical Areas Ordinance Handbook (see (https://www.ezview.wa.gov/site/alias__1949/library_draft_documents/36886/draft_documents.aspx).

Riparian ecosystems make up between 10-18% of the terrestrial landscape in the state and commonly intersect private property. Improving how we deliver riparian protection, with increased transparency and fairness, clarity of regulations, and better ecological outcomes, can have a positive impact on communities throughout the state. Monitoring, in this context, is part of the overall goal of improving outcomes for communities and for the ecosystems whose values and functions we are charged with protecting. Counties' efforts to protect and monitor critical areas like riparian ecosystems are being supported by regional approaches to reach the same end. For example, the Puget Sound Partnership uses vital signs of ecosystem health and recovery to adaptively manage near- and long-term restoration actions. One of the vital signs indicators developed by the Partnership is riparian forest cover in Puget Sound. The process for protection and monitoring we describe here support these larger-scale efforts. Linking local and regional efforts should provide powerful information on our collective efforts to maintain and protect the riparian ecosystem.

Thus, we focus on monitoring to answer questions about the implementation and effectiveness of actions that could lead to increased protection of riparian ecosystems through improved policy, technical assistance, and permit processes. Monitoring becomes increasingly important as uncertainty about outcomes increases. For instance, if we do not know the ecological impacts of a particular policy choice and the outcome is important to the community, then we should monitor the ecological outcomes associated with that choice. In this chapter, we will focus on monitoring to inform adaptive management, which is the process by which we learn, improve and address uncertainty and risk.

5.2 GOALS OF MONITORING

The goals of a monitoring and adaptive management program described here are increased fairness, transparency, accountability and improved ecological outcomes from regulations for

critical areas protection. We encourage local governments to institute two types of monitoring: implementation and effectiveness, starting with implementation. Implementation monitoring tracks whether application requirements are being applied consistent with the regulations and allows a local government to track the execution of the permitting system and to produce regular status reports for the public to review. It also tracks compliance with the regulations (i.e., did the permit holder do what the permit required) and thus provides accountability to the public and applicants when they see that all applicants are being treated fairly and consistently. Finally, implementation monitoring can also include tracking the number of unpermitted activities. Tracking unpermitted activities is relatively expensive and should probably be considered only in in areas with some history of this type of activity.

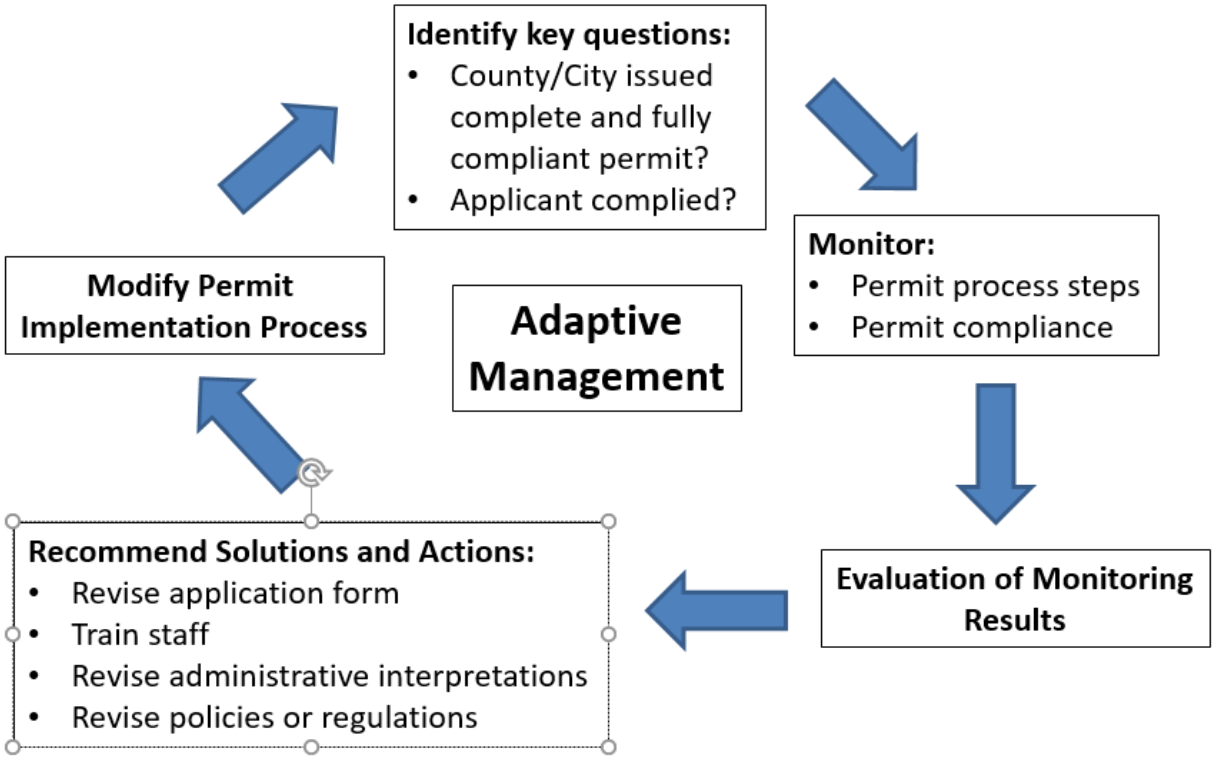


Figure 5-1. A depiction of the conceptual framework of the adaptive management process for improved permitting via implementation of monitoring.

Effectiveness monitoring determines if the ecological outcomes, consistent with the permit, are met. The development of effectiveness monitoring programs logically follows development of implementation monitoring programs. This is because effectiveness is best measured when permit programs are implemented correctly and actions on the ground comply with county codes. Effectiveness monitoring of poorly implemented permits or good permits with poor compliance can lead to inefficient use of monitoring funds and irrelevant adaptive management responses.

Adopting an adaptive management program allows local government to respond to implementation and ultimately effectiveness monitoring results by changing approaches for protecting and managing critical areas, and to redirect resources as warranted by new information. A willingness

to make improvements to address issues identified through this process is critical to the idea of adaptive management.

5.3 Types of Monitoring

There are three levels of monitoring discussed in this chapter:

- *Permit implementation monitoring* asks if the local government issues permits that comport with regulations/policy, and if are permit conditions are written in a clear and easily understood way. These questions reflect on the local government's ability to issue clear, concise guidance to permittee consistent with the law. Implementation also includes permit compliance monitoring that asks if the applicant complied with each permit requirement. Compliance monitoring usually takes place very soon after permitted work has been completed.
- *Effectiveness monitoring* typically asks questions about how permit provision are working relative to expectations about how they should work. For example, are permit conditions that are expected to provide full riparian function (e.g., shade, bank stability) actually providing shade to the stream and evidence that banks are being protected? Another variant of effectiveness monitoring refers to asking implementation monitoring questions over long periods of time, for example are RMZ tree counts in year 1 and 5 post construction the same or nearly the same as counts immediately after construction; or is the garage footprint in 2020 the same as the garage permitted in 2010.
- *Validation monitoring* asks questions related to how critical area management affects species (e.g., salmon). Validation monitoring, which is commonly referred to as research, may be beyond the means of most local governments. Moreover, validation monitoring often involves questions that must be address regionally (for example throughout an entire watershed or across many watersheds) as opposed to implementation and effectiveness which are most often tied to a local jurisdictions regulatory processes issued at the site scale.

While providing methods for monitoring are beyond the scope of the document, WDFW provides technical assistance in setting up these types of programs. Moreover, Puget Sound Partnership, particularly its Puget Sound Ecosystem Monitoring Program (PSMEP), is helping to develop standard sampling protocols that may also aid interested counties in the Puget Sound region.

Monitoring does not have to be complicated. Simply choosing to monitor permit implementation can provide key information for permit process improvement.

5.4 Monitoring Implementation and Effectiveness

Monitoring does not have to be complicated. We suggest starting with permit implementation and compliance because it can provide key information for permit process improvement (Figure 5-2). Even in cases where you cannot monitor all steps in Figure 5-2, we have found that monitoring any

step—linking policy to permits, permits to inspections, and inspections to enforcement—can help begin the process of evaluating implementation and effectiveness of local government authority.

Because this requires little or no fieldwork, the easiest and least expensive step to monitor is the link between policy and permit, that is, are local government policies being faithfully and clearly transmitted into permit provisions that can be easily understood? We recommend that some implementation monitoring become part of all local regulatory programs, even if it only on a relatively small, random subset of permits. A database for storing information on each step (i.e., a permit tracking system) is a critical tool for creating a complete system of accountability.

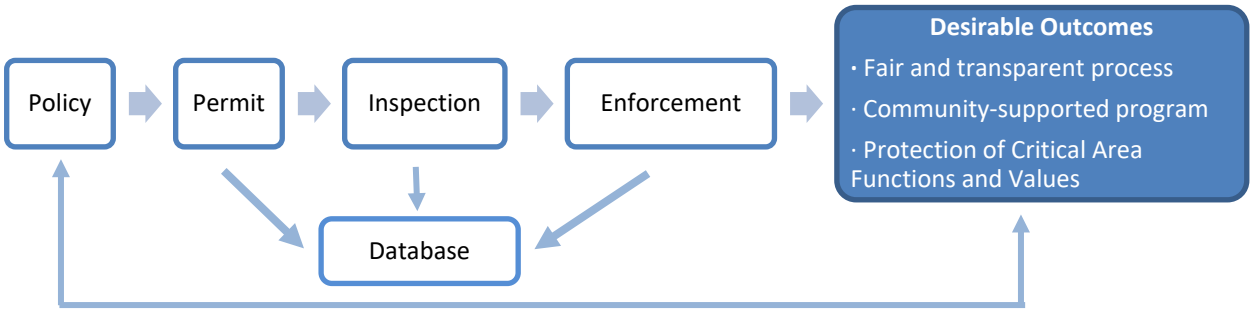


Figure 5-2. One system of permit accountability that includes implementation monitoring of the internal permit process, inspection for permit compliance, a database from which to judge outcomes, and a feedback loop connecting outcomes with policy intent.

2251 **Table 5-1. Implementation monitoring key questions during the Critical Areas permit review process.**

Process Steps	Key study questions to evaluate permit implementation	Proposed metrics
Application	Was adequate information gathered from the applicant? Did the local government provide timely and necessary technical assistance to the applicant?	Number and percent of complete applications. i.e., include all information necessary to issue a permit. Number and percent by type of applications missing information
Permit	Do permit provisions follow the local government code?	Number and percent of permit provisions by type consistent with code.
Permit	Do permit provision identify intent of protection and how it can be accomplished? Provision examples: area of tree retention, distance of structure from stream, clearing, grading, or stormwater provisions, replanting requirements, maximum extent of impervious surface.	Number and percent of (complete) permits (i.e., include all provisions that enable a permittee to be fully compliant with the permit.) Number, percent, and type of missing provision/information
Permit (variance)	If a variance was granted, is the reason for the variance clearly stated?	Percent of variances by type justified by code or policy Percent of permits with variances by type.
Permit (mitigation)	If compensatory mitigation was required, were the unavoidable impacts clearly identified\quantified? Was the rational clearly stated?	Number and percent of permits by type with unavoidable impacts Percent of permits by type with quantified mitigation requirements
Compliance	Post-Construction Visit: Did the applicant comply with the permit? This requires field measurements of some or all of the provisions in the permit. For riparian ecosystems, key provisions to inspect: retention of trees, replanting, structure distances from stream, area of impervious surface, and implementation of stormwater provisions.	Number and percent by type of provision that were out of compliance.
Enforcement	Are enforcement actions necessary to meet permit provisions and/or the regulations?	Number and percent by type of permit enforcement actions.

2252 5.5 USING LAND COVER CHANGE TO UNDERSTAND EFFECTIVENESS OF REGULATORY
2253 PROTECTIONS

2254 Effectiveness monitoring can help answer the question: are current rules/regulations adequately
2255 protecting the riparian ecosystem? One new innovative way to inform regulatory effectiveness is
2256 through the use of land cover change detection program. Land cover describes the type and amount
2257 of vegetation, roads, buildings, etc., that are occurring on the landscape. For instance, through aerial
2258 photography, we can see that part of any town is covered in buildings, roads, trees, lawns and other
2259 landscape features like riparian vegetation. By comparing aerial photographs over time, we can
2260 quantify change and attribute change to specific causes, for example, forestry, development, road

building, etc. The use of aerial photography is not new, but with increasing technical capabilities, jurisdictions have the opportunity to automate and create land cover change analysis more cheaply than ever before.

High Resolution Change Detections (HRCD) is a tool to that can be used to explore how well a jurisdiction is implementing land use regulations and informing the goal of achieving No Net Loss of riparian ecosystem functions. Assuming that riparian ecosystems lie within one Site-Potential Tree Height (SPTH at age 200 years) of the active channel, then certain changes (e.g., from vegetation to impervious surface) land cover within one SPTH are indicators of changes to riparian ecosystem functions and values. Results from land cover change analysis show jurisdictions where critical area regulations may be poorly or improperly implemented. Jurisdiction-wide interpretation of land cover change analysis can lead to a better understanding of how and why regulations may be ineffective at protecting the riparian area. For instance, the loss of riparian habitat may be due to unclear permit provisions, permit provisions inappropriate for site-specific circumstances, poor enforcement of existing code, or natural causes. Many of these reasons for loss of riparian habitat would be identified through implementation monitoring which would precede or go hand-in-hand with HRCD monitoring. No loss of riparian habitat indicates issuance of clear permit provisions, outreach and education during pre-site investigations, or effective enforcement. Through targeted questions of the permitting process and the land cover change analysis, jurisdictions can begin to adaptively manage changes to their overall permit system.

The following example is from the Department of Commerce's CAO Handbook. Additional examples of implementation monitoring can be found in the handbook's Monitoring and Adaptive Management chapter, available at https://www.ezview.wa.gov/site/alias__1949/library_draft_documents/36886/draft_documents.aspx.

5.5.1 *Example: Thurston County/WDFW Shoreline Master Program*

In 2015, Thurston County Long Range Planning and Washington Department of Fish and Wildlife (WDFW) utilized a National Estuary Program (NEP) grant to quantify shoreline vegetation and land cover change and evaluate land use permit compliance within Thurston County's shoreline regulatory jurisdiction.

1. Reasons for Monitoring

   Thurston County used WDFW's High Resolution Change Detection (HRCD) data to monitor compliance and effectiveness within the County's Shoreline Master Program (SMP) jurisdiction. This project developed a protocol manual for using HRCD for use by any jurisdiction within the Puget Sound region.

2. Key Study Questions/Objectives

   The project was designed as a pilot to answer several related sets of questions for both Thurston County and WDFW.

   For Thurston County:

   - What land cover change is happening within designated SMP areas? What change is happening throughout the Deschutes River watershed (WRIA 13)?

- How does the change known by Thurston County permit records compare with detected changes by the HRCD?
- What changes, if any, can be made to the land use permits or process that could increase the relevancy or effectiveness in utilizing the HRCD in compliance monitoring?

For WDFW:

- How well can the HRCD detect changes relative to land use permit records?
- Using Thurston County's SMP area as an example test area, what land cover changes are happening not captured by the HRCD?
- With the development of a HRCD user manual, can the HRCD be effectively utilized by other entities in the absence of further assistance by WDFW?

3. Monitoring Program Design

The exercise was designed to quantify the increase in impervious surfaces and decrease in canopy within Thurston County's marine SMP area. The project consisted of five phases:

Phase 1: Initial SMP Change Analysis: WDFW Habitat program staff and Thurston County's long range planning staff intersected the HRCD dataset with Thurston County's SMP area and parcel data for the three time periods of HRCD available (2006 to 2009, 2009 to 2011, and 2011 to 2013) within ArcGIS. With known areas of change found, those locations were compared with land use permit records from Thurston County. The intent was to find locations of observed change via HRCD without any permit record. This was not meant to be a direct means of enforcement, but an initial analysis of undocumented change that could provide a pared-down set of locations for further investigation. This phase would also produce land cover change statistics, including area of change and counts of land cover change events, by SMP designation and parcel.

Phase 2: Learning What the HRCD Misses: Using the SMP area in Thurston County, WDFW staff manually looked for land cover changes not captured by the HRCD. This was intended to help WDFW understand rates of omission in the HRCD using an area under some developmental pressure with relatively small changes. This was done by manually finding and digitizing changes using the NAIP imagery that were not captured by the HRCD dataset.

Phase 3: Developing a Standardized Method for Utilizing the HRCD: A major goal of this project was to develop support materials for others to utilize the HRCD to answer their land use management questions in the absence of in-person WDFW staff assistance. Using the lessons learned in Phase 1 & 2, WDFW and Thurston County cooperated on composing a manual for a recommended method to applying the HRCD to a specific land use management question. This phase also included the development of a web-based service for users to download the HRCD dataset, detail the methodology of HRCD construction, find contact information, and more. This is located at www.pshrcd.com.

Phase 4: Testing the Manual through Remaining SMP Analysis in WRIA 13: Using only the HRCD dataset and the manual produced in Phase 3, Thurston County planning staff developed an application and utilized the HRCD successfully. For their application, they

examined the land cover change within the remaining SMP areas within WRIA 13 for the three periods that HRCD data was available.

Phase 5: Training and Outreach: With the lessons learned and products derived from Phases 1 through 4 of the project, WDFW and Thurston County staff, working in conjunction with the Coastal Training Program, developed a workshop for planning staff with other state agencies, local governments, and some non-governmental organizations. WDFW also used this opportunity to train internal staff on the benefits, limitations, and uses of HRCD.

4. Monitoring Time Frame

The evaluators analyzed land cover change within Thurston County's SMP area between 2006 and 2013. At the time of the project (2015), three iterations of the HRCD dataset were available for analysis for the study area, 2006 to 2009, 2009 to 2011, and 2011 to 2013. Permit records were pulled that corresponded to these timeframes.

5. Evaluation of Results and Recommendations

Currently, the only way the County has knowledge of unpermitted activity is through public complaints (i.e. neighbor complaining about the construction of something). This is an unreliable way to assess compliance. The county found that HRCD data, while not perfect, could be used to assess compliance and find unpermitted activity.

Overall, the data showed that less than half of one percent (0.39%) of the SMP area had change identified by HRCD from 2006 to 2013. Approximately two-thirds of this was due to canopy loss, with one-third due to new impervious surfaces. The project did not find any developments that were out of compliance, though it did find unpermitted events in each of the periods (e.g., tree removal).

The Thurston HRCD project demonstrated the utility of the HRCD in analyzing the patterns of land cover change in a specific geographic area of concern. However, Thurston County found that measuring compliance with HRCD data was "tedious and difficult" because of the capacity of the county's current permit tracking database (AMANDA). In many cases land use permits did not include enough information to determine conclusively that a parcel with observed change via HRCD was out of compliance or determine that the parcel had a permit record during the study's timeframe in question.

Improvements in methods of permit tracking could improve the capacity to use HRCD data in pairing with permitting to track compliance. This result was not entirely unexpected, as the HRCD can serve as a starting point and help local governments find otherwise unknown changes, understand patterns, and investigate unexpected changes more closely. Furthermore, the HRCD proved to be a relatively simple dataset to use. With the development of standard application methods, Thurston County was able to complete an analysis of their remaining SMP area without any further assistance from WDFW.

5.6 Conclusion

Targeted implementation and effectiveness monitoring are important parts of good government. Well-implemented and effective regulations depend in part on citizens' belief that local regulatory

programs are fair. Communities within a local jurisdiction are more likely to support regulation if they understand the ecological importance of protection and if they believe that the government is delivering fair and transparent regulations.

Despite advances in science and efforts to improve regulatory processes, we are confronted with climatic change and increasing population pressures in many parts of the state. Our challenge will be made easier by tracking our successes and learning from our failures through monitoring and adaptive management.

APPENDIX 1: DETERMINING SITE-POTENTIAL TREE HEIGHT

A1.1 DETERMINING SITE-POTENTIAL TREE HEIGHT

The easiest way to determine Site-Potential Tree Height for a particular location is through resources on the internet. The Washington Department of Natural Resources provides online interactive maps of site productivity classes for all nonfederal and nontribal forestlands in Washington. To access the map, go to http://www.dnr.wa.gov/ and follow these steps:

1. Click on "Forestry" box.
2. Select "Forest Practices" from menu that appears within Forestry box.
3. Click on "Forest Practices Application Review System (FPARS)".
4. Click on "Forest Practices Activity Mapping Tool".
   That will take you to https://fortress.wa.gov/dnr/protectiongis/fpamt/index.html#
5. Click on "Map Themes" (upper left corner of map).
6. From drop down menu, select "Site Class".
7. Zoom into map repeatedly until site class polygons appear (about seven clicks on "+").
8. Click on "Legend", near upper left corner of screen.

Use the legend to determine the site class of your location. Use Table A1-1 to determine the 200 year Site-Potential Tree Height for your location.

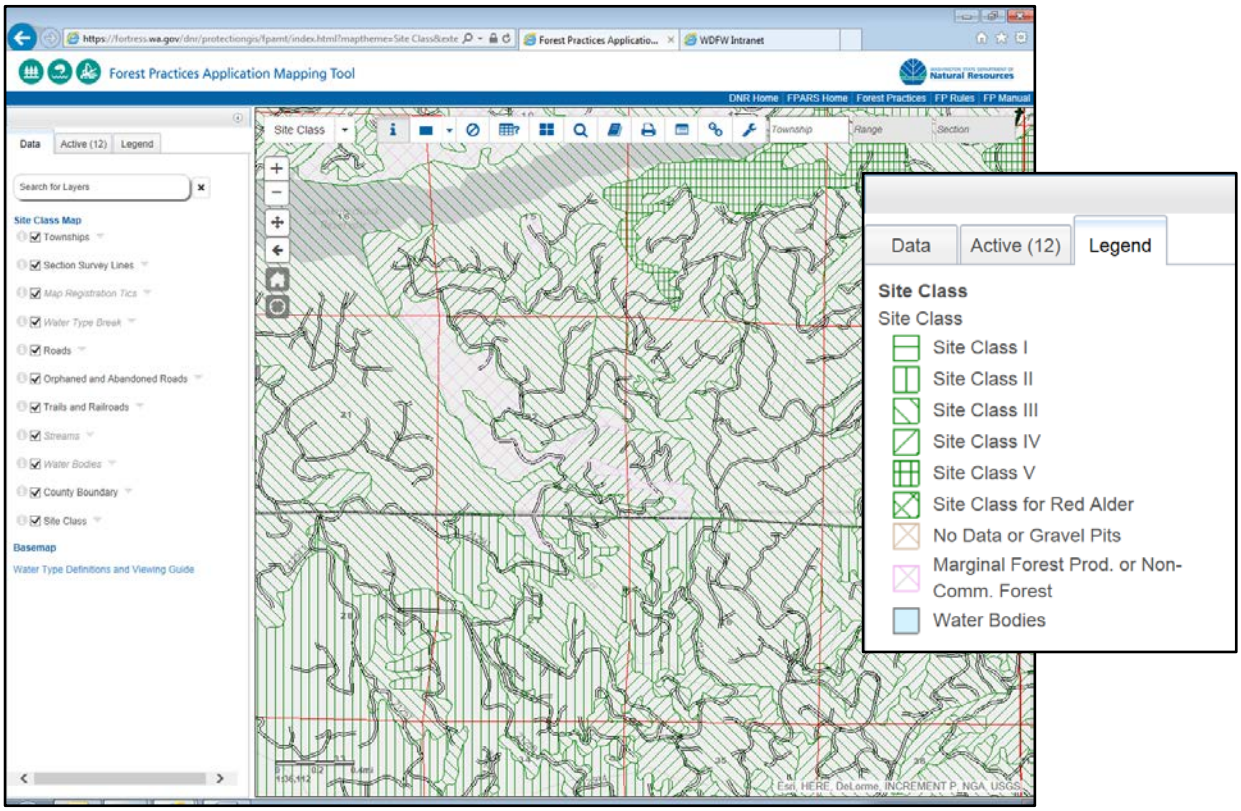


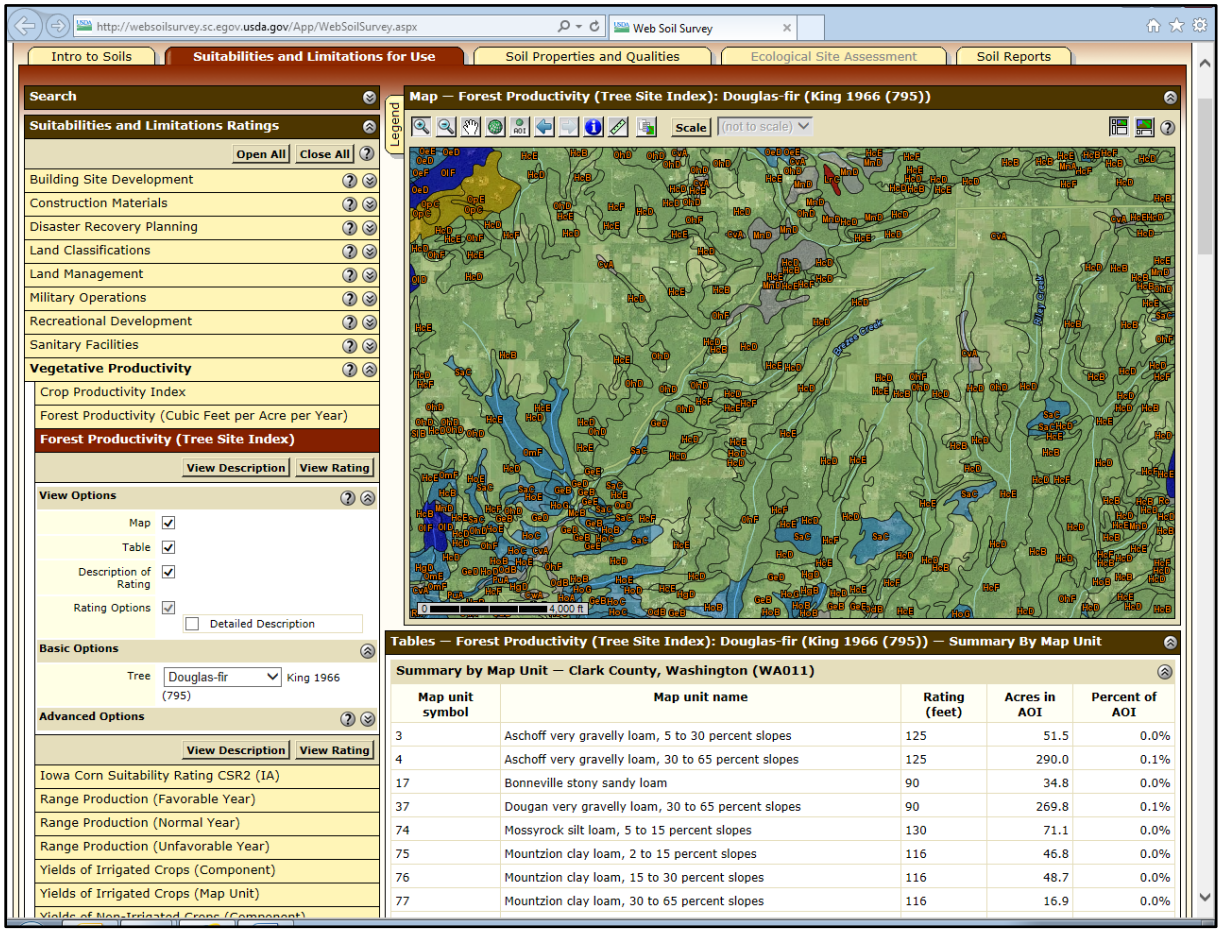
Figure A1-1. Example of interactive on-line site class map, with legend. Black lines are roads. Red lines are section boundaries. https://fortress.wa.gov/dnr/protectiongis/fpamt/index.html#

Table A1-1. 200-year Site-Potential Tree Heights in feet by site productivity class. Two different estimates give approximately the same heights.

Site Class	King (1966)	Curtis et al. (1974)
I	276	275
II	225	223
III	185	183
IV	146	145
V	100	99

Another source of information on site productivity that can be used to determine Site-Potential Tree Height is the Web Soil Survey (WSS) provided by the Natural Resources Conservation Service. To access the map, go to http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm and follow these steps:

1. Click on the green "WSS" button.
   That will take you to http://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx
   You can use this site to access NRCS soil survey data.
2. Define an area of interest (AOI).
   a. Under "Quick Navigation", click on 'Soil Survey Area".
   b. Select state and county from drop down menus.
   c. Select soil survey dataset with radio button.
   d. Check "Show Soil Survey Areas Layer in Map"
   e. Click on "Set AOI".
3. Click on "Soil Data Explorer" tab (above map).
4. If not already selected, click "Suitabilities and Limitations for Use" tab (above map).
5. Click on "Vegetative Productivity" in menu on left.
6. Click on "Forest Productivity (Tree Site Index)".
7. Check "Map", "Table", and "Description of Rating".
8. Select tree species from drop-down menu.
   a. In western Washington, select Douglas-fir (King 1966).
   b. In eastern Washington, select Douglas-fir (Cochran 1979) or Ponderosa Pine (Meyer 1961), depending upon dominant tree species at the site.
9. Click on "View Rating"
   You will end up with a map of all of the soils within the AOI. Alphanumeric labels on the map are the soil number or soil type. Only colored polygons have a site index "rating" for the selected tree species. Scroll down toward bottom of window to view site indices for each soil type.
10. Use map tools (upper left corner of map) to zoom into project area.
    a. Zoom into map repeatedly until soil symbols appear on map.
11. To set a new AOI, click on "Area of Interest (AOI)" tab (upper left corner).
12. Click on "Clear AOI".
13. Repeat steps 2 through 10.



Map unit symbol	Map unit name	Rating (feet)	Acres in AOI	Percent of AOI
3	Aschoff very gravelly loam, 5 to 30 percent slopes	125	51.5	0.0%
4	Aschoff very gravelly loam, 30 to 65 percent slopes	125	290.0	0.1%
17	Bonneville stony sandy loam	90	34.8	0.0%
37	Dougan very gravelly loam, 30 to 65 percent slopes	90	269.8	0.1%
74	Mossyrock silt loam, 5 to 15 percent slopes	130	71.1	0.0%
75	Mountzion clay loam, 2 to 15 percent slopes	116	46.8	0.0%
76	Mountzion clay loam, 15 to 30 percent slopes	116	48.7	0.0%
77	Mountzion clay loam, 30 to 65 percent slopes	116	16.9	0.0%

Figure A1-2. Example of interactive on-line soil survey map. Alphanumeric symbols denote various soils types, which are separated by thin black lines on map. The "Rating" column in table below map is the site index for Douglas-fir.

The "Rating" column in table below soils map is the site index for the selected tree species. In western Washington, to translate Douglas-fir site index to site productivity class see Table A1-2, and then use Table A1-1 to determine the 200-year Site-Potential Tree Height for your location. In eastern Washington, use Table A1.3 for Douglas-fir or Table A1.4 for Ponderosa pine, depending upon the dominant tree species in the riparian ecosystem. When determining the dominant tree species in the riparian ecosystem, assess the ecosystem's zone of influence, which is typically the upland portion of the riparian ecosystem. Use the floodplain, channel migration zone, or classical riparian zone only when no trees exist in the zone of influence.

Table A1-2. Translation of Douglas-fir site index (King 1966) to site productivity classes. Use Table A1-1 to determine 200-year Site-Potential Tree Height for Douglas-fir.

Site Index Range		
Lower Limit	**Upper Limit**	**Site Class**
135	160	I
115	134	II
95	114	III
75	94	IV
50	74	V

Table A1-3. Site-potential tree heights in feet by site index for interior (east side) Douglas-fir (Cochran 1979). Interior Douglas-fir can live for over 300 years, however, diameter growth becomes extremely slow and height growth practically ceases after age 200 years (Burns and Honkala 1990). Height equations in Cochran (1979) only valid for stand ages less than 180 to 190 years, depending upon site class. Stand age is total age, which was determined by adjusting breast-height age with equation 10 in Thrower and Goudie (1992).

Site Index	Height at Age 180 to 190 Years
50	88
60	104
70	120
80	135
90	151
100	167
110	182

Table A1-4. Two-hundred year Site-Potential Tree Heights in feet by site index for Ponderosa pine (Meyer 1961). Stand age is total age.

Site Index	40	50	60	70	80	90	110	110	120	130	140
Height at Age 200 Years (ft)	50	64	80	97	112	128	143	157	172	187	198

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[1] References are classified according to RCW 34.05.271 (see Volume 1, Appendix 1) denoted by a lower case roman numeral (i – viii) in parentheses at the end of the citation.

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APPENDIX 2: SITE-POTENTIAL TREE HEIGHT HISTOGRAMS BY COUNTY

A2.1 INTRODUCTION

The following graphs show the distribution of 200-year Site-Potential Tree Heights (SPTHs) for riparian areas in each county.

The graphs were created by intersecting soil-type polygons from the Natural Resources Conservation Service (NRCS) with rivers and streams in the National Hydrography Dataset (NHD). For the tree species most likely to grow at a site, NRCS provides a site index value based on the most appropriate site index curves (e.g., King (1966) for west side Douglas-fir). A site index value is the tree height attained at the index's base age, typically either 50 or 100 years. We extrapolated tree heights from the base age to 200 years using the appropriate site index equation (Table A2-1). If a soil-type polygon contained site index values for more than one tree species, then we used the species that is expected to grow taller. In the graphs below, "no data" indicates that the soil-type polygon did not provide a site index value. This generally occurs where ecological site conditions are unsuitable for trees (e.g., arid sub-regions of the Columbia Plateau), or where current and expected future land use was judged by NRCS to never allow trees to become established (e.g., intensive agriculture). Federal and tribal lands are not covered by the standard NRCS soils data.

Means, medians, and quartiles of SPTH were calculated using stream miles. Stream miles roughly correspond to the amount of riparian area in a county. The mean 200-year SPTH of a county, for instance, was calculated as a stream-length weighted mean. The median represents the 200-year SPTH that is greater than the SPTHs along half the stream miles in a county and less than the SPTHs along the other half of stream miles.

Table A2-1. Site index curves used in calculations of 200-year Site-Potential Tree Heights.

Tree Species	Side of Cascade Crest	Site Index Curve
Douglas-fir	West	King (1966)
Western Hemlock		Wiley (1978)
Western Red Cedar		Kurucz (1978)
Red Alder		Worthington (1960)
Douglas-fir	East	Cochran (1979a)
Rocky Mountain Douglas-fir		Monserud (1985)
Western Hemlock		Barnes (1962)
Ponderosa Pine		Meyer (1961)
Western Larch		Schmitt et al. (1976)
Grand Fir		Cochran (1979b)
Western White Pine		Haig (1932)
Engelmann Spruce		Alexander (1967a)
Lodgepole Pine		Alexander (1967b)
Black Cottonwood		BCFS (1977)

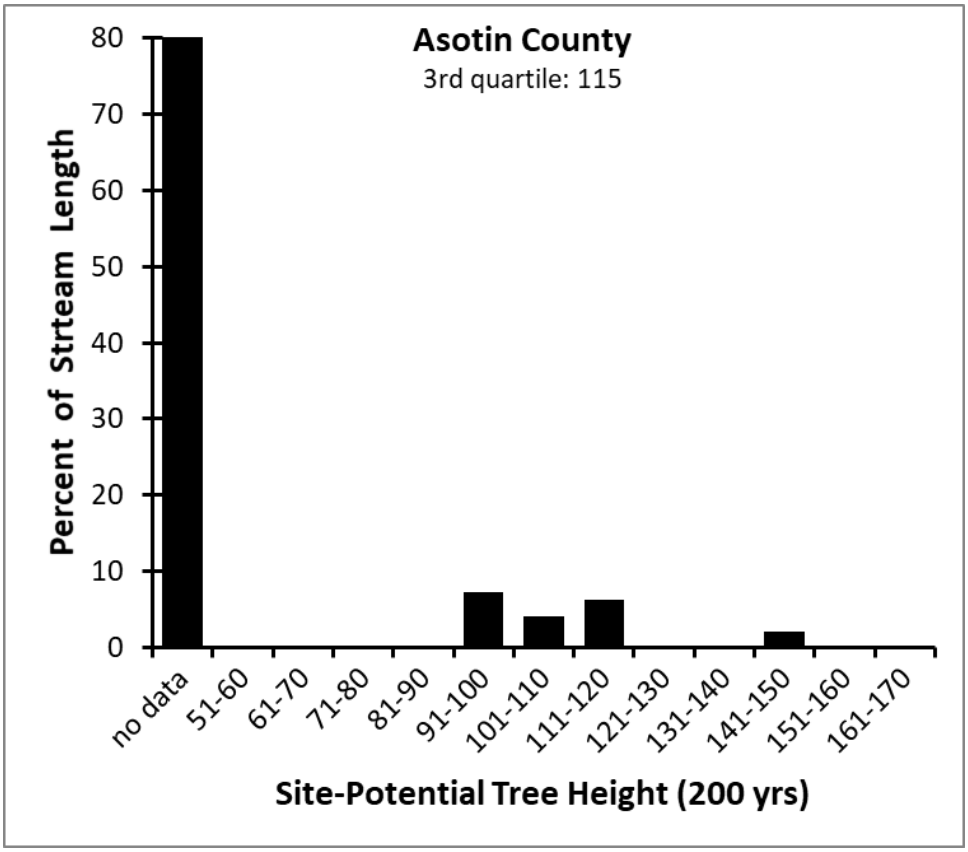


Figure A2-1: Asotin County stream length-weighted third quartile of 200-year SPTH: 115 ft

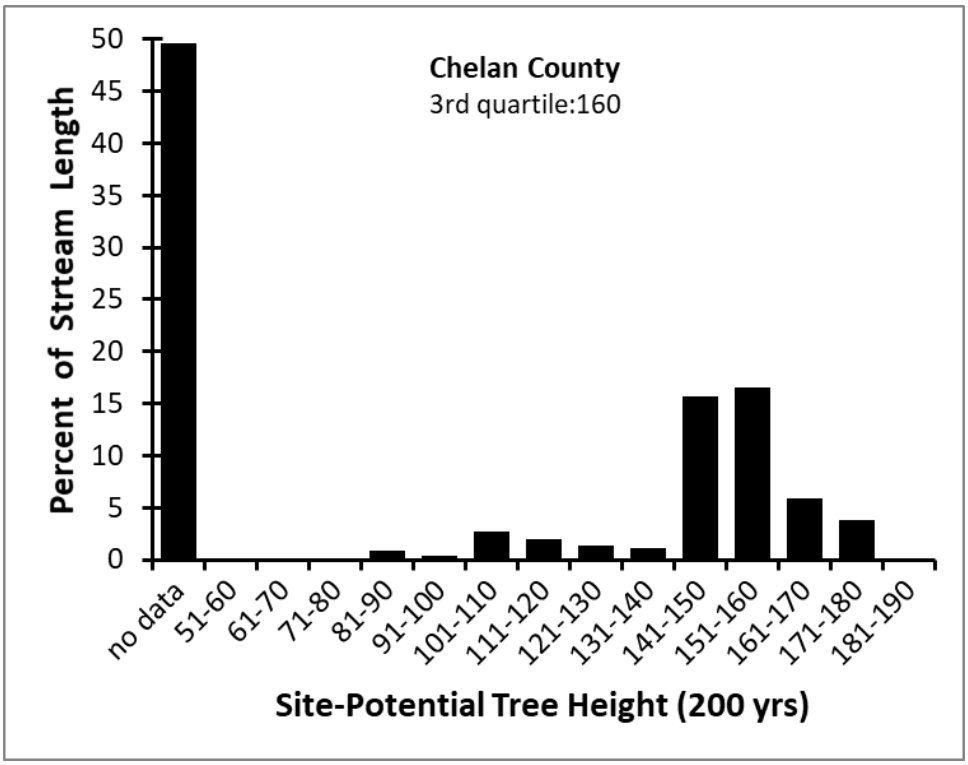
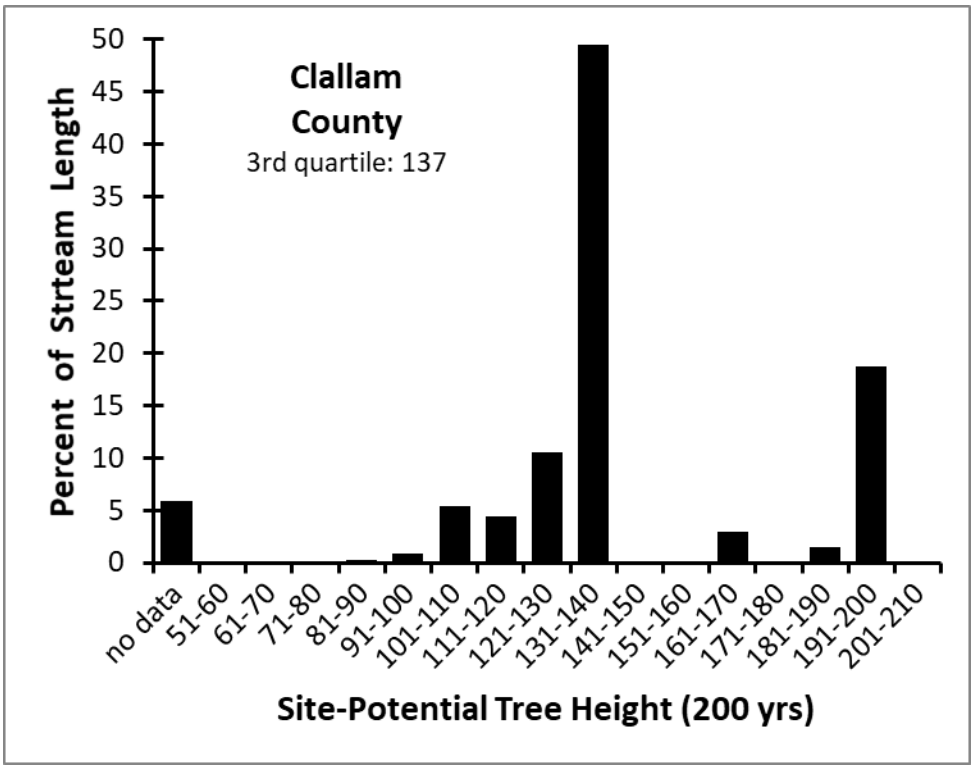
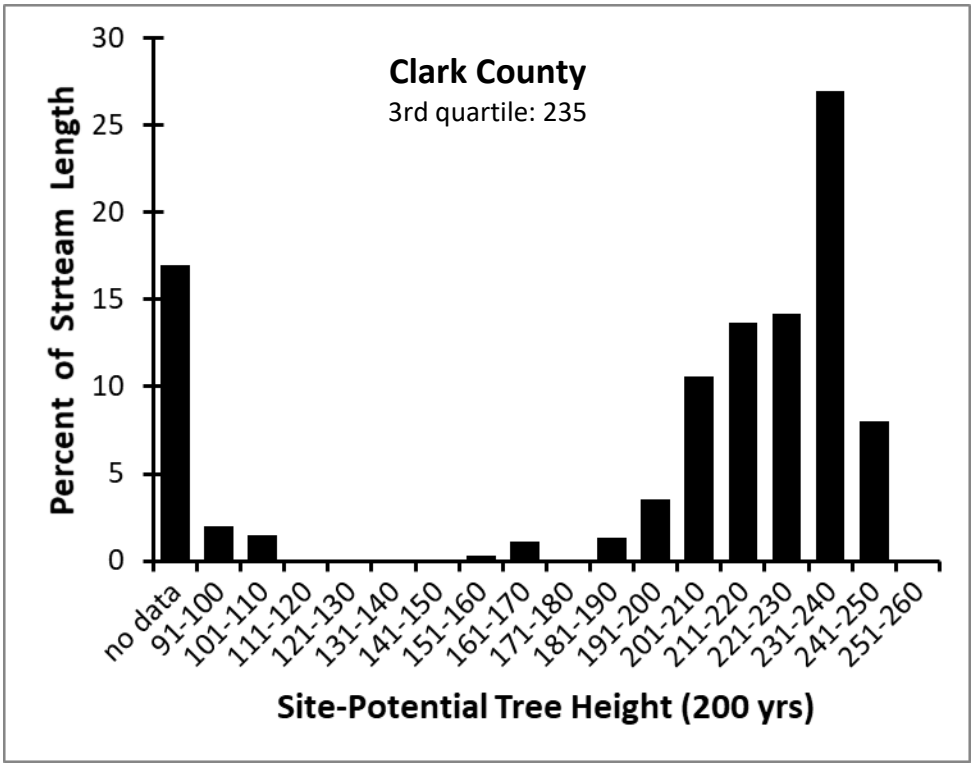


Figure A2-2: Chelan County stream length-weighted third quartile of 200-year SPTH: 160 ft



2537 **Figure A2-3: Clallam County stream length-weighted third quartile of 200-year SPTH: 137 ft**



2538 **Figure A2-4: Clark County stream length-weighted third quartile of 200-year SPTH: 235 ft**

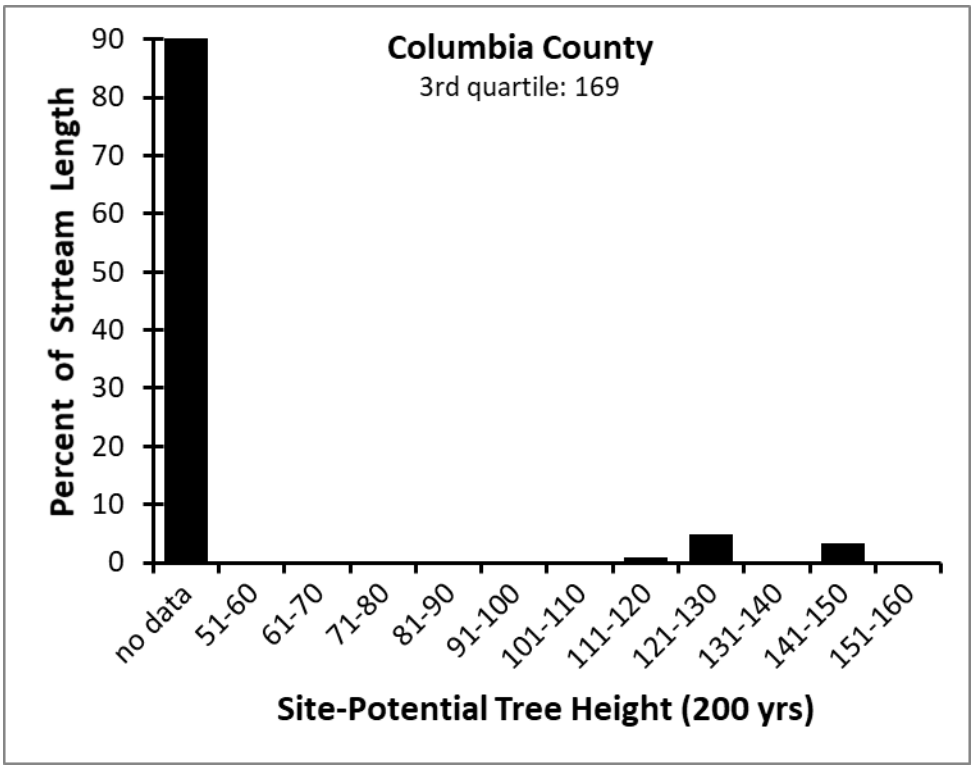


Figure A2-5: Columbia County stream length-weighted third quartile of 200-year SPTH: 169 ft

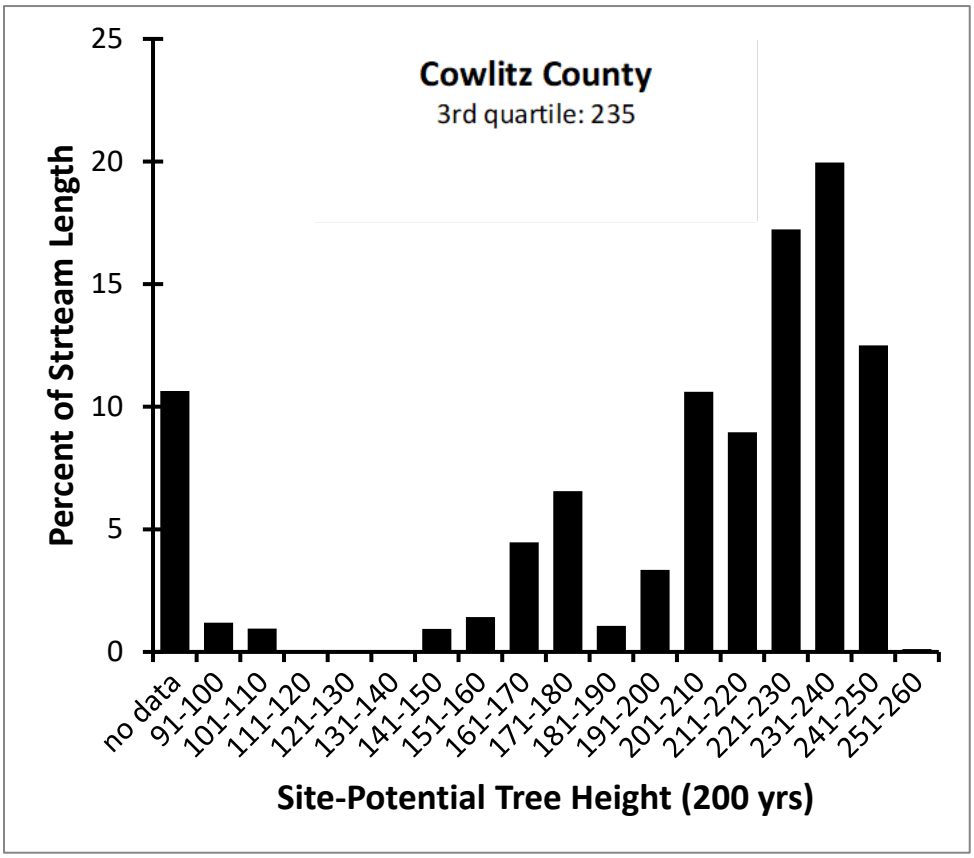
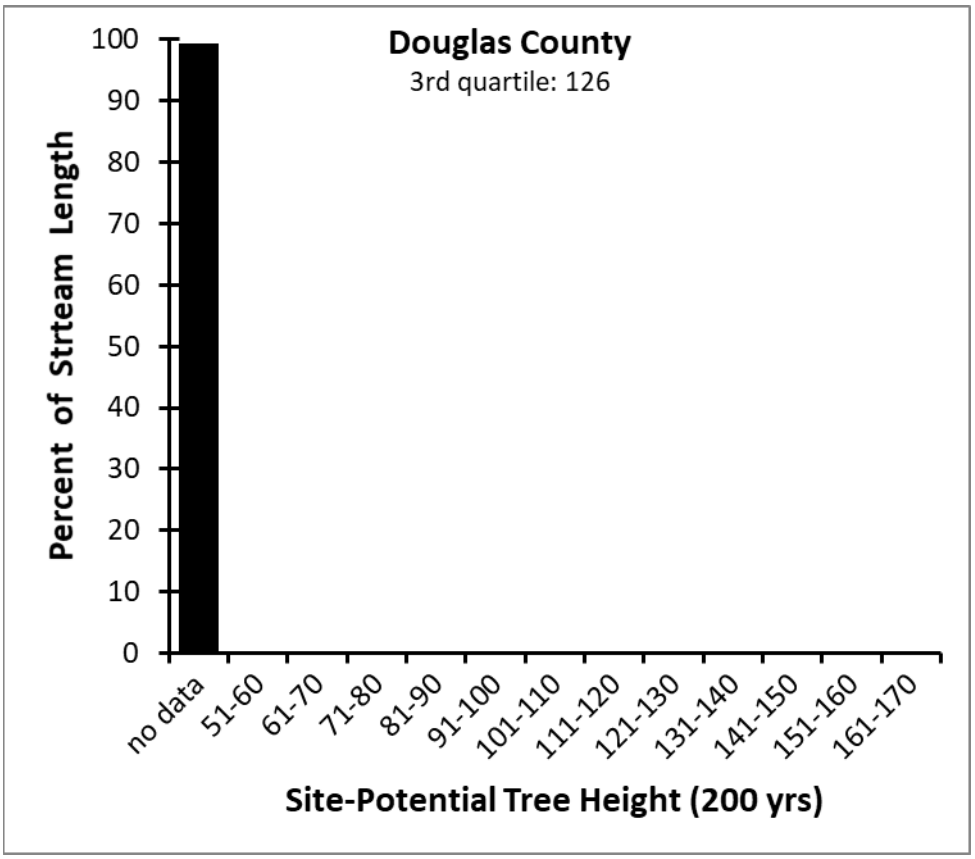
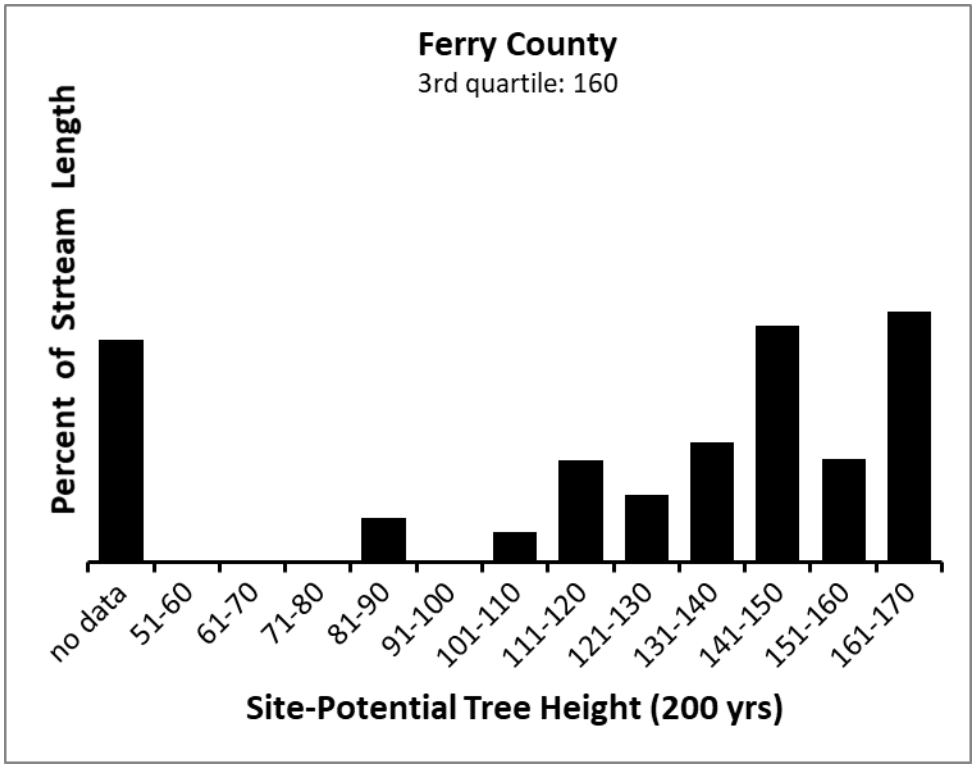


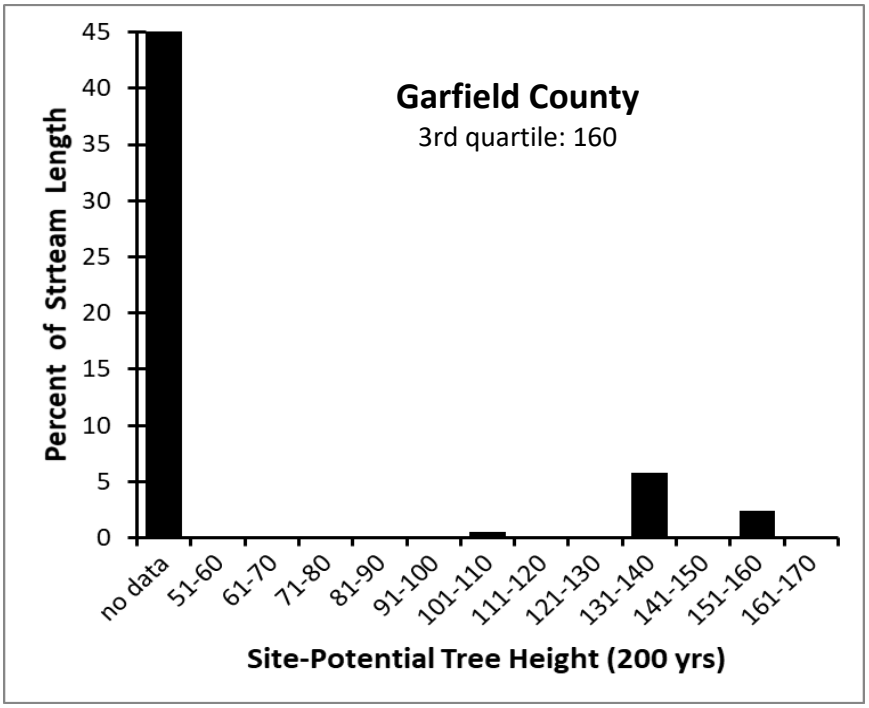
Figure A2-6: Cowlitz County stream length-weighted third quartile of 200-year SPTH: 235 ft



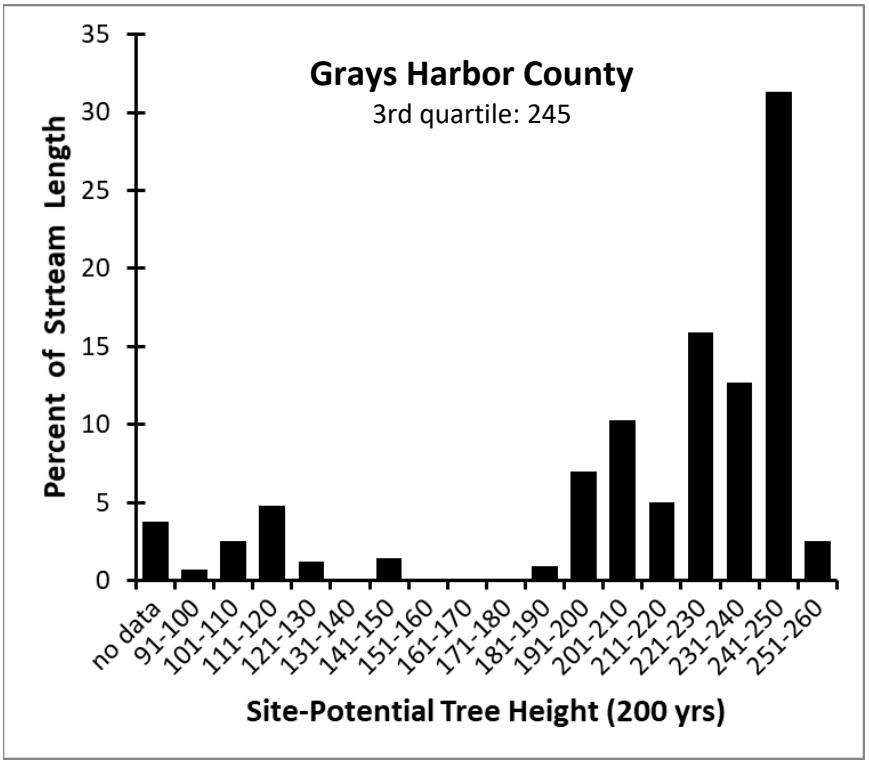
2541 **Figure A2-7: Douglas County stream length-weighted third quartile of 200-year SPTH: 126 ft**



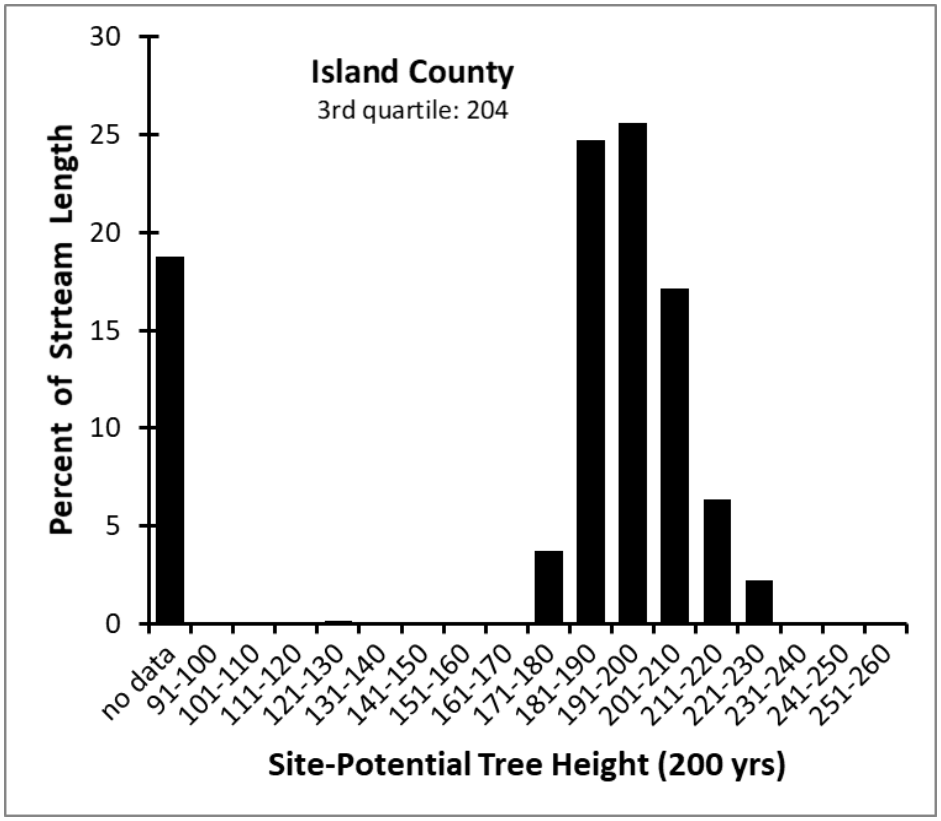
2542 **Figure A2-8: Ferry County stream length-weighted third quartile of 200-year SPTH: 160 ft**



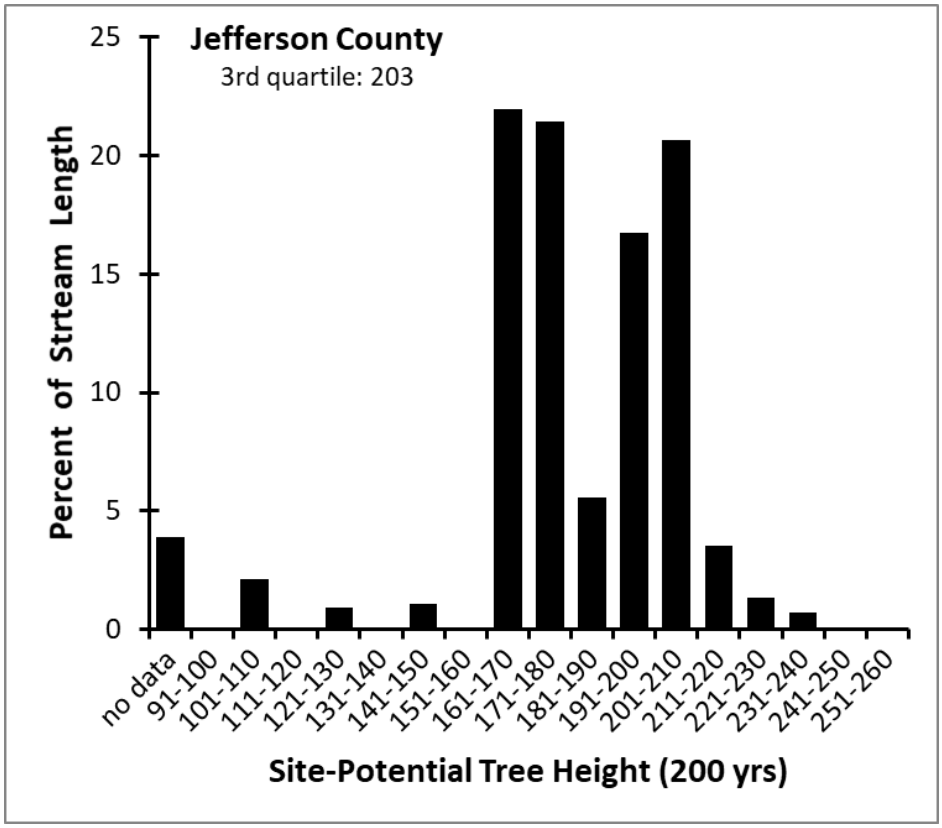
2543 **Figure A2-9: Garfield County stream length-weighted third quartile of 200-year SPTH: 160 ft**



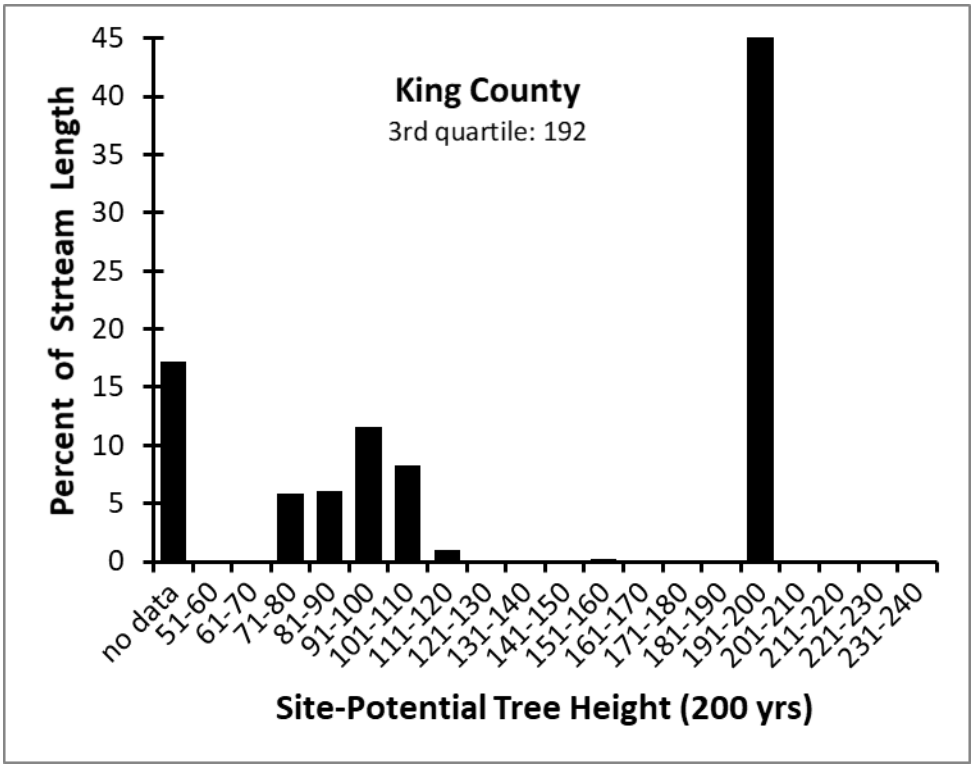
2544 **Figure A2-10: Grays Harbor County stream length-weighted third quartile of 200-year SPTH: 245 ft**



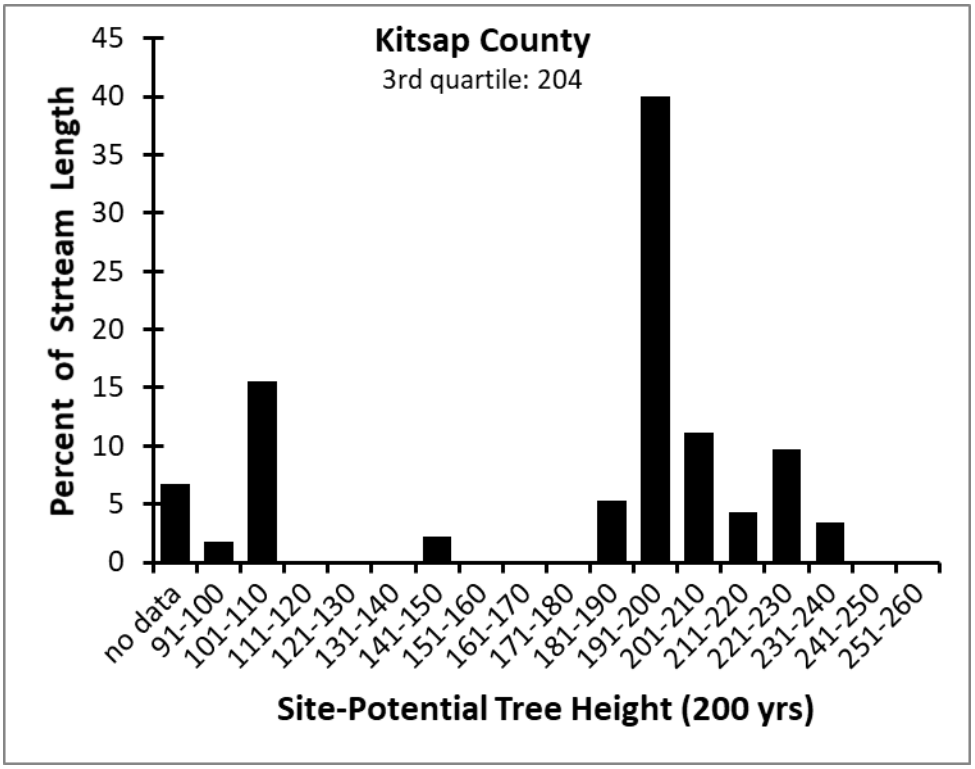
2545 **Figure A2-11: Island County stream length-weighted third quartile of 200-year SPTH: 204 ft**



2546 **Figure A2-12: Jefferson County stream length-weighted third quartile of 200-year SPTH: 203 ft**



2547 **Figure A2-13: King County stream length-weighted third quartile of 200-year SPTH: 192 ft**



2548 **Figure A2-14: Kitsap County stream length-weighted third quartile of 200-year SPTH: 204 ft**

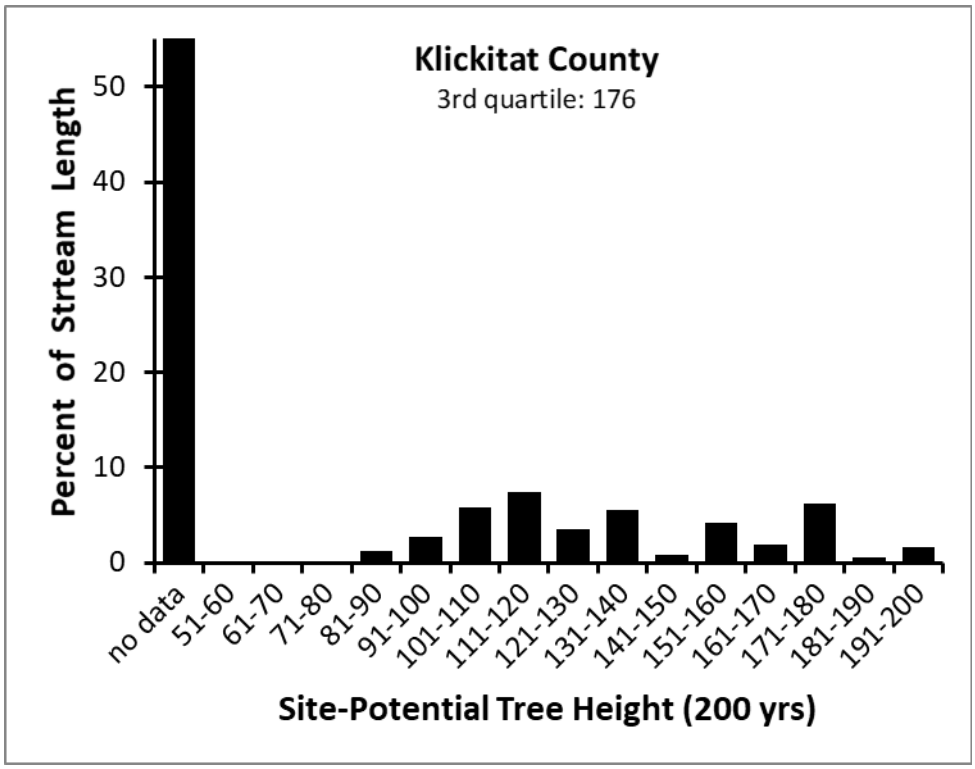


Figure A2-15: Klickitat County stream length-weighted third quartile of 200-year SPTH: 176 ft

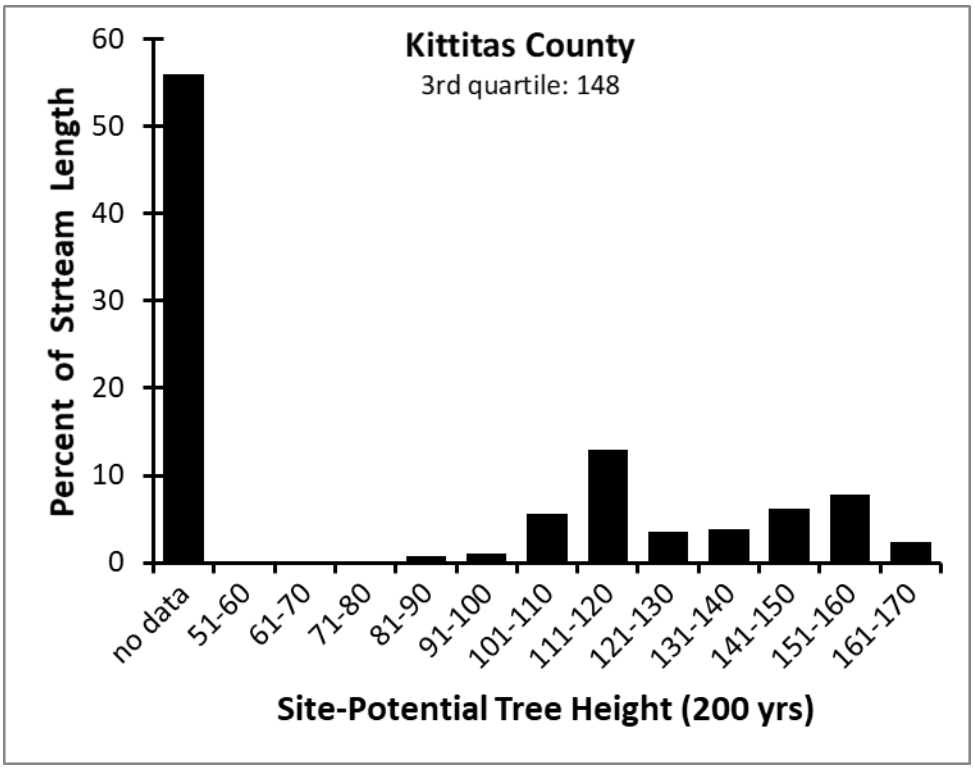
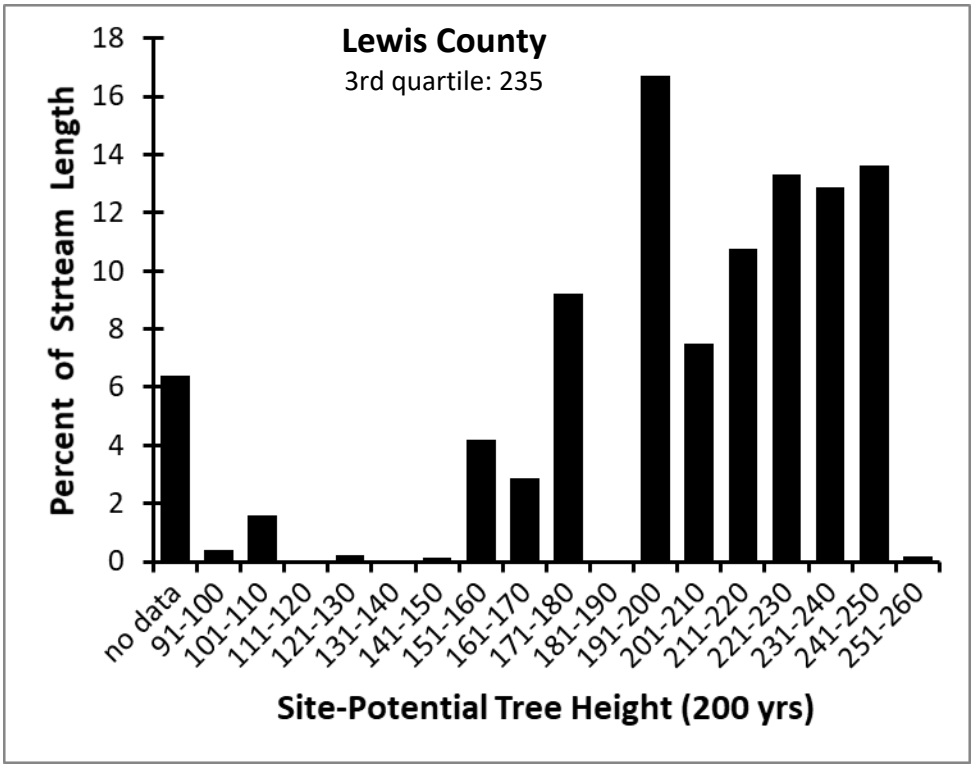
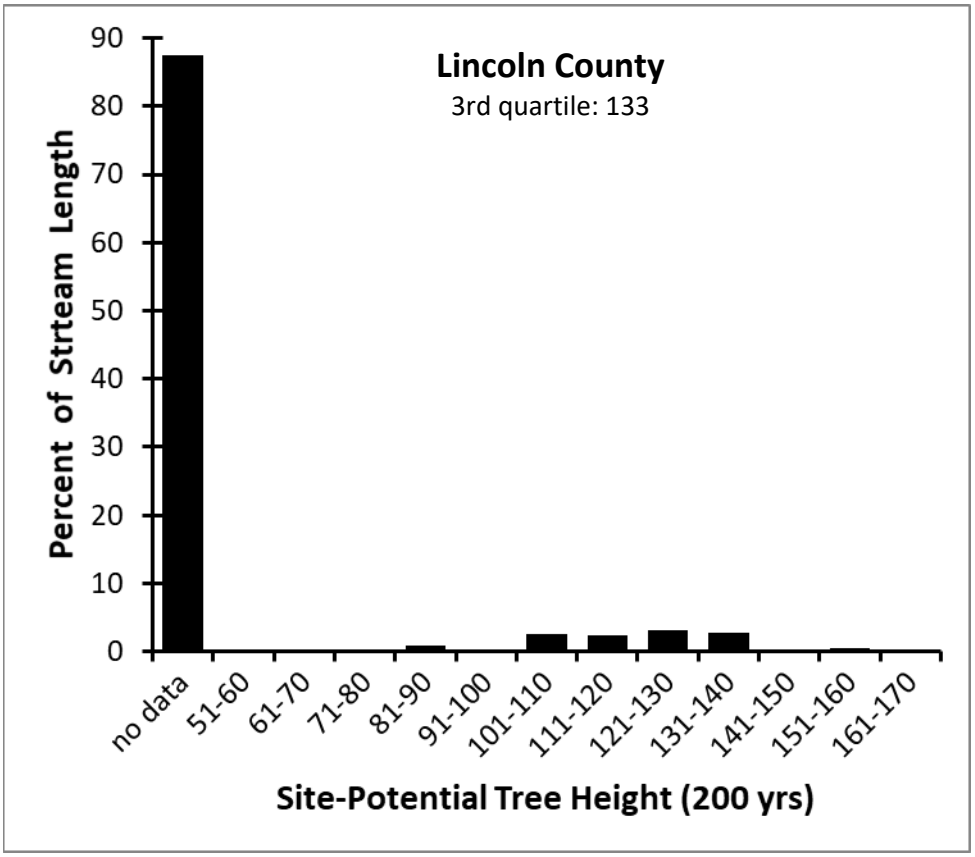


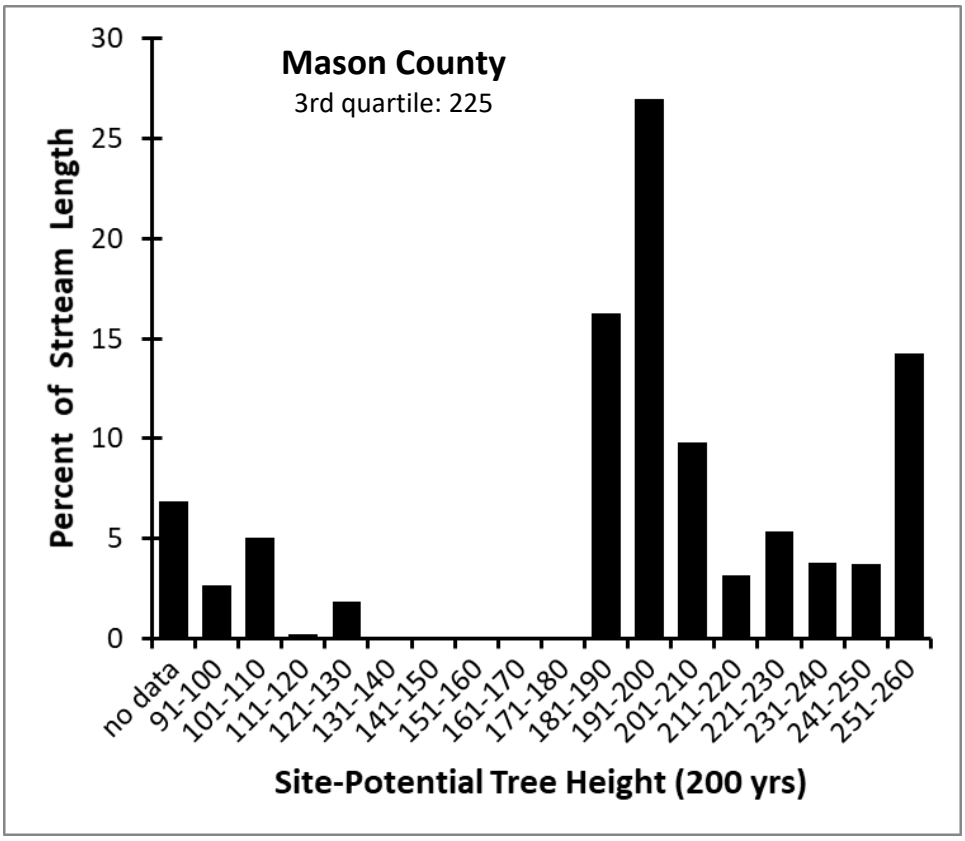
Figure A2-16: Kittitas County stream length-weighted third quartile of 200-year SPTH: 148 ft



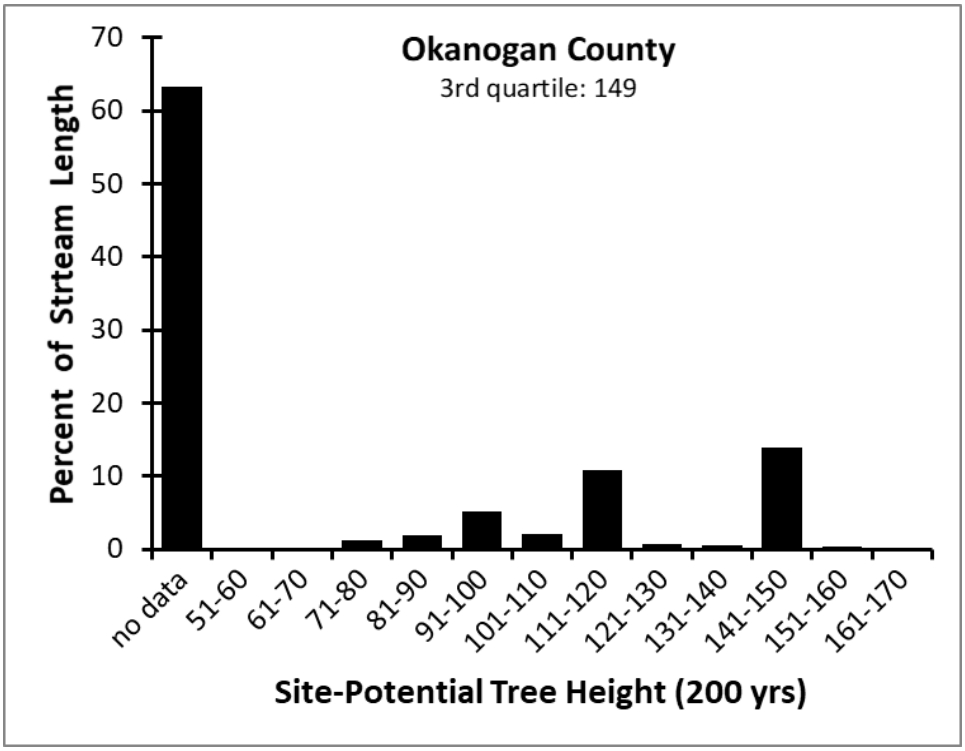
2551 **Figure A2-17: Lewis County stream length-weighted third quartile of 200-year SPTH: 235 ft**



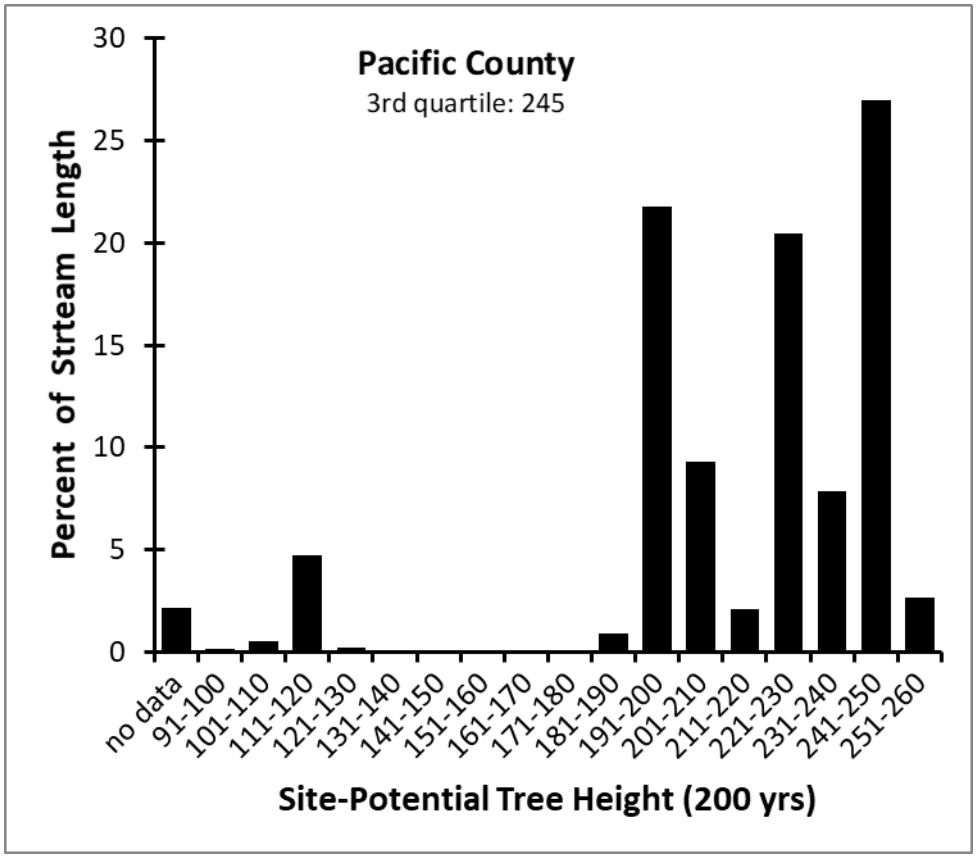
2552 **Figure A2-18: Lincoln County stream length-weighted third quartile of 200-year SPTH: 133 ft**



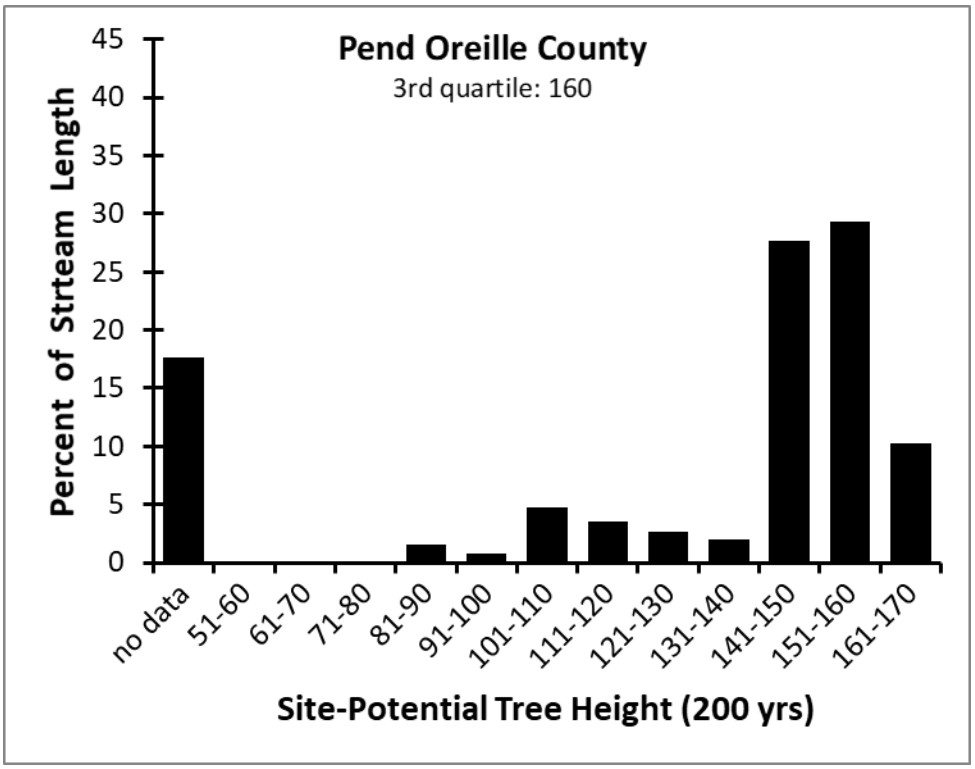
2553 **Figure A2-19: Mason County stream length-weighted third quartile of 200-year SPTH: 225 ft**



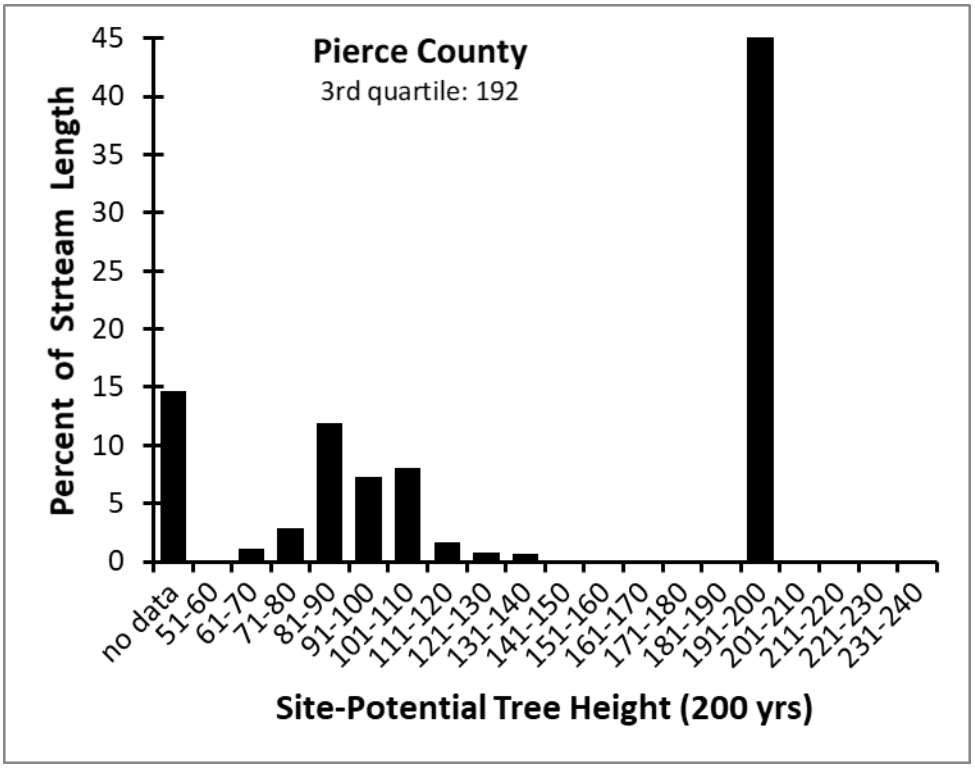
2554 **Figure A2-20: Okanogan County stream length-weighted third quartile of 200-year SPTH: 149 ft**



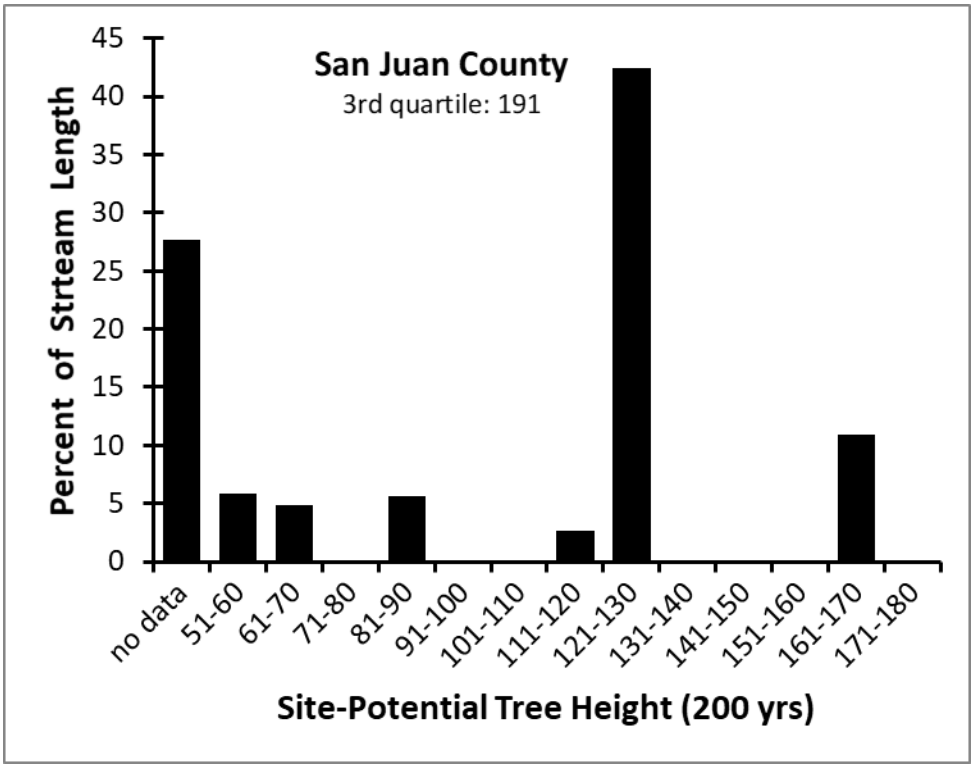
2555 **Figure A2-21: Pacific County stream length-weighted third quartile of 200-year SPTH: 245 ft**



2556 **Figure A2-22: Pend Oreille County stream length-weighted third quartile of 200-year SPTH: 160 ft**



2557 **Figure A2-23: Pierce County stream length-weighted third quartile of 200-year SPTH: 192 ft**



2558 **Figure A2-24: San Juan County stream length-weighted third quartile of 200-year SPTH: 191 ft**

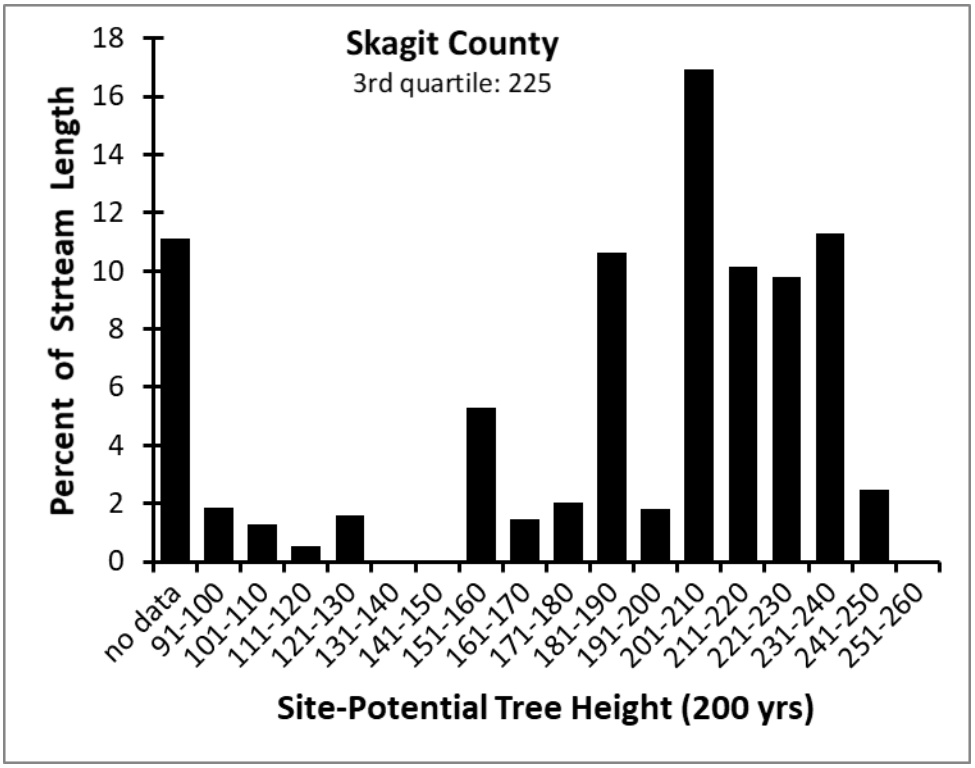


Figure A2-25: Skagit County stream length-weighted third quartile of 200-year SPTH: 225 ft

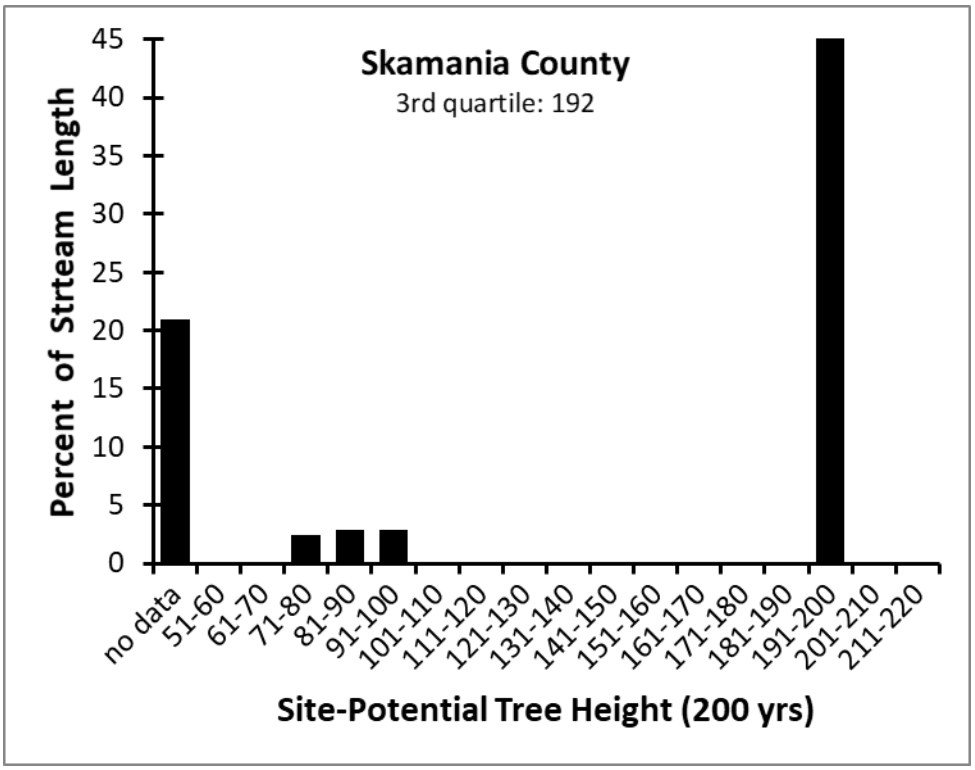


Figure A2-26: Skamania County stream length-weighted third quartile of 200-year SPTH: 192 ft

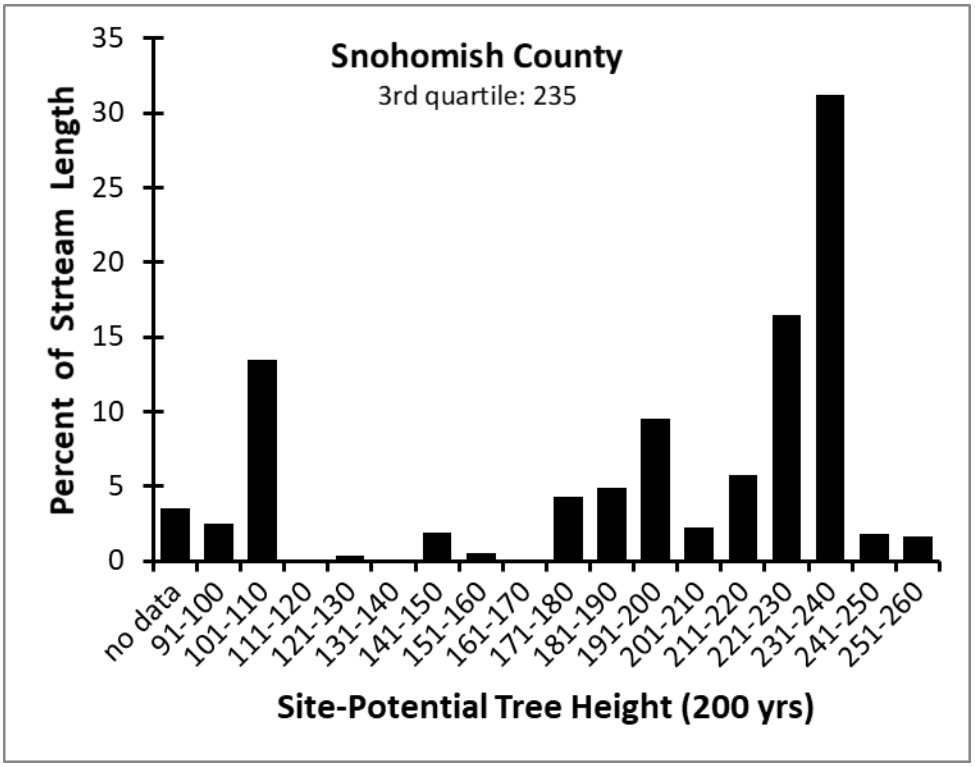


Figure A2-27: Snohomish County stream length-weighted third quartile of 200-year SPTH: 235 ft

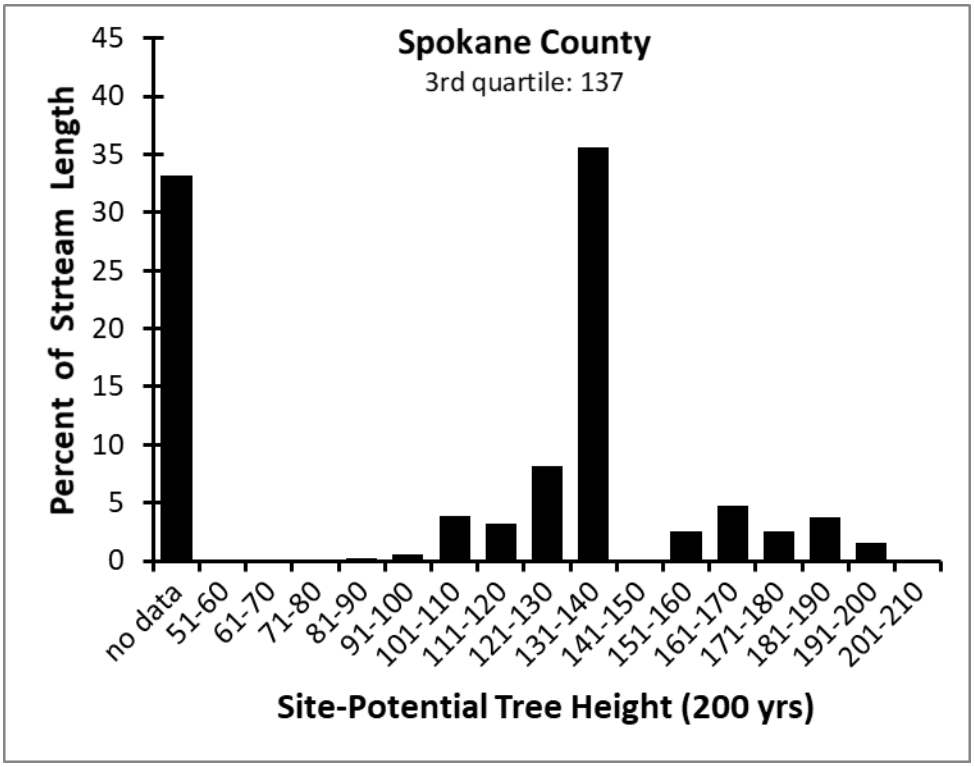
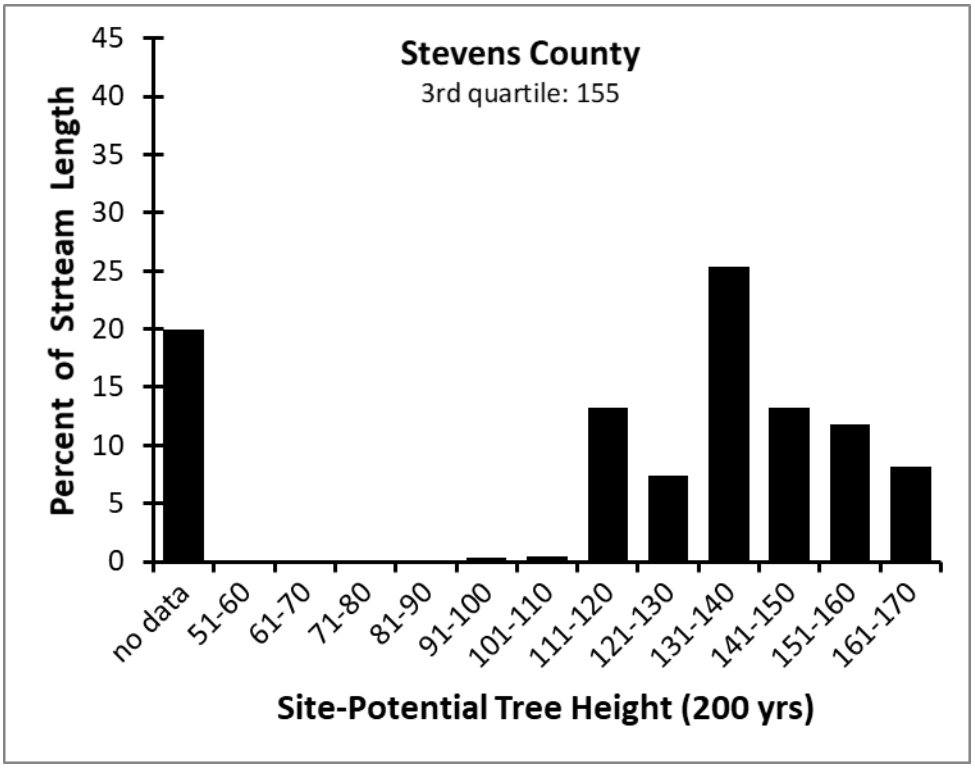
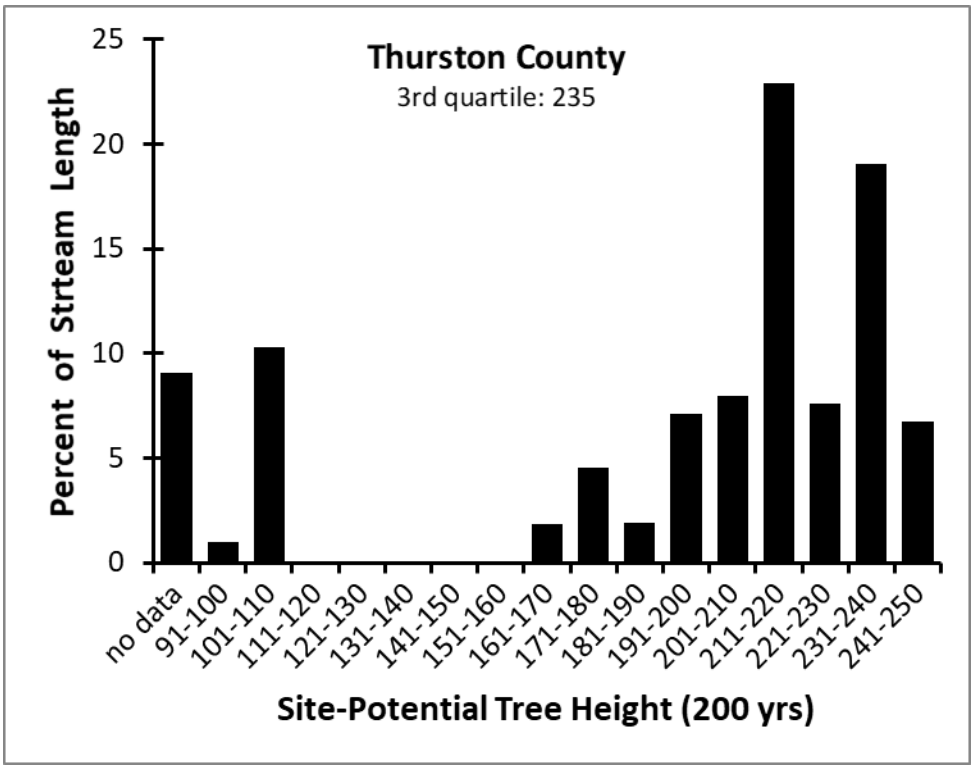


Figure A2-28: Spokane County stream length-weighted third quartile of 200-year SPTH: 137 ft



2563 **Figure A2-29: Stevens County stream length-weighted third quartile of 200-year SPTH: 155 ft**



2564 **Figure A2-30: Thurston County stream length-weighted third quartile of 200-year SPTH: 235 ft**

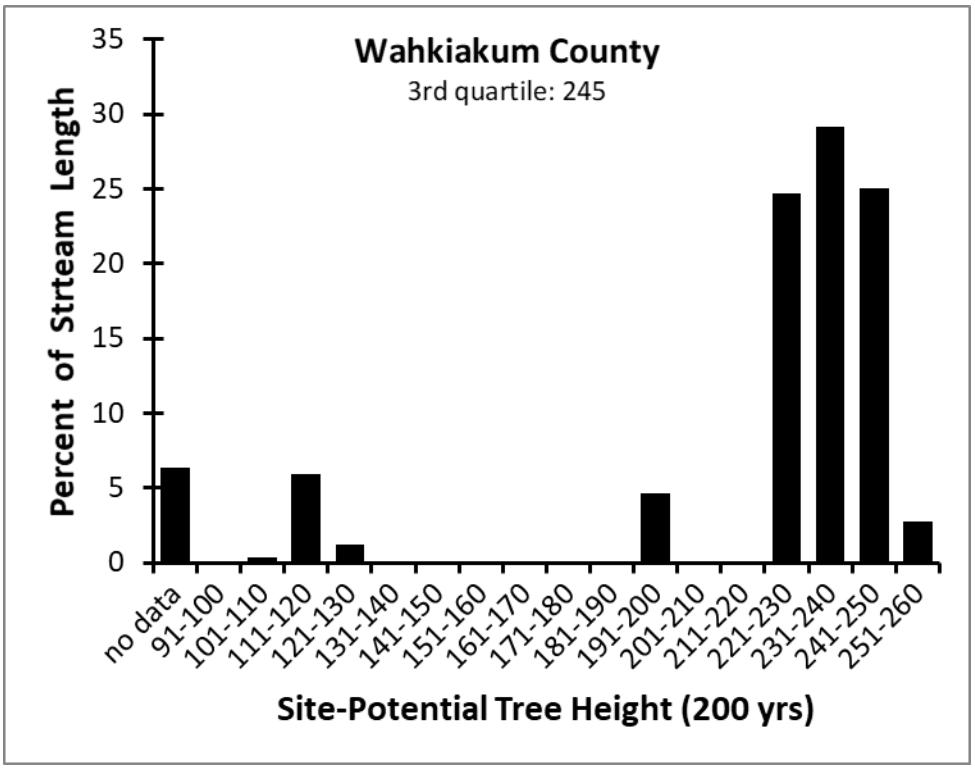


Figure A2-31: Wahkiakum County stream length-weighted third quartile of 200-year SPTH: 245 ft

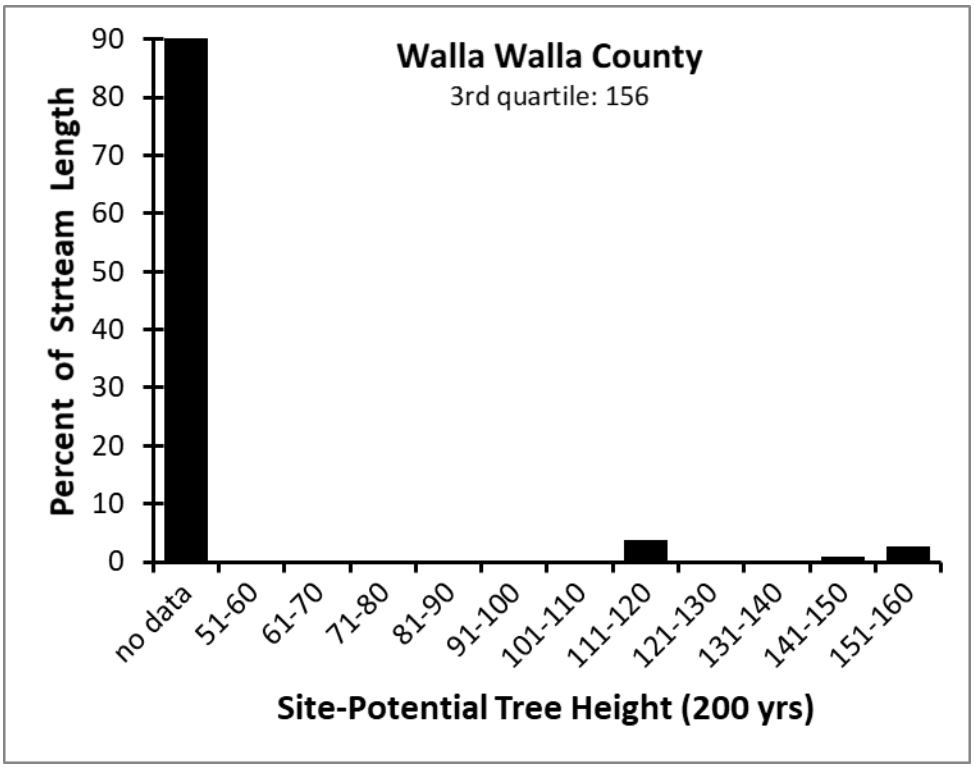


Figure A2-32: Walla Walla County stream length-weighted third quartile of 200-year SPTH: 156 ft

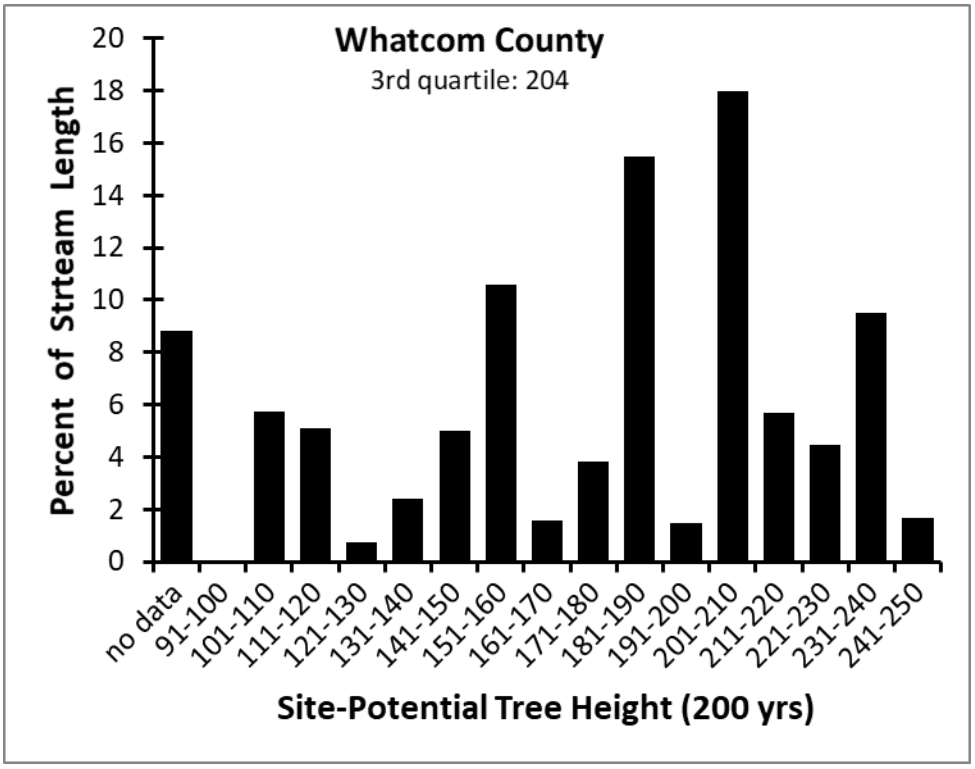


Figure A2-33: Whatcom County stream length-weighted third quartile of 200-year SPTH: 204 ft

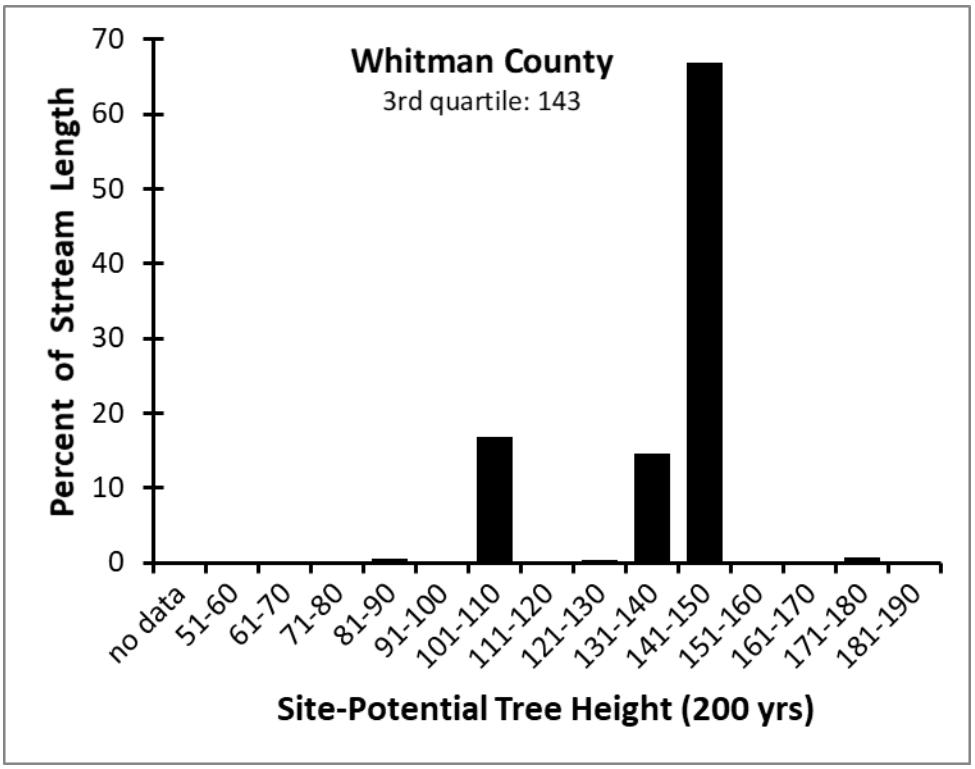


Figure A2-34: Whitman County stream length-weighted third quartile of 200-year SPTH: 143 ft

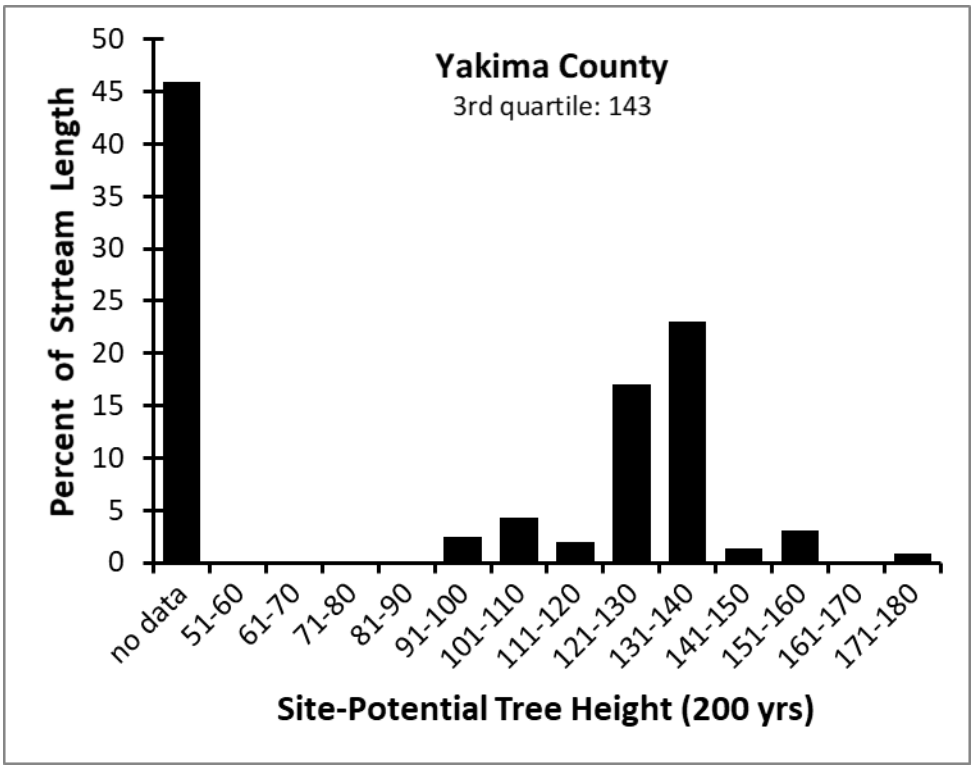


Figure A2-35: Yakima County stream length-weighted third quartile of 200-year SPTH: 143 ft

2571 **Table A2-2: Stream length-weighted third quartile of 200-year SPTH of Counties in Western and Eastern**
2572 **Washington text**

Counties in Western Washington	3rd Quartile (ft)
Clallam	137
Clark	235
Cowlitz	235
Grays Harbor	245
Island	204
Jefferson	203
King	192
Kitsap	204
Lewis	235
Mason	225
Pacific	245
Pierce	192
San Juan	191
Skagit	225
Skamania	192
Snohomish	235
Thurston	235
Wahkiakum	245
Whatcom	204
Average	**215**

Counties in Eastern Washington	3rd Quartile (ft)
Asotin	115
Chelan	160
Columbia	169
Douglas	126
Ferry	160
Garfield	160
Kittitas	176
Klickitat	148
Lincoln	133
Okanogan	149
Pend Oreille	160
Spokane	137
Stevens	155
Walla Walla	156
Whitman	143
Yakima	143
Average	**149**

APPENDIX 3: VOLUNTARY STEWARDSHIP PROGRAM ADAPTIVE MANAGEMENT MATRIX

Appendix I. Chelan County Voluntary Stewardship Program (VSP) Adaptive Management Matrix

This adaptive management matrix is provided in three parts: 1) critical area protection benchmarks; 2) voluntary enhancement measures; and 3) agricultural viability aims and outcomes.

Row Num	Critical Area Goals High level goal of project. There are just a handful.	Critical Area Benchmark Specific environmental conditions desired from project	Performance Metric What will be measured to know if adaptive management objective is achieved	Monitoring Method How the performance metric will be measured	Adaptive Management Action Threshold Project result that, if achieved, must be addressed with an action	Adaptive Management Action Action that will be taken if threshold is reached (A No Action Alternative is implied as an option for every Objective Listed Below)	Who Monitors Person or organization responsible for adaptive management objective monitoring	When When monitoring will occur	Party Responsible for An Action Person or organization responsible for implementing adaptive management action including all elements of contracting and fiscal responsibility if threshold is reached.	Funding source for Adaptive Management Action Organization with funding available to assist agricultural owner
Critical Area Protection Benchmarks: RCW 36.70A.720 (1) (e) Create measurable benchmarks that, within ten years after the receipt of funding, are designed to result in (i) the protection of critical area functions and values										
1.	CA Goal-I. In areas of critical area intersect with agricultural activities, and at the watershed level: Prevent the degradation of critical area functions and values, due to agricultural activities, existing as of July 22, 2011 including: •Geologically hazardous areas •Fish and wildlife habitat conservation areas (e.g., streams, wildlife corridors, etc.) •Wetlands •Frequently flooded areas •Critical aquifer recharge areas	Benchmark-A. In areas of critical area intersect with agricultural activities, and at the watershed level: Protect critical area functions and values through voluntary measures in areas of intersection with agricultural activities across watersheds.	P-1 Area of cover of natural or managed vegetation in areas subject to sheet and rill erosion. P-2 Footprint of agriculture in relation to areas of riparian vegetation. P-3 Footprint of agriculture in relation to areas of wetland habitat. P-4 Continued application of critical area regulations for designated flood hazard areas incorporated into work plan. P-5 Continued application of groundwater quality critical area regulations for designated critical aquifer recharge areas incorporated into work plan.	M-1 Repeat baseline critical area mapping for each reporting period to determine significant changes in extent, amount, or quality of critical areas intersecting agriculture identified similar to Appendices A and B and Table 7.	5% net reduced critical areas in areas of intersect due to agricultural activities. (% double the mapping error rate)	Evaluate if changed mapping or aerial interpretation is due to quality of mapping data or due to on-the-ground loss of critical area due to agricultural activities in areas of intersect.	CCNRD Type A.	Type 2	Chelan County	See budget
				M-2 Cumulative percent of acreage of conservation practices in areas of intersect by basin based on direct and indirect VSP participation, using Tracking Tool. Identify changes with and without enhancement projects that have been implemented.	10% net decrease in direct participation by acreage in areas of intersect with agriculture in existence as of 2011. Participation is measured per Benchmark I below. 10% net decrease in percent of acres of indirect participation in areas of intersect with agriculture in existence as of 2011. Indirect participation is measured per Benchmark I below.	Seek willing landowners in areas of intersect to reestablish or add new conservation practices.	CCNRD: Type B	Type 1	Chelan County	See budget
				M-3 Percent of acres of agricultural activities with direct participation in conservation practices related to intersecting critical areas is documented using self-certification (e.g. checklist in Appendix H), or phone, mail, or online surveys.	10% net reduction of conservation practices in areas of intersect.	Seek willing landowners in areas of intersect to reestablish conservation practices.	CCD Type A and B. CCNRD Type B, D and E. Other Technical Providers support with willing landowners per Work Plan.	Self-certification: Type 1. Phone, mail, or online survey: Type 2.	Cascadia Conservation District	See budget

PRIORITY GOALS, BENCHMARKS, VOLUNTARY MEASURES, OR AIMS

Receive priority when determining available resources.

WHO MONITORS

Cascadia Conservation District (CCD)

CCD Type A: Educate, facilitate, and/or implement conservation practices with willing landowners
CCD Type B: Collect follow-up monitoring information from willing landowners through phone, email, and/or site visits, based on available funding
CCD Type C: Annual Report

Chelan County Natural Resources Department (CCNRD)

CCNRD Type A: Mapping
CCNRD Type B: Tracking Tool / Database Management and Review available Census of Agriculture
CCNRD Type C: High Resolution Change Detection (HRCD)
CCNRD Type D: Producer Survey (Field Sample, Phone, or Online)
CCNRD Type E: Educate, facilitate, and/or implement conservation practices with willing landowners
CCNRD Type F: Convene expert panel; rapid watershed assessment may be used as an alternative for or supplement to CCNRD Type C based on assessment need and available funding
CCNRD Type G: Annual Summary of Watershed Meetings and VSP Activities

WHEN

Type 1: Annual, e.g. Tracking Tool Output
Type 2: Complete by September 1 of each biennium prior to required periodic evaluations and December 31 prior to each 5-year reporting period, with review time by Work Group. Reports to Work Group: •10/31/2018 •7/1/2019 •7/1/2021 •10/31/2023. Stagger activities where periods are close (e.g. 2018/2019).

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CHELAN COUNTY VSP ADAPTIVE MANAGEMENT MATRIX
EXAMPLE MONITORING FRAMEWORK-WDFW

	Critical Area Goals	Critical Area Benchmark	Performance Metric	Monitoring Method	Adaptive Management Action Threshold	Adaptive Management Action	Who Monitors	When	Party Responsible for An Action	Funding source for Adaptive Management Action
2.	CA Goal-II. Geologic hazard goals: In areas of critical area intersect with agricultural activities, and at the watershed level Protect geologic hazard functions and values existing as of July 22, 2011 from degradation due to agricultural activities. The purposes of Geologic Hazard protection are to: •Avoid increases in erosion. •Avoid steep slopes or help to stabilize steep slopes where practical. •Avoid irrigating unstable slopes.	Benchmark-B. No net increase at the watershed level in sheet and rill erosion due to agricultural activities in areas of critical area intersect with agricultural activities. • Conservation practices are retained for existing orchards, vineyards, and rangeland. • Conservation practices are implemented for new or altered orchards, vineyards, and rangeland. • Fire danger is managed with conservation practices such as fuel reduction projects to limit damage to soils, grazing land, and downstream agricultural operations and critical areas.	P-6 Percent cover of natural or managed vegetation in areas subject to sheet and rill erosion in basins with areas of intersect. Focus is on 40% slopes and 15%+ slopes that have a severe/very severe erosion hazard % slopes.	M-4 Sample areas subject to erosion for vegetative cover using aerial photography and site visits by technical assistance providers with participating landowners. Surrogates for monitoring include conservation practice implementation tracking.	Net loss of more than 5% vegetation due to agricultural activities in areas of intersect between 5-year reporting periods: •July 22, 2011-July 22, 2018 •July 22, 2011 and July 22, 2023	Provide education and information to VSP participants. Implement conservation practices to reestablish lost vegetation with current and added VSP Participants.	CCD Type A and B CCNRD: Type D and E; secondarily Type B.	Type 2	Cascadia Conservation District	See budget
				M-5 The number and extent of conservation practices in basins that are intended to reduce erosion potential. Direct evaluation based on site visits by technical assistance providers with participating landowners. Aerial photography for indirect participation.	10% net reduction in acres where conservation practices are applied in areas of intersect.	Implement conservation practices to reestablish lost vegetation with current and added VSP Participants.	Same as above.	Type 2	Cascadia Conservation District	See budget
				M-6 To address soil loss through erosion and effects on fish habitat, evaluate water quality monitoring of sediments in hydrologic study areas as defined in Appendix B, where such results can be attributed to agricultural activities. Existing or new water quality sampling locations may be used.	Measurable decrease in water quality below State standards where results can be attributed to agricultural activities.	Implement conservation practices to reestablish lost vegetation. Where appropriate, conduct water quality assessments and identify control programs or improvement projects.	Same as above.	Type 2	Cascadia Conservation District	See budget

PRIORITY GOALS, BENCHMARKS, VOLUNTARY MEASURES, OR AIMS

Receive priority when determining available resources.

WHO MONITORS

Cascadia Conservation District (CCD)

CCD Type A: Educate, facilitate, and/or implement conservation practices with willing landowners

CCD Type B: Collect follow-up monitoring information from willing landowners through phone, email, and/or site visits, based on available funding

CCD Type C: Annual Report

Chelan County Natural Resources Department (CCNRD)

CCNRD Type A: Mapping

CCNRD Type B: Tracking Tool / Database Management and Review available Census of Agriculture

CCNRD Type C: High Resolution Change Detection (HRCD)

CCNRD Type D: Producer Survey (Field Sample, Phone, or Online)

CCNRD Type E: Educate, facilitate, and/or implement conservation practices with willing landowners

CCNRD Type F: Convene expert panel; rapid watershed assessment may be used as an alternative for or supplement to CCNRD Type C based on assessment need and available funding

CCNRD Type G: Annual Summary of Watershed Meetings and VSP Activities

WHEN

Type 1: Annual, e.g. Tracking Tool Output

Type 2: Complete by September 1 of each biennium prior to required periodic evaluations and December 31 prior to each 5-year reporting period, with review time by Work Group. Reports to Work Group: •10/31/2018 •7/1/2019 •7/1/2021 •10/31/2023. Stagger activities where periods are close (e.g. 2018/2019).

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CHELAN COUNTY VSP ADAPTIVE MANAGEMENT MATRIX
EXAMPLE MONITORING FRAMEWORK-WDFW

	Critical Area Goals	Critical Area Benchmark	Performance Metric	Monitoring Method	Adaptive Management Action Threshold	Adaptive Management Action	Who Monitors	When	Party Responsible for An Action	Funding source for Adaptive Management Action
3.	CA Goal-III. In areas of critical area intersect with agricultural activities, and at the watershed level: Protect fish and wildlife habitat conservation areas, including associated species populations and their associated habitats.	Benchmark-C. In areas of intersect with agricultural activities, and at the watershed level: Protect remaining riparian vegetation at baseline or better conditions along waterbodies. • Maintain interface between agriculturally-managed areas and existing riparian areas. Retain riparian vegetated conditions, except for noxious weeds. Recognize changes to riparian areas may occur due to erosion and natural events; allow riparian areas to reestablish. • Promote actions to avoid conversion of riparian areas to agricultural uses.	P-7 Percent cover of natural vegetation (tree and shrub) in hydrologic study areas intersecting agriculture.	M-7 Preferred: Sample areas using aerial photography and site visits by technical assistance providers with participating landowners. Alternative: Surrogates for aerial monitoring include conservation practice implementation (tracking tool) and/or periodic rapid watershed assessments by fish and stream habitat experts with a focus on relevant critical area functions and values and agricultural intersect.	Loss of more than 5% vegetation due to agricultural activities in areas of intersect between 5-year reporting periods: •July 22, 2011-July 22, 2018 •July 22, 2011 and July 22, 2023	Implement conservation practices to reestablish lost vegetation with current and added VSP Participants.	CCD Type A and B. CCNRD: Preferred: Type C. Alternative: B, D and F.	Type 2	Chelan County	See budget
				M-8 The number and extent of conservation practices that protect riparian areas are maintained in areas of agriculture-critical area intersects.	10% reduction in percent of intersecting acres where conservation practices are applied.	Implement conservation practices to reestablish lost vegetation with current and added VSP Participants.	CCD: Type A and B. CCNRD: Type B.	Type 1	Chelan County	See budget
		Benchmark-D. In areas of critical area intersect with agricultural activities, and at the watershed level: Miles of fencing and its proper management for wildlife exclusion is maintained or improved. • Avoid animal "hang ups" such as with plastic fencing; protect young trees/crops during establishment.	P-8 Percent in miles of exclusion fencing with material that avoids animal hang-ups in areas of intersect. P9 Percent in length or area of alternative wildlife management measures that protect trees/crops and protect wildlife in areas of intersect.	M-9 Preferred: Sample areas using aerial photography and conduct brief survey (mailed, phone, or online). Alternative: Conservation practice implementation (tracking tool).	Miles of fencing or area of management practices is reduced more than 10% due to agricultural activities.	Implement conservation practices to maintain or increase type of fencing or alternative management techniques current and added VSP Participants.	CCD: Type A and B. CCNRD: Preferred: Type D and E. Alternative: Type B.	Type 2	Chelan County	See budget
				M-10 Length or area of conservation practices that install or replace wildlife exclusion fencing or other management techniques in areas of intersect during monitoring period using tracking tool.				Type 2	Chelan County	See budget
		Benchmark-E In areas of critical area intersect with agricultural activities, and at the watershed level: Maintain livestock management measures that protect riparian functions and values. Where appropriate to the critical area function allow	P-10 Maintain or increase length or area of livestock management measures in hydrologic study areas.	M 11 Sample areas using aerial photography and conduct brief survey (mailed, phone, or online).	Miles of fencing or area of management practices is reduced more than 10% due to agricultural activities.	Implement conservation practices to maintain or increase type of fencing or alternative management techniques current and added VSP Participants.	Same as above.	Type 2	Chelan County	See budget
				M-12 Conservation practices that manage livestock access to riparian areas.				Type 2	Chelan County	See budget

PRIORITY GOALS, BENCHMARKS, VOLUNTARY MEASURES, OR AIMS

Receive priority when determining available resources.

WHO MONITORS

Cascadia Conservation District (CCD)

CCD Type A: Educate, facilitate, and/or implement conservation practices with willing landowners

CCD Type B: Collect follow-up monitoring information from willing landowners through phone, email, and/or site visits, based on available funding

CCD Type C: Annual Report

Chelan County Natural Resources Department (CCNRD)

CCNRD Type A: Mapping

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CCNRD Type D: Producer Survey (Field Sample, Phone, or Online)

CCNRD Type E: Educate, facilitate, and/or implement conservation practices with willing landowners

CCNRD Type F: Convene expert panel; rapid watershed assessment may be used as an alternative for or supplement to CCNRD Type C based on assessment need and available funding

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WHEN

Type 1: Annual, e.g. Tracking Tool Output

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CHELAN COUNTY VSP ADAPTIVE MANAGEMENT MATRIX
EXAMPLE MONITORING FRAMEWORK-WDFW

	Critical Area Goals	Critical Area Benchmark	Performance Metric	Monitoring Method	Adaptive Management Action Threshold	Adaptive Management Action	Who Monitors	When	Party Responsible for An Action	Funding source for Adaptive Management Action
		managed or flash grazing or other appropriate agricultural practices.								
		Benchmark-F. In areas of critical area intersect with agricultural activities, habitat for complementary wildlife species is maintained (e.g., pollinators, raptors, bats, and other species), and there is no net loss in designated critical area habitat at the watershed level. One type of habitat may change to another.	P-11 Percent of wildlife habitat in areas of agriculture intersect.	M-13 Extent of mapped or documented Priority habitat as a percent of acres in areas of intersect.	5% net reduced priority habitat in areas of intersect due to agricultural activities.	Evaluate if changed mapping is due to quality of mapping data or due to on-the-ground loss of habitat due to agricultural activities in areas of intersect.	CCNRD: Type A.	Type 2	Chelan County	See budget
				M-14 Conservation practices that maintain complementary species or habitat (e.g., pollinators, raptors, bats, etc.) in areas of intersection during monitoring period.	10% net reduction in intersecting acres where conservation practices are applied.	Implement conservation practices to reestablish lost vegetation with current and added VSP Participants.	CCNRD: Type B.	Type 1	Chelan County	See budget
4.	CA Goal-V. In areas of critical area intersect with agricultural activities, and on a watershed basis: Protect the ecological and environmental functions of wetlands and protect the public health, safety, and welfare benefits provided by wetlands by preventing loss of wetlands.	Benchmark-G. In areas of critical area intersect with agricultural activities, and at the watershed level: Protect existing wetlands. •Maintain baseline or better interface between agriculturally-managed areas and existing wetlands. Retain wetland vegetation conditions, except for noxious weeds. •Maintain use of conservation practices by ongoing agricultural activities in or abutting wetlands. •Avoid negative changes to hydrology of natural wetlands such as through changes to drainage patterns or facilities. •Avoid conversion of natural wetlands to agricultural uses. (See regulatory backstop.)	P-12 Percent of wetlands is in hydrologic study areas intersecting agriculture.	M-16 Sample areas using aerial photography and site visits by technical assistance providers with participating landowners.	Loss of more than 5% wetland area due to agricultural activities in areas of intersect between 5-year reporting periods: •July 22, 2011-July 22, 2018 •July 22, 2011 and July 22, 2023	Implement conservation practices to reestablish wetlands with current and added VSP Participants.	CCD: Type A and B. CCNRD Type D, and E.	Type 2	Chelan County	See budget
				M-17 The number and extent of conservation practices that protect wetlands.	10% reduction in acres where conservation practices are applied in areas of intersect.	Implement conservation practices to reestablish lost vegetation with current and added VSP Participants.	CCNRD: Type B.	Type 1	Chelan County	See budget
		Benchmark-H. In areas of critical area intersect with agricultural activities, and at the watershed	P-13 Percent change in length or area of livestock management measures	M 18 Sample areas using aerial photography and conduct brief survey (mailed, phone, or online).	Miles of fencing or area of management practices is reduced more than 10% on	Implement conservation practices to maintain or increase type of fencing	CCD: Type A and B. CCNRD Type B, D, E.	Type 2	Chelan County	See budget

PRIORITY GOALS, BENCHMARKS, VOLUNTARY MEASURES, OR AIMS

Receive priority when determining available resources.

WHO MONITORS

Cascadia Conservation District (CCD)

CCD Type A: Educate, facilitate, and/or implement conservation practices with willing landowners

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CCD Type C: Annual Report

Chelan County Natural Resources Department (CCNRD)

CCNRD Type A: Mapping

CCNRD Type B: Tracking Tool / Database Management and Review available Census of Agriculture

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CCNRD Type D: Producer Survey (Field Sample, Phone, or Online)

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CHELAN COUNTY VSP ADAPTIVE MANAGEMENT MATRIX
EXAMPLE MONITORING FRAMEWORK-WDFW

	Critical Area Goals	Critical Area Benchmark	Performance Metric	Monitoring Method	Adaptive Management Action Threshold	Adaptive Management Action	Who Monitors	When	Party Responsible for An Action	Funding source for Adaptive Management Action
		level: Maintain livestock management or exclusion measures that protect wetland functions and values. Where appropriate to the critical area function allow managed or flash grazing or other appropriate agricultural practices.	protecting wetland areas in locations of intersect.	M-19 Extent of conservation practices that manage livestock access to wetland areas.	intersecting acres due to agricultural activities.	or alternative management techniques current and added VSP Participants.		Type 2	Chelan County	See budget
5.	CA Goal-VII. In areas of critical area intersect with agricultural activities, and at the watershed level: Avoid environmental damage due to flooding such as from loss of floodplain storage or due to agricultural chemicals. CA Goal-VIII. In areas of intersect and at the watershed level: Maintain floodplain capacity.	Intersect areas are protected by the regulatory backstop including flood hazard management regulations and pesticide regulations. No benchmarks or measurement required.	P-14 Continued application of critical area regulations for designated flood hazard critical areas incorporated into work plan.	Not applicable.	Not applicable.	Not applicable.	Chelan County implementation of flood hazard regulations incorporated into work plan from Critical Areas Ordinance.	Not applicable.	Not applicable.	Not applicable.
6.	CA Goal-X. In areas of critical area intersect with agricultural activities, and at the watershed level: Protect water quality and water quantity in areas having a critical recharging effect on aquifers used for potable water.	Intersect areas are protected by the regulatory backstop including pesticide regulations. No benchmarks or measurement required.	P-15 Continued application of groundwater quality critical area regulations for designated critical aquifer recharge areas incorporated into work plan.	Not applicable.	Not applicable.	Not applicable.	Chelan County implementation of Aquifer regulations incorporated into work plan from Critical Areas Ordinance.	Not applicable.	Not applicable.	Not applicable.
7.	CA Goal-XI. Promote volunteerism and stewardship of agricultural land and critical areas.	Benchmark-I. Sufficient active participation by commercial and non-commercial agricultural operators (farmers and ranchers) over 10 years that achieves the protection of critical area functions and values across WRIA basins.	P-16. Minimum annual outreach events held or education opportunities provided reported each biennium. P-17. Landowners contacted within 2 years of plan approval.	M-21 Indicators of active participation include: • Number of outreach events • Number/percentage of landowners contacted • Number of event attendees	5% reduction in participation in VSP program, by WRIA basin	Increase outreach and education events. Identify who drops out and why to modify outreach.	CCD: Type C CCNRD: Type B and G	Type1	Cascadia Conservation District	See budget

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CHELAN COUNTY VSP ADAPTIVE MANAGEMENT MATRIX
EXAMPLE MONITORING FRAMEWORK-WDFW

Critical Area Goals	Critical Area Benchmark	Performance Metric	Monitoring Method	Adaptive Management Action Threshold	Adaptive Management Action	Who Monitors	When	Party Responsible for An Action	Funding source for Adaptive Management Action
		Annually, include County Assessor mailer to current use tax participants. Annually information is provided to past and current VSP participants by Technical Providers. P-18. Technical assistance sought by cumulative number of calls, meetings, applications, and contracts is maintained or increased. P-19. VSP participants in each WRIA basin by each biennium is maintained or increased. P-20. Participating agricultural acreage and participating private or leased rangeland acreage in each basin based on self-certification entries by VSP Participants as of first biennium is maintained or increased each biennium thereafter. First biennium goal is participation acreage within areas of intersect that equals or exceeds acreage participating in conservation practice cost-share programs or voluntary enhancement projects with Technical Providers between 2011 and 2016.	• Number of VSP participation signs and marketing materials distributed • Education opportunities provided • Technical assistance sought by producers (as tracked through meetings, calls, applications, and contracts with technical assistance providers) • Self-certification: See Appendix H for a checklist.					

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CHELAN COUNTY VSP ADAPTIVE MANAGEMENT MATRIX
EXAMPLE MONITORING FRAMEWORK-WDFW

	Critical Area Goals	Critical Area Benchmark	Performance Metric	Monitoring Method	Adaptive Management Action Threshold	Adaptive Management Action	Who Monitors	When	Party Responsible for An Action	Funding source for Adaptive Management Action
		Benchmark-J. Passive participation by commercial and non-commercial agricultural operators in VSP conservation practices is maintained or increased over 10 years on agricultural land (including but not limited to those listed in Appendices D and H).	P-21 Acres of collective conservation practices applied. P-22 Survey demonstrates an increase in understanding of VSP in agricultural households.	M-22 Passive participation in common stewardship practices may be tracked and reported using one or more methods: • Mapping and aerial photo or evaluation and/or rapid watershed assessment of practices in place, and • Random sampling of farmers and ranchers in the field by technical assistance providers with willing landowners, or • Phone, mail, or online surveys.	5% reduction in acres where conservation practices are applied in areas of intersect.	Seek willing landowners in areas of intersect to reestablish conservation practices	CCD: Type A and B. CCNRD: Type A, B, D and E.	Type 1	Cascadia Conservation District	See budget
					5% reduction in awareness of VSP program	Increase outreach and education events.	See above.	Type 1	Cascadia Conservation District	See budget
Voluntary Enhancement or Restoration Measures: RCW 36.70A.720 (1) (e) Create measurable benchmarks that, within ten years after the receipt of funding, are designed to result in: (ii) the enhancement of critical area functions and values through voluntary, incentive-based measures										
8.	CA Goal-IV. Promote voluntary enhancement of fish and wildlife habitat conservation areas, associate species populations and their associated habitats in areas of intersect with agricultural activities.	Voluntary Meas I. Encourage voluntarily enhancement riparian areas to: • Improve partially functioning riparian areas with poor existing vegetative cover that has an ability to recover. • Enhance impaired riparian vegetation. • Consider selecting heights and varieties to achieve proper microclimate and to avoid agricultural pests. Priority is given to basins where the benchmark of riparian area protection of functions and values is at risk of degrading compared to baseline. Second priority is other areas of focus per county, state, regional, tribal priorities for enhancement.	P-23 Percent of acres with enhancement or restoration projects in riparian areas within hydrologic study areas intersecting agriculture in areas of first and second priority.	M-15 The number and extent of riparian enhancement projects in areas of agriculture-critical area intersect in areas of first and second priority. Implemented activities show intactness and survival based on specifications of installed projects.	10% reduction in number of interactions promoting restoration or enhancement projects. .	Seek willing landowners in areas of intersect.	CCD Type A and B. CCNRD: First Order: Type C and D. Second Order: B and F.	Type 2	Chelan County	See budget

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CHELAN COUNTY VSP ADAPTIVE MANAGEMENT MATRIX
EXAMPLE MONITORING FRAMEWORK-WDFW

	Critical Area Goals	Critical Area Benchmark	Performance Metric	Monitoring Method	Adaptive Management Action Threshold	Adaptive Management Action	Who Monitors	When	Party Responsible for An Action	Funding source for Adaptive Management Action
		Voluntary Meas-II Promote voluntary increase in livestock management measures that protect the functions and values of riparian areas.	P-24 Length or area of livestock management measures in hydrologic study areas.	M 11 Sample areas using aerial photography and conduct brief survey (mailed, phone, or online).	Miles of fencing or area of management practices is reduced more than 10% on intersecting acres due to agricultural activities.	Implement conservation practices to maintain or increase type of fencing or alternative management techniques current and added VSP Participants.	CCD: Type A and B. CCNRD: Type A, B, D and E.	Type 2	Chelan County	See budget
				M-12 Conservation practices that manage or reduce livestock access to riparian areas.				Type 2	Chelan County	See budget
		Voluntary Meas-III Promote voluntary enhancement of habitat for complementary wildlife species (e.g., pollinators, raptors, bats, and other species).	P-25 Percent of acres with wildlife habitat enhancement or restoration projects in areas of agriculture intersect.	M-13 Extent of mapped or documented Priority habitat as a percent of areas of intersect.	5% reduced priority habitat on intersecting acres due to agricultural activities.	Evaluate if changed mapping is due to quality of mapping data or due to on-the-ground loss of habitat due to agricultural activities in areas of intersect.	CCNRD: Type A..	Type 2	Chelan County	See budget
				M-14 Conservation practices that add complementary species or habitat (e.g., pollinators, raptors, bats, etc.) in areas of intersection during monitoring period.	10% reduction in acres where conservation practices are applied in areas of intersect.	Implement conservation practices to reestablish lost vegetation with current and added VSP Participants.	CCNRD: Type B	Type 1	Chelan County	See budget

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CHELAN COUNTY VSP ADAPTIVE MANAGEMENT MATRIX
EXAMPLE MONITORING FRAMEWORK-WDFW

	Critical Area Goals	Critical Area Benchmark	Performance Metric	Monitoring Method	Adaptive Management Action Threshold	Adaptive Management Action	Who Monitors	When	Party Responsible for An Action	Funding source for Adaptive Management Action
9.	CA Goal-VI. Where practical, encourage voluntary enhancing of wetland functions and values.	Voluntary Meas IV. Wetland areas voluntarily enhanced in areas of intersect. Voluntary Meas V. Livestock management or exclusion measures that reduce livestock access to wetland areas.	P-26 Percent of wetland areas within hydrologic study areas intersecting agriculture.	M-20 The number and extent of wetland enhancement projects in areas of agriculture-critical area intersect.	10% reduction in number of interactions promoting enhancement projects.	Seek willing landowners in areas of intersect.	CCNRD: Type B.	Type 2	Chelan County	See budget
10.	CA Goal-IX. Support voluntary floodplain enhancement activities such as levee setbacks to improve floodplain functions and support other critical area enhancement activities.	Intersect areas are protected by the regulatory backstop including flood hazard management regulations and pesticide regulations. No benchmarks or measurement required. See Fish and Wildlife benchmarks and voluntary measures for related activities to support restoration in floodplains.	P-27 Continued application of critical area regulations for designated flood hazard areas incorporated into work plan.	Not applicable.	Not applicable.	Not applicable.	Chelan County implementation of flood hazard regulations incorporated into work plan from Critical Areas Ordinance. Implementation of Watershed Plan for voluntary restoration.	Not applicable.	Not applicable.	Not applicable.
Agricultural Viability Aims, Incentives and Activities: RCW 36.70A.720 (1) A watershed group designated by a county under RCW 36.70A.715 must develop a work plan to protect critical areas while maintaining the viability of agriculture in the watershed.										
11.	AG Aim-I. Protect agricultural activities from geologic hazards such as erosion and landslides.	There are no formal measurable benchmarks, nor do they determine whether the plan meets compliance. Agriculture viability aims, incentives, and activities are meant to help the County do its planning for	AG Track-1. Increased agricultural crop production and economic value annually. AG Track-2. Designated agricultural land in Comprehensive Plan	AG Track-1 Evaluation: Production and value: Review agricultural economy data: Census of Agriculture, WSU Extension reports, and other industry AG Track-2 Evaluation: Land in agriculture: See M-1.	Reduction in production, value, or percent of acres of agricultural land designated for long-term protection.	Determine if due to natural causes or regulatory causes. If regulatory in nature, conduct study to determine how to protect land and improve production.	Production and Economic Value: WSU Extension. Information provided to Chelan County for Work Group review purposes. Land base: Chelan County – Type A.	Type 2	Cascadia Conservation District: Outcome 1 Chelan County: Outcome 2	See budget

PRIORITY GOALS, BENCHMARKS, VOLUNTARY MEASURES, OR AIMS

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CHELAN COUNTY VSP ADAPTIVE MANAGEMENT MATRIX
EXAMPLE MONITORING FRAMEWORK-WDFW

	Critical Area Goals	Critical Area Benchmark	Performance Metric	Monitoring Method	Adaptive Management Action Threshold	Adaptive Management Action	Who Monitors	When	Party Responsible for An Action	Funding source for Adaptive Management Action
		resource lands and to help the local agricultural economy. Suggested aims, incentives, and activities relate to the protection and enhancement of agriculture in the watershed. These should be considered throughout implementation, monitoring, and adaptive management of the VSP Work Plan.	continues to be protected.				Water resources: Chelan County – Type G.			
12.	AG Aim-II. Promote economical water, soil, pest, and nutrient management that maximizes produce quality.		See AG Track-1 and 2 above. AG Track-3. Water resources necessary for producers are available and reliable.	AG Track-3 Evaluation: WRIA Plan implementation results.	Reduced availability of water unforeseen in WRIA plans or state rules.	Update watershed plans to address water uses and resources.	See above.	Type 2	Cascadia Conservation District: AG Track-1 Chelan County: AG Track-2 and 3	See budget
13.	AG Aim-III. Protect orchards and vineyards from wildlife and pest damage.		See AG Track-1 and 2 above.	See above.	See above.	See above.	See above.	Type 2	Cascadia Conservation District: AG Track-1 Chelan County: AG Track-2	See budget
14.	AG Aim-IV. Avoid water contamination, damage to crops, loss of livestock, increased susceptibility of livestock to disease, and damaged farm machinery due to flooding.		See AG Track-1 and 2 above.	See above.	See above.	See above.	See above.	Type 2	Cascadia Conservation District: AG Track-1 Chelan County: AG Track-2	See budget
15.	AG Aim-V. Promote the prevalence of conservation practices to help avoid unnecessary local critical area regulations.		See AG Track-1 and 2 above.	See above.	See above.	See above.	See above.	Type 2	Cascadia Conservation District: AG Track-1 Chelan County: AG Track-2	See budget

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CHELAN COUNTY VSP ADAPTIVE MANAGEMENT MATRIX
EXAMPLE MONITORING FRAMEWORK-WDFW

	Critical Area Goals	Critical Area Benchmark	Performance Metric	Monitoring Method	Adaptive Management Action Threshold	Adaptive Management Action	Who Monitors	When	Party Responsible for An Action	Funding source for Adaptive Management Action
16.	AG Aim-VI Increase the viability of the agricultural industry in Chelan County.		See AG Track-1, 2, and 3 above. AG Track-4 Producers have more regulatory stability in Chelan County. AG Track-5 On-farm and commercial storage, aggregation, and distribution services are available. AG Track-6 Necessary supplies, equipment, and other farm inputs are accessible and available. AG Track-7 Producers have access to farm business expertise, training, and practical research that advances farm profitability and conservation.	See above. AG Track -4 Evaluation: Continued applicability of VSP. AG Track 5 Evaluation: Number of Storage and Food Distribution Establishments serving the county, and volume of storage and distribution; Covered Employment and Businesses AG Track 6 Evaluation: Options for farmers to reduce their production expenses are disseminated by technical assistance providers. USDA Economic Research Service, Census of Agriculture, Department of Revenue, technical assistance services. AG Track 7 Evaluation: Number of producers using business planning and technical assistance services.	VSP Program is at risk of being discontinued. Storage, food distribution, and access to markets is reduced. Decrease in use of practices that reduce inputs and associated costs. Decrease in number of producers using business planning and technical assistance services.	VSP Program: Follow GMA Critical Area provisions if VSP Work Plan is not in effect. Additional outreach and education on conservation practices and available technical assistance.	Outcomes 1, 2, and 3: See above. Outcome 4: VSP Program Implementation Status: CCD: Type C and CCNRD Type G Outcomes 5 and 6: Economic and land use regulation study. Outcome 7: Roundtable with technical service providers and study to identify solutions.	Type 2	Cascadia Conservation District: AG Track-7 Chelan County: AG Track-3, 4, 5, and 6	See budget

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APPENDIX 4: ECOSYSTEM BASED MANAGEMENT CASE STUDIES

OR

HOW WIDE IS WIDE ENOUGH?: VALUES AND LAW IN RIPARIAN HABITAT CONSERVATION

By George Wilhere and Timothy Quinn

A4.1 INTRODUCTION

An important question in fish and wildlife conservation, perhaps the most important question, is "how much is enough?" That is, what is the minimum amount of habitat, smallest population size, or least land area that is adequate for the long-term survival of self-sustaining fish and wildlife populations? These types of questions have been the basis for some of the most contentious environmental issues in Washington State's recent history, such as recovery of the northern spotted owl (*Strix occidentalis caurina*), gray wolf (*Canis lupus*), and anadromous salmon (e.g., *Oncorhynchus tshawytscha*, *O. mykiss*). With respect to riparian habitat conservation, "how much is enough?" encompasses challenging questions such as: how wide is wide enough for riparian management zones (RMZs), how much riparian habitat is enough for fish and for wildlife?, how much of each riparian function is enough?, and how much riparian area is enough to accommodate channel migration, flooding, debris flows, and other natural disturbances?

Determining "how much is enough?" is difficult because, like most environmental issues, the answer involves both science and human values (Dietz and Stern 1998, Policansky 1998, Wilhere 2008). The other chapters in this document have focused exclusively on science. This chapter focuses on values and their role in developing environmental policy. Values are normative conceptions of what the world ought to be (Spates 1983, Hitlin and Piliavin 2004). That is, values are subjective beliefs about what is good or bad, what is right or wrong. In contrast, science attempts to provide objective explanations or factual descriptions of the physical world as it is. When developing an environmental policy, science can predict, with varying degrees of uncertainty, the impacts or potential outcomes resulting from alternative policies, however, science cannot "predict" which impacts are good or bad, or which outcomes are right or wrong. Values are the ultimate basis for those judgments.

A4.1.1 Values

The words "value" or "values" have many different meanings. A common use of "value" is mathematical, such as the value of x in the equation 5 = x + 2. Another familiar use of "value" is associated with physical measurements, which determine the "value" of an object's mass, volume, temperature, or other physical attributes. In ecology, habitat "value" often refers to empirically derived functional relationships that describe a species' response to the physical environment. These uses of "value" are objective and unaffected by human preferences.

In environmental policy, "value" has at least four different meanings. The first meaning is the objective uses of "value" described above. Another meaning of "value" denotes features, components, or qualities of the environment or ecosystems (Reser and Bentrupperbäumer 2005). This use of "value" often refers to things that are thought to be beneficial or important, but it may also refer to an object's intrinsic value. "Natural heritage values", for instance, refer to all elements of biodiversity, including plants, animals, fungi, microorganisms, biological communities, ecosystem types, genes, etc. Likewise, "ecological values" were defined by Cordell et al. (2005) as the level of benefits that space, water, minerals, biota, and all other factors that make up natural ecosystems provide to support native life forms. This meaning of "values" implies that natural heritage values and ecological values can be identified, measured, and managed (Reser and Bentrupperbäumer 2005). The third meaning of "value" encountered in environmental policy is relative worth, utility, or importance. This is the meaning most often used by economists, and is also referred to as economic value or instrumental value. Economic valuation measures the difference an object (tangible or intangible) makes to the satisfaction of human preferences (Farber et al. 2002). In other words, economic "value" expresses subjective beliefs about relative worth of an object. Monetization of ecosystem services is one way to measure the economic value of ecosystems.

The fourth meaning of "values" is enduring conceptions of the preferable (Brown 1984) or desirable (Spates 1983, Hitlin and Piliavin 2004), and this is the only meaning of "values" used in this chapter. This type of values is often called human values, societal values, or cultural values. Values are relatively stable principles or standards that specify what is moral, just, or desirable, and consequently, influence personal and collective decisions (Dietz et al. 2005). Ethical behavior is behavior consistent with societal or cultural values. Values are deeply embedded into consciousness and absorbed through socialization, and hence, are the deepest level of thinking and feeling about an issue (Whitely 1995). Values affect the economic worth of objects, including ecosystem services, through deeply held preference relationships (Brown 1984).

Environmental policy and ecosystem management usually deals with three categories of values: ecological, economic, and social. We like Reser and Bentrupperbäumer's (2005) definition of environmental/ecological values: individual and shared community or societal beliefs about the significance, importance, and well-being of the natural environment, and how the natural world should be treated by humans. We created a similar definition for economic values: individual and shared community or societal beliefs about the significance, importance, and well-being of the human economy, and how the human economy should be managed. "Human economy" refers to the production, distribution or trade, and consumption of goods and services by different agents in a given geographical location, and it could include ecosystem services. Our definition of social values is derived from the definitions of Bryan et al. (2010), van Riper et al. (2012), and Kenter et al. (2015): individual and shared community or societal beliefs about the significance, importance, and well-being of non-monetary (or non-monetized) use and non-use benefits that support human well-being, and how these non-monetary benefits should be managed.

Ecological, economic, and social values are categories of societal or cultural values. Heterogeneous societies may consist of multiple cultural groups with different cultural values that overlap to a greater or lesser degree with each other (Kenter et al. 2015). Societal values are those values shared by all cultural groups within a society. At the root of many conflicts over habitat

conservation are dissimilar values of different cultural groups (Proctor 1998, Gritten et al. 1999), which includes different stakeholder groups. The purpose of this chapter is to help the main clients of the PHS program—citizens, stakeholders, land managers, and local governments—understand the role of values in developing policies for habitat conservation. We do this by presenting three case studies that describe how other organizations developed strategies/plans for management of forested riparian ecosystems.

A4.2 Case Studies in Riparian Habitat Conservation

How wide is wide enough for riparian buffers on rivers and streams? That question is perhaps the most fundamental and challenging policy question regarding the conservation of salmon freshwater habitats. In Washington State, three monumental conservation plans for freshwater habitats provide different answers to that question. The three answers are different largely because of differences in: 1) stakeholder desires and cultural values, 2) legal context and political leadership, and 3) perceived risks and trade-offs amongst conflicting values. The three plans (Table A4-1) are the federal Northwest Forest Plan developed between 1992 and 1994 covering 1.8 million acres in Washington, the habitat conservation plan for Washington's forested trust lands developed between 1994 and 1997 covering 1.4 million acres, and the habitat conservation plan for Washington's forest practices rules developed between 1996 and 1999 covering 9.3 million acres of nonfederal and nontribal land.

This chapter demonstrates the important role of values in developing policies for habitat conservation. We do this by focusing on three conservation plans that are similar in fundamental ways—all dealing with riparian and aquatic habitats, all establishing policies for forest management, all conserving habitats of imperiled species, all complying with the Endangered Species Act, all millions of acres in size, all located in Washington State, all developed during the 1990s, and because all three plans were developed for the same habitats and species in the same region over a span of roughly 6 years, all drew from the same body of science to inform policy development. These similarities (i.e., land use, issues, size, location, time, science) among the three conservation strategies/plans are "controlled variables" that are held constant. By controlling these variables, the effects of different laws and values on each plan should be more clearly evident. Specifically, we posit that significant differences in the level of habitat protection among these otherwise comparable conservation strategies/plans are due to differences in the laws that governed them and the values of those stakeholders and government officials involved in their development. Although the three case studies deal exclusively with forest management, the lessons learned about the role of values are highly relevant to other land uses.

A4.2.1 The Northwest Forest Plan

In July 1992, all timber sales of old-growth forest on national forests within the range of the northern spotted owl were enjoined by a federal district court (*Seattle Audubon Society v. Moseley* 1992).[1] Judge Dwyer ruled that the U.S. Forest Service was in violation of the National Forest Management Act (NFMA) and the National Environmental Policy Act (NEPA). Harvest of old-growth

[1] In February 1992 the federal district court of Oregon enjoined timber sales on lands administered by the Bureau of Land Management within the geographic range of the northern spotted owl (*Audubon Society v. Lujan* 1992).

forest on national forests within the range of the northern spotted owl was prohibited until the Forest Service came into compliance with federal law. The court's order, which culminated four years of litigation challenging the management of old-growth forests, affected 15.7 million acres of federal land in Washington, Oregon, and northern California (USDA & USDI 1994a).

For environmentalist organizations, the court injunction was a major victory in the so-called "spotted owl wars" (Yaffee 1994). For managers of federal forests, Judge Dwyer's ruling initiated a political crisis—a crisis caused by an unresolved conflict between ecological and economic values. On the one hand, the Endangered Species Act (ESA) and federal regulations promulgated under the NFMA demanded a high degree of protection for fish and wildlife species on federal lands. Section 7 of the ESA says,

> *"Each Federal agency shall… insure that any action authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of habitat of such species…"*

The northern spotted owl and marbled murrelet (*Brachyramphus marmoratus*), two species closely associated with old-growth forests (Ruggerio et al. 1991), were listed as threatened under the ESA, and therefore, harvest of old-growth forest on federal lands could not jeopardize the continued existence of these two species.

Title 36, §219.19 of the Code of Federal Regulations says,

> *"Fish and wildlife habitat shall be managed to maintain viable populations of existing native and desired non-native vertebrate species in the planning area."*

Under this regulation, which was known as the NFMA's "viability standard," management plans for national forests were required to assess the impacts of future timber harvests on the population viability of vertebrate species, and the assessment had to credibly show that planned future timber harvest would maintain viable populations. At that time, 111 vertebrate species were thought to be strongly associated with old-growth forest, including 29 fish species (FEMAT 1993).

The protection of fish and wildlife species on federal lands was clearly articulated in federal law, however, on the other hand, the Multiple-Use Sustained-Yield Act directed the Forest Service to manage for:

> *"... the achievement and maintenance in perpetuity of a high-level annual or regular periodic output of the various renewable resources of the national forests without impairment of the productivity of the land."*

In the Pacific Northwest, timber was considered the renewable resource. Many rural economies depended on timber from federal lands, and influential members of Congress from Oregon and Washington expected the U.S. Forest Service and Bureau of Land Management (BLM) to provide that timber (Jones and Callaway 1995, Burnett and Davis 2002). The Forest Service had tried to achieve two conflicting goals—"viable populations" of vertebrate species and "high-level annual" timber production, but the federal court determined that national forest managers had not struck a lawful balance.

When President Clinton assumed office in January of 1993, timber harvest on federal lands in the Pacific Northwest was still under the federal court's injunction. In April 1993 he convened a Northwest Forest Conference in Portland, Oregon. At the conference numerous stakeholder groups, including environmentalists, the timber industry, the fishing industry, and local governments, were allowed to testify before the President (Yaffee 1994). At that conference the President set forth five principles to guide the development of a management plan (USDA & USDI 1994a, p. 3):

- "First, we must never forget the human and economic dimensions of these problems. Where sound management policies can preserve the health of forest lands, sales should go forward. Where this requirement cannot be met, we need to do our best to offer new economic opportunities for year-round, high-wage, high-skill jobs.
- Second, as we craft a plan, we need to protect the long-term health of our forests, our wildlife, and our waterways. They are a... gift from God; and we hold them in trust for future generations.
- Third, our efforts must be, insofar as we are wise enough to know it, scientifically sound, ecologically credible, and legally responsible.
- Fourth, the plan should produce a predictable and sustainable level of timber sales and non-timber resources that will not degrade or destroy the environment.
- Fifth, to achieve these goals we will do our best, as I said, to make the federal government work together and work for you. We may make mistakes but we will try to end the gridlock within the federal government and we will insist on collaboration not confrontation."

The President wanted a plan that would comply with federal law and strike the appropriate balance between protecting old-growth forests and providing a sustainable timber harvest from federal lands. In response to the President's request, the Forest Service formed the Forest Ecosystem Management Assessment Team (FEMAT) which developed and assessed 10 options for the management of federal lands in the range of the northern spotted owl (FEMAT 1993, Thomas et al. 2006). The 10 options presented a range of protection for fish and wildlife habitats, from 6.0 to 13.3 million acres in reserves, and a range of timber harvest volumes, from 0.1 to 1.8 billion board feet/year (USDA & USDI 1994a, pp. 20-24). Because they were listed under the ESA, much of FEMAT's focus was on management for and impacts to the spotted owl and marbled murrelet. However, because of the viability standard, impacts to 89 other vertebrate species, including 7 salmonid species/subspecies and 12 riparian-dependent amphibian species, and 118 invertebrate species, including 54 freshwater snails, 3 freshwater clams and 5 functional groups of aquatic or riparian-dependent arthropods, were also assessed by FEMAT. FEMAT's report was a monumental achievement—weighing in at over 1000 pages and completed in 90 days (Marcot and Thomas 1997).

The habitat requirements of aquatic and riparian-dependent species were addressed by the Aquatic Conservation Strategy (ACS)[2]. The ACS was especially important because listing under the ESA of

[2] The Aquatic Conservation Strategy of the Northwest Forest Plan was largely based on the work of Thomas et al. (1993).

several salmon subspecies appeared to be imminent (Reeves et al. 2006)[3]. The nine goals of the ACS were (USDA & USDI 1994a, p. B-11):

1. Maintain and restore the distribution, diversity, and complexity of watershed and landscape-scale features to ensure protection of the aquatic systems to which species, populations, and communities are uniquely adapted.
2. Maintain and restore spatial and temporal connectivity within and between watersheds. Lateral, longitudinal, and drainage network connections include floodplains, wetlands, upslope areas, headwater tributaries, and intact refugia. These network connections must provide chemically and physically unobstructed routes to areas critical for fulfilling life history requirements of aquatic and riparian-dependent species.
3. Maintain and restore the physical integrity of the aquatic system, including shorelines, banks, and bottom configurations.
4. Maintain and restore water quality necessary to support healthy riparian, aquatic, and wetland ecosystems. Water quality must remain in the range that maintains the biological, physical, and chemical integrity of the system and benefits survival, growth, reproduction, and migration of individuals composing aquatic and riparian communities.
5. Maintain and restore the sediment regime under which an aquatic ecosystem evolved. Elements of the sediment regime include the timing, volume, rate, and character of sediment input, storage, and transport.
6. Maintain and restore instream flows sufficient to create and sustain riparian, aquatic, and wetland habitats and to retain patterns of sediment, nutrient, and wood routing. The timing, magnitude, duration, and spatial distribution of peak, high, and low flows must be protected.
7. Maintain and restore the timing, variability, and duration of floodplain inundation and the water table elevation in meadows and wetlands.
8. Maintain and restore the species composition and structural diversity of plant communities in riparian zones and wetlands to provide adequate summer and winter thermal regulation, nutrient filtering, appropriate rates of surface erosion, bank erosion, and channel migration and to supply amounts and distributions of coarse woody debris sufficient to sustain physical complexity and stability.
9. Maintain and restore habitat to support well-distributed populations of native plant, invertebrate, and vertebrate riparian-dependent species.

[3] In 1993, salmon species listings under the Endangered Species Act within the range of the northern spotted owl were indeed imminent. Salmon are listed by evolutionary significant units (ESUs), which are roughly the same as subspecies. The Southern Oregon and Northern California Coasts ESU of coho salmon was listed as threatened in 1997, and the Lower Columbia ESU of steelhead was listed as threatened in 1998. Since 1993, 23 ESUs for five species of salmon and 3 distinct population segments of bull trout have been listed under the ESA within the range of the northern spotted owl (Reeves et al. 2006).

Six of the first seven goals address watershed-scale processes; the third goal is the exception. The last two goals are particularly important—the eighth goal addresses riparian areas and the ninth refers to the NFMA's viability standard.

The ACS has four components (USDA & USDI 1994a, Reeves et al. 2006): key watersheds, watershed analysis, watershed restoration, and riparian reserves. *Key watersheds* are crucial refugia for at-risk fish species, and therefore, they were the highest priority for protection and restoration. *Watershed analysis* provides information on geomorphic and ecological processes that is needed for the watershed plans that will guide managers toward achieving the strategy's goals. *Watershed restoration* is a long-term program for restoring watershed health, and its most important element is the control of road-related runoff and sediment production (FEMAT 1993, p. V-57). *Riparian reserves* are no-timber-harvest zones along rivers and streams. Riparian reserves were estimated to encompass about 2.6 million acres of federal forest land (USDA & USDI 1994a, p. B-18) and were the foundation that: 1) protected the ecological functions and processes necessary to create and maintain habitat for aquatic and riparian-dependent species over time, and 2) maintained or restored stream network connectivity within a watershed (Reeves et al. 2006).

The ACS was based on two principles. The first principle addressed the natural variability of aquatic and riparian ecosystems. FEMAT (1993, p. V-29) said:

> *"Stewardship of aquatic resources has the highest likelihood of protecting biological diversity and productivity when land use activities do not substantially alter the natural disturbance regime to which these organisms are adapted."*

According to FEMAT (p. V-30), the scientific understanding of fish-habitat relationships was inadequate for the task of managing watersheds for fish habitats. Habitat requirements of the sundry life histories of many fish species within watersheds subject to a variety of natural disturbances at multiple spatial and temporal scales precluded managing for specific habitat conditions. Instead, FEMAT aimed to maintain and restore "ecosystem health" by maintaining and restoring disturbance processes such as floods, channel migration, landslides, and debris flows. Hence, the four components of the ACS are intended to maintain and restore the natural disturbance regimes of aquatic and riparian ecosystems on federally managed forests.

The second principle articulated by FEMAT (1993) was that an effective conservation strategy must protect riparian ecosystem functions and processes. Using expert judgment informed by the scientific literature, FEMAT constructed graphical relationships that describe how four key functions or processes change with distance from the stream channel (Figure A4-1). The four key functions or processes were root strength, litter fall, large wood recruitment, and shading. The curves convey two important concepts: 1) the full contribution of riparian forest to these four riparian ecosystem functions or processes occurs within one tree height, and 2) the marginal return for each function or process decreases as distance from the stream channel increases (i.e., follows a law of diminishing marginal returns).

FEMAT (1993, p.V-28) also considered microclimate as a function of riparian forest because microclimate was thought to influence the suitability of riparian areas for riparian-dependent wildlife (Thomas et al. 1993). FEMAT's microclimate curves (Figure A4-2) show that the full

contribution of riparian forest to the maintenance of microclimatic variables (e.g., air temperature, soil temperature, relative humidity) was thought to occur within two to three tree heights.

The width of riparian reserves was based on the protection of riparian ecosystem functions and processes. Providing for full root strength, litter fall, large wood recruitment, and shading would require reserves of one Site-Potential Tree Height. A width of two Site-Potential Tree Heights was thought to be adequate for maintaining microclimate in riparian areas. FEMAT (1993, p. V-37) developed three management alternatives for riparian reserves, and all three applied the same width to fish-bearing streams. The main differences among the alternatives were the riparian reserve widths on non-fish-bearing and intermittent streams. The most protective alternative was adopted for the Northwest Forest Plan. The adopted alternative specified a reserve width on all fish-bearing streams of two Site-Potential Tree Heights or 300 ft, whichever is greater, a reserve width on all permanently flowing non-fish-bearing streams of one Site-Potential Tree Height or 150 ft, whichever is greater, and a reserve width on intermittent streams of one Site-Potential Tree Height or 100 ft, whichever is greater. Site-potential tree height was defined as the average maximum height of the tallest dominant trees (200 years old or greater). Heights of dominant trees in riparian old-growth forest of Washington range from 100 to 240 ft (Fox 2003), depending on site class.

In April 1994, the Secretaries of Interior and Agriculture adopted Alternative 9 (Option 9 modified by adding 775,000 acres of reserves) as the Northwest Forest Plan. Their Record of Decision states:

> *"Alternative 9…is the best alternative for providing a sustainable level of human use of the forest resource while still meeting the need to maintain and restore the late-successional and old-growth forest ecosystem." (USDA & USDI 1994a, p. 26).*

Alternative 9 was a compromise between the area of reserves (riparian reserves, later-successional reserves, and administratively withdrawn areas) and timber harvest volume. Amongst the 10 alternatives, Alternative 9 ranked sixth for reserves and ranked third for the amount of annual timber harvest. The area of reserves in Alternative 9 was 20% less than the alternative with the most reserves and the amount of timber harvest was 39% less than the alternative with the most timber harvest (USDA & USDI 1994a, pp. 20-24). Mean likelihood of viability for the seven salmonid species/subspecies assessed was 81%, which ranked second amongst the 10 alternatives (USDA & USDI 1994b, p. 3&4-196).

In FEMAT's assessment, if a species had at least an 80% likelihood of viability—defined as a stable, well-distributed population over 100 years—then that species was considered viable. FEMAT (1993, p. II-28), believed it likely that alternatives attaining the 80% likelihood for a species "would be viewed as meeting the [viability standard]" for that species. No other justification for the 80% viability threshold was given. Scientists on the FEMAT team chose 80% because they believed it was reasonable, and their choice was later ratified by Department of Justice lawyers who were responsible for the Northwest Forest Plan meeting the requirements of federal law (M. Raphael, U.S. Forest Service, pers. comm.).

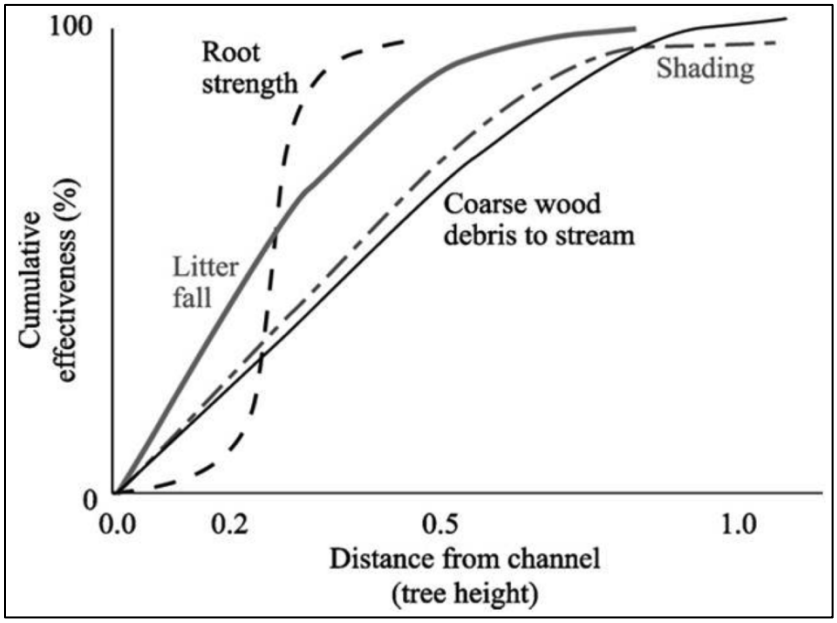

Figure A4.1. The "FEMAT Curves" (FEMAT 1993, p. V-27): generalized curves showing riparian forest contributions to riparian ecosystem functions and processes as distance from a stream channel increases. "Tree height" refers to average maximum height of the tallest dominant trees (200 years old or greater).

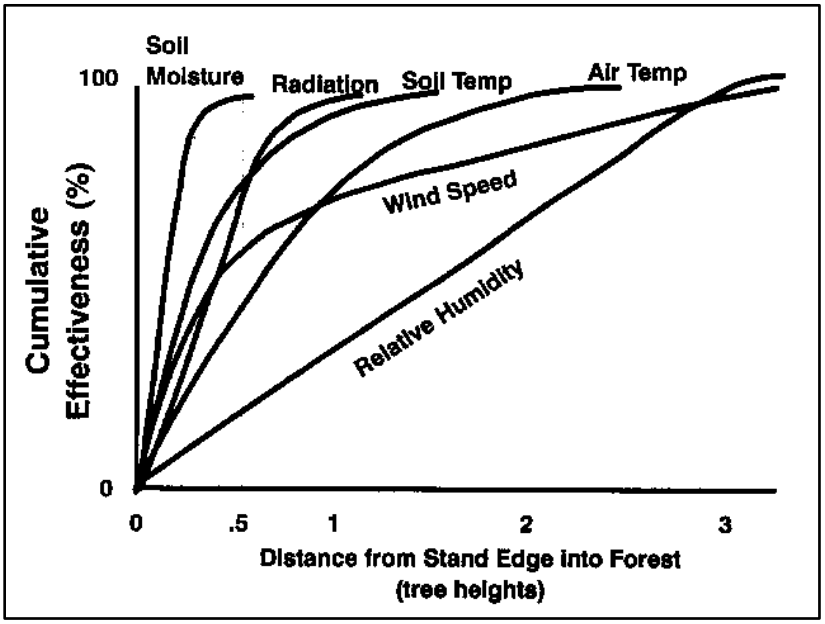

Figure A4-2. Generalized curves showing relationships between distance from edge of riparian forest and microclimate attributes (FEMAT 1993, p. V-27). "Tree height" refers to average maximum height of the tallest dominant trees (200 years old or greater).

After adoption of Alternative 9, environmentalist groups immediately sued the Departments of Interior and Agriculture to challenge the plan's lawfulness (*Seattle Audubon Society v. Lyons* 1994). A timber industry organization also sued the Secretary of Interior, and the challenges of both sides—environmentalist and timber industry—were heard together in the U.S. District Court for the Western District of Washington. One complaint of the environmentalist plaintiffs was that the 80% viability threshold was too low. Judge Dwyer disagreed, writing that the government cannot

be "held to a degree of certainty that is ultimately illusory." However, he also warned that the plan's uncertainties must be adequately addressed, writing:

> *"The effectiveness of the Aquatic Conservation Strategy is still subject to debate among scientists. If the plan as implemented is to remain lawful the monitoring, watershed analysis, and mitigating steps called for by the Record of Decision will have to be faithfully carried out, and adjustments made if necessary."*

In December 1994, Judge Dwyer ruled in favor of the Secretaries saying that they acted within the lawful scope of their discretion in adopting the Northwest Forest Plan. As of November 2015, the Northwest Forest Plan continues to govern forest management on Forest Service and BLM lands within the range of the northern spotted owl.

The Northwest Forest Plan promised to address uncertainty through a process known as *adaptive management*, which it described as a continual process of planning, monitoring, evaluation and adjustment with the purpose of achieving the Plan's goals (USDA & USDI 1994a, p. E-12). After four years of monitoring program development, effectiveness monitoring for the Aquatic Conservation Strategy began in 2000 (Gallo et al. 2005). Sixteen years of adaptive management have led to no adjustments to the Aquatic Conservation strategy.

A4.2.2 Washington's Forested State Trust Lands HCP

The Washington State Department of Natural Resources (DNR) manages about 2.1 million acres of commercial forestland. The purpose of these "trust lands" is to generate perpetual income for the trust beneficiaries, which are various public institutions such as kindergarten through 12th grade public schools and the state's two major universities. Under the "trust mandate," DNR must act with undivided loyalty to the trust beneficiaries by striving to obtain the most substantial financial support possible from the trust property over time, while exercising ordinary prudence and taking necessary precautions for the preservation of the trust estate (DNR 2006a). Exercising ordinary prudence includes complying with all environmental regulations; preventing losses of ecological function, which may contribute to the listing of species as threatened or endangered; and avoiding circumstances likely to lead to public demand for increased restrictions on forest management (DNR 2006a).

In the late 1980s and early 1990s, the spotted owl conflict, which had been confined to federal lands, spread to state forestlands as well. In 1988, DNR under the threat of legal action by environmentalist groups agreed to defer harvest of spotted owl habitat in its Olympic Region (DNR 1989). DNR's deferred timber sales in the Olympic Region were worth approximately $60 million in potential revenue (DNR 1989; equivalent to $115 million in 2015[4]). In 1990, the northern spotted owl was listed as a threatened species under the ESA. To avoid incidental take of spotted owls and violation of the ESA, the U.S. Fish and Wildlife Service (USFWS) recommended that spotted owl habitat, which consists of structurally complex mature and old-growth forest, should cover at least 40% of the area within a median home range radius (1.8 miles in the Cascades and 2.2 miles on the Olympic Peninsula) of spotted owl nests. Much of the mature and old-growth forest under DNR's

[4] Past monetary values adjusted to 2015 values with U.S. Bureau of Labor Statistics Consumer Price Index Inflation Calculator (http://www.bls.gov/data/inflation_calculator.htm).

management was situated in "owl circles" below the 40% threshold and could not be harvested. In addition, DNR was spending approximately 4 million dollars per year (equivalent to $6 million in 2015) on spotted owl surveys to avoid timber harvest that could violate the ESA. In response to the listing, the Washington Forest Practices Board, which is responsible for regulations governing timber harvest on nonfederal lands, initiated a rule-making process for the protection of spotted owl habitat. An economic analysis estimated that the proposed rules could reduce income to the state trusts by $410 million to $1.49 billion per decade (Lippke & Conway 1994; equivalent to $658 million to $2.39 billion per decade in 2015).

In 1992, the marbled murrelet was also listed as a threatened species, which resulted in additional disruptions to DNR's timber sales and lost revenue for the trust beneficiaries. Furthermore, the listing of anadromous salmon and bull trout under the ESA appeared to be imminent. If a salmonid species were listed, then state forest managers worried that the National Marine Fisheries Service (NMFS) would issue recommendations for avoiding incidental take, as USFWS had done for spotted owls, and that those recommendations would be similar to the recently proposed riparian reserves of FEMAT (1993). A salmonid species listing west of the Cascade Crest could affect over 12,000 miles of streams, including 1,410 miles of fish-bearing streams, on 1.4 million acres of DNR-managed forest (DNR 1997).

In 1992, Jennifer Belcher was elected as the Commissioner of Public Lands, which is the office that administers and directs DNR. Belcher assumed office in 1993, and during her first year she initiated development of a habitat conservation plan (HCP) that would resolve DNR's spotted owl, marbled murrelet, and salmonid crisis. The HCP was Commissioner Belcher's top priority (Belcher 2001).

Under Section 10(a) of the ESA, incidental take of federally listed endangered or threatened species may be permitted subject to federal approval of an HCP. An HCP is the basis for a contract between an applicant (typically a private landowner) and the federal agencies responsible for protecting listed species, USFWS or NMFS (jointly known as the Services). The contract (called an ''implementation agreement'') allows a permittee (formerly the applicant) to degrade or destroy habitat, thereby causing incidental take, in exchange for conservation measures that minimize and mitigate the habitat loss. According to section 10(a), issuance of an incidental take permit requires that:

(1) The taking of federally listed species is incidental to otherwise lawful activities;

(2) The taking is, to the maximum extent practicable, minimized and mitigated;

(3) The taking will not appreciably reduce the likelihood of the survival and recovery of the species in the wild;

(4) Adequate funding for the conservation plan is ensured; and

(5) Other measures required by the Services as being necessary and appropriate for the purposes of the plan are met.

An HCP describes in detail what the applicant will do to satisfy the five issuance criteria. DNR hoped to develop an HCP for 1.6 million acres of state trust that would enable it to generate the greatest feasible income for the trusts while fully complying with the ESA. The agency developed separate conservation strategies for spotted owls, marbled murrelets, salmonids, and a "multi-species"

strategy that provided habitats for 49 other at-risk wildlife species. The latter three strategies were developed for state trust lands in western Washington only[5]. If approved by the Services, DNR's HCP would be the nation's largest HCP.

DNR's salmonid or riparian conservation strategy specified two conservation goals: 1) maintain or restore salmonid freshwater habitat on DNR-managed forestlands, and 2) contribute to the conservation of other aquatic and riparian obligate species (DNR 1997). The strategy consisted of five components: riparian management zones (RMZs), wetland buffers, protection of unstable slopes, comprehensive road network management, and hydrologically mature forest in the rain-on-snow zone (DNR 1997). The goal of RMZs was to maintain the functions of riparian ecosystem processes. Five functions of riparian ecosystems were specifically addressed: water temperature, steam bank integrity, sediment load, nutrient load, and delivery of large woody debris. The RMZ consisted of a "riparian buffer" that would maintain the five functions, and when needed, a "wind buffer" on the RMZ's windward side that would protect the riparian area (Figure A4-3). The riparian buffer was broken into three areas: a 25 ft wide no-harvest area adjacent to the stream channel, a 75 ft wide minimal-harvest area where up to 10 percent of timber volume may be harvested, and farthest from the channel, a low-harvest area where up to 25 percent of timber volume may be harvested (DNR 1997). Up to 50 percent of the timber volume in the wind buffer could be harvested.

[5] Because of differences in forest types and management practices between western and eastern Washington, DNR decided not to develop riparian (or salmonid) and multi-species conservation strategies for eastern Washington. Also, the riparian conservation strategy for the Olympic Peninsula, covering 264,000 acres, was different than the strategy for other parts of western Washington, covering 1.14 million acres. Both riparian conservation strategies covered 1.4 million acres of forested state trust land. For simplicity, we describe only the latter strategy.

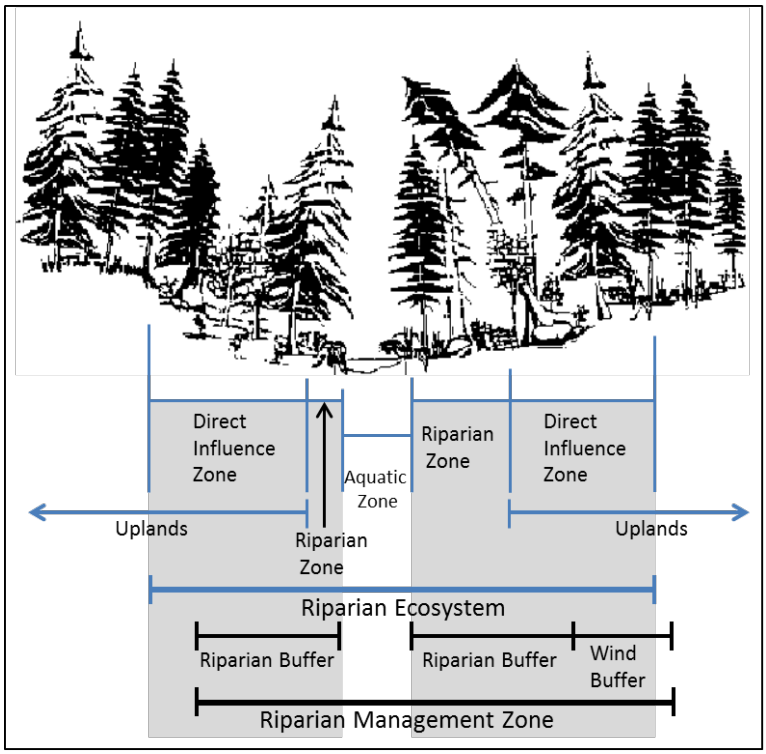

Figure A4-3. Riparian management zone for DNR's forested state trust land HCP. Riparian ecosystem (blue lines) consisting of aquatic zone, riparian zone, and direct influence zone, and the riparian management zone for fish-bearing streams (black lines) consisting of riparian and wind buffers (modified from DNR 1997). No-harvest, low-harvest, and minimal-harvest areas are located within the riparian buffer.

Like FEMAT's riparian reserves, the width of DNR's riparian buffer on fish-bearing streams (water Types 1, 2, and 3) was based on "Site-Potential Tree Height," however, unlike FEMAT, which used potential height of "old-growth" trees, where old-growth was defined as 200 years or older, DNR used the potential height of mature trees, where "mature" was defined as 100 years old. Consequently, the site-potential height for DNR's HCP would range from 86 to 215 ft (DNR 1997). In contrast, FEMAT's site-potential height, which was based on trees 200 years old or greater, could range from roughly 100 to 270 ft (McArdle et al. 1961). DNR set the minimum width of the riparian buffer at 100 ft, and therefore, the buffer width would range from 100 to 215 ft, with an average width on fish-bearing streams between 150 and 160 ft (DNR 1997)[6]. The buffer width on non-fish-bearing, perennial or intermittent streams wider than 2 ft (Type 4 waters) was set to 100 ft No buffer was required on non-fish-bearing streams narrower than 2 ft (Type 5 waters).

DNR explained that a 150 to 160 ft riparian buffer should fully maintain the riparian processes and functions of water temperature, stream bank integrity, sediment load, and nutrient load on fish-bearing streams, however, the quantity of large wood recruitment was expected to "approximate" that provided by old-growth riparian forest. Citing McDade et al. (1990) as scientific support, DNR (1997) estimated that its RMZ would provide more than 90% of the natural level of in-stream large woody debris on fish-bearing streams and 80% on non-fish-bearing streams wider than 2 ft.

[6] The 150 to 160 ft range for the average riparian buffer width on fish-bearing streams was later revised to be more accurate and precise. The new estimate for the average width is 145 ft (DNR 2006b).

During negotiations between DNR and the Services, forest management along non-fish-bearing streams narrower than 2 ft was a particularly difficult issue. The Services wanted a riparian buffer along these "Type 5" streams. However, DNR estimated that about 40% (over 4,500 miles) of all streams within the HCP planning area were Type 5, and therefore, buffering every Type 5 stream would greatly reduce income to the trust beneficiaries. The disagreement was largely based on scientific uncertainty. There had been very little scientific research on the site and watershed-level impacts of forest management along Type 5 streams. Consequently, there was no scientific consensus that provided a common understanding and a mutual starting point for negotiations. Both parties acknowledged this situation and reached a compromise—DNR would conduct a 10-year research program to study the effects of forest management on along Type 5 streams, and after 10 years DNR would develop a long-term conservation strategy for Type 5 streams. Furthermore, to address other uncertainties in its riparian conservation strategy DNR also agreed to ongoing adaptive management for delineation of unstable hillslopes, road network management, timber harvest in the riparian buffer, and wind buffer management (DNR 1997).

Stakeholders, special interest groups, and citizens were not directly involved in development of DNR's HCP. The only formal public involvement occurred through the public review and comment requirements of Washington's State Environmental Policy Act (SEPA) and the National Environmental Policy Act (NEPA)[7]. Comments on the HCP from the majority of tribes, environmentalist groups, and individual citizens expressed their desire for more habitat protection (DNR 1998). In contrast, the majority of comments from most timber industry organizations and trust beneficiaries expressed their belief that DNR's HCP provided too much habitat protection. Two environmentalist groups, for instance, suggested that the riparian reserve widths in the Northwest Forest Plan should be the minimum standards for DNR's HCP, but the Washington Forest Protection Association[8], a timber industry organization, said the Washington Forest Practices Rules, which required much narrower RMZs, provided adequate protection of public resources (DNR 1998).

The Services communicated to DNR that its HCP met the five issuance criteria of Section 10(a) for incidental take permits for spotted owl, marbled murrelets, and salmonids. If any salmonid species, other at-risk species addressed in the plan, or any other animal species was listed as endangered or threatened under the ESA, then the Services would issue to DNR an incidental take permit for that species.

The decision to approve and adopt the HCP was the responsibility of Washington's Board of Natural Resources, which is comprised of six members with four members representing the major trust beneficiaries. Threats of legal action by some county governments who obtain income from state trust lands reminded the Board of its "undivided loyalty" obligation to the trust beneficiaries. Furthermore, the trust mandate led many to believe that the Board could only approve and adopt

[7] Because the HCP entailed a permitting decision by federal agencies (USFWS and NMFS) with potentially significant environmental impacts, a NEPA process was also required. SEPA and NEPA require opportunities for public review and written comment on major environmental policy decisions.
[8] The Washington Forest Protection Association (WFPA) is a trade association representing approximately 50 large and small timber companies and commercial forest land owners. It was founded in 1908 to protect private forest lands from wildfire.

an HCP that obtained the most substantial financial support possible from the trust property over time. The trust mandate was so central to the HCP's approval that the Plan's overall goal was described as follows (DNR 1997):

> (1) Providing certainty and stability in complying with the Endangered Species Act while producing substantial long-term income for the trust beneficiaries;
>
> (2) Allowing more predictable timber sales levels;
>
> (3) Ensuring future productivity of trust lands;
>
> (4) Keeping options open for future sources of income from trust lands;
>
> (5) Increasing management flexibility; and
>
> (6) Reducing the risk of loss to the trusts.

The Board was presented with three alternatives for the riparian conservation strategy: A) the status quo, which followed Washington Forest Practices Rules for RMZs; B) the HCP; and C) the HCP plus Site-Potential Tree Height riparian buffers on non-fish-bearing streams, wind buffers on both sides of the RMZ, and effectively no-timber harvest in riparian buffers. An economic analysis showed that the HCP would provide 7% more timber harvest than the status quo alternative and 16% more timber harvest than the more environmentally protective alternative (DNR 1998). Consequently, in 1996 the Board approved and adopted the HCP.

In 1998 Lower Columbia River steelhead were listed as threatened and in 1999 Lower Columbia River and Puget Sound Chinook, Hood Canal summer-run and Columbia River chum, and Lake Ozette sockeye were also listed as threatened. In 1999, DNR was issued an incidental take permit for all listed salmon subspecies that is valid until 2067. As of November 2015, Washington State's forested trust lands are still managed under the HCP.

A4.2.3 Washington's Forest and Fish HCP

In 1999 the Forests and Fish Report[9] (DNR 1999) was announced to the public. The historic Report was actually a recommendation with broad political support to the Washington Forest Practices Board from the Washington Departments of Natural Resources, Fish & Wildlife, and Ecology; the Governor's Office and the Washington State Association of Counties; the U.S. Fish and Wildlife Service, National Marine Fisheries Service, and U.S. Environmental Protection Agency; the Washington Forest Protection Association and Washington Farm Forestry Association; and nearly all treaty tribes in Washington[10] on new forest practices rules that would achieve the following goals:

1. Comply with the Endangered Species Act for aquatic and riparian-dependent species.

[9] The Forests and Fish Report is also known as the Forests and Fish Agreement, Forests and Fish Rules, Forests and Fish HCP, and the Washington Forest Practices HCP. It also became the "Forestry Module" of the Washington State Salmon Recovery Strategy.

[10] Three tribes – the Muckleshoot, Puyallup, and Tulalip – withdrew from the negotiations (Furman 2010), but they ultimately decided not to oppose the agreement (J. Mankowski, pers. comm.). All environmentalist organizations also withdrew from the negotiations over an unresolvable disagreement. Environmentalist organizations later rejoined the TFW process after the Forests and Fish Report was announced to the public.

2. Support a harvestable supply of fish.
3. Meet the requirements of the Clean Water Act.
4. Keep the timber industry economically viable in the state of Washington.

The first and third goals address compliance with federal statues, the second goal addresses treaty rights of Indian tribes (explained below), and the fourth goal is derived from the Forest Practices Act (RCW 76.09.010) which says:

> "The legislature hereby finds and declares…a *viable forest products industry is of prime importance* to the state's economy; that it is in the public interest for public and private commercial forest lands to be managed consistent with sound policies of natural resource protection; that coincident with *maintenance of a viable forest products industry*, it is important to afford protection to forest soils, fisheries, wildlife, water quantity and quality, air quality, recreation, and scenic beauty." (emphasis added)

In 2001, Washington's Forest Practices Board adopted the rules proposed in the Forests and Fish Report.[11] The Report formed the basis for an HCP, completed in 2005, that covers all forest management activities on nonfederal and nontribal lands that could affect any anadromous or freshwater fish species or seven amphibian species[12]. DNR administers and enforces the Washington Forest Practices Rules. In 2006, the National Marine Fisheries Service issued to DNR an incidental take permit for 16 listed salmon subspecies that is valid until 2056, and consequently, when DNR issues a forest practices permit to a private forest manager, compliance with the permit also assures compliance with the ESA.

The Forests and Fish Report was a negotiated agreement that depended on substantial compromise by the major stakeholders, and that may have been impossible without the foundation laid by the Timber, Fish and Wildlife (TFW) Agreement. The TFW Agreement can be traced back to June 1986 when Billy Frank Jr., a leader of the Nisqually Tribe, approached Stewart Bledsoe, executive director of the Washington Forest Protection Association, with a proposal to negotiate new forest practices rules (Associated Press 1987). Bledsoe agreed to give it a try. At that time the Washington Forest Practices Board, which promulgates regulations for forest management on nonfederal lands, was considering new regulations for riparian areas. The main stakeholders—treaty tribes, the timber industry, small forest landowners, and environmentalist organizations—were anxious about the outcome and dissatisfied with the rule-making process (Phinney et al. 1989). The timber industry was also concerned about Indian treaty rights pertaining to fish habitat (Flynn and Gunton 1996). In *United States v. Washington* (1974), Judge George Boldt ruled that treaties entitled Indians to a fair share of the fish resources at all their usual and accustomed places. In that same trial, the tribes claimed that the degradation of fish habitat had destroyed or impaired their fishing treaty rights. Boldt reserved resolution of that claim for a future trial, which became known as Boldt Phase II (Belsky 1996). In the first trial of Phase II, *United States v. Washington* (1980), the court found an implicit right in the treaties to have fish habitats protected from "man-made despoliation."

[11] The Forests and Fish Report lead directly to state legislation in 1999, Engrossed Substitute House Bill 2091 which directed the Forest Practices Board to adopt new forest practice rules consistent with the Report.
[12] The seven amphibian species covered by the HCP are Cascade, Columbia, and Olympic torrent salamanders, Dunn's and Van Dyke's salamanders, and coastal and Rocky Mountain tailed frogs.

However, in *United States v. Washington* (1985) the ninth Circuit Court of Appeals vacated the district's court original opinion on the habitat degradation issue because sound judicial discretion indicated a decision should await a concrete case. How this treaty right should impact land uses, such as forestry, that are known to degrade fish habitats has yet to be determined in federal court (however, see *United States v. Washington* 2013).

In July 1986, a 2½ day meeting in Port Ludlow, Washington brought together over 40 people representing 24 parties—various state agencies, numerous Indian tribes, the timber industry, and environmental organizations (Phinney et al. 1989, Halbert and Lee 1990). Six months and some 60 meetings later the final TFW Agreement was completed (Phinney et al. 1989, Halbert and Lee 1990). The TFW Agreement included negotiated forest practices rules, which were adopted by the Washington Forest Practices Board in September 1987.

The historic TFW agreement led to the Forests and Fish Report because it established a cooperative process with ground rules for ongoing resolution of conflicts amongst the stakeholder factions. The TFW Agreement provided a framework "to meet the needs of a viable timber industry and at the same time provide protection for our public resources: fish, wildlife, and water," and the TFW participants "chose to resolve differences through education, negotiation, and respect for each other's views" (TFW 1987). The TFW participants admitted that the agreement was "by its very nature a compromise or more accurately a series of accommodations of the various goals and needs" (TFW 1987).

Perhaps most importantly, the TFW agreement established an adaptive management program through which cooperative monitoring, evaluation, and research (CMER) provides information to policy makers for identifying and improving forest practices that need to be modified.

In November 1996, policy makers within TFW and local officials of three federal agencies—USFWS, NMFS, and the U.S. Environmental Protection Agency (EPA)—met to discuss the development of new forest practice regulations that would address a looming regulatory crisis—the federal listing of anadromous salmon and bull trout as endangered or threatened species (Furman 2010).[13] In addition, more than 300 stream segments on Washington forestlands were identified as non-compliant with Section 303(d) of the federal Clean Water Act (Nelson 2005). The federal agencies agreed to a jointly developed "forestry module"[14] that would rely upon the TFW process. A result much desired by the timber industry and state agencies was regulatory assurances from the Services that forest practices compliant with the new forest practices rules would also be compliant

[13] In June 1994, USFWS found that listing of bull trout as endangered or threatened in the conterminous United States was warranted but precluded (USFWS 1994). In June 1995 NMFS received a petition to list Chinook salmon throughout its range in California, Oregon, Washington, and Idaho (NMFS 1995), and in 1999 the Lower Columbia and Puget Sound ESUs of Chinook were listed as threatened (NMFS 1999). In August 1996 NMFS proposed to list Upper Columbia steelhead as endangered and Lower Columbia steelhead as threatened (NMFS 1996).

[14] In 1997, shortly after the 1996 meeting, Governor Locke formed a Joint Natural Resources Cabinet and charged it with creating a salmon recovery strategy for Washington State. The cabinet asked TFW to develop a "forestry module" which would contain recommendations for addressing impacts to listed salmonids and water quality attributed to forest management on nonfederal lands (Furman 2010). The Forests and Fish Report became the forestry module (GSRO 1999). The other modules in the strategy were agriculture and urban.

with the ESA with respect to listed salmonids. Furthermore, it was hoped that EPA would make similar assurances for the Clean Water Act. The federal agencies also required that the new rules not violate the federal trust responsibilities to Indian tribes.

In May 1997, a new round of TFW negotiations commenced with the goal of agreeing upon new forest practices regulations that would achieve the four Forests and Fish goals (listed above). All TFW participants were motivated to make a deal. On one side of the negotiations, the tribes, environmentalist groups, and Washington Departments of Fish & Wildlife and Ecology believed that the forest practices rules did not provide enough protection for fish and water resources. Under the rules, RMZs on fish-bearing streams could be 25 ft wide and no RMZs were required on non-fish-bearing streams. On the other side, the timber industry and small non-industrial forest owners wanted economic viability and greater regulatory certainty. The costly spotted owl wars were subsiding, but federal salmon listings were looming, and NMFS had indicated that the current forest practices rules posed an unacceptable risk of jeopardizing the continued existence of several salmon subspecies proposed for listing (NMFS 1998). The Forests and Fish Report was seen as the most practical way to avoid the costly disruptions of a potential "salmon war", and to get ahead of rumors that NMFS might recommend FEMAT-like RMZs on nonfederal lands to protect endangered or threatened fish, and Boldt Phase II litigation for "man-made despoliation" of fish habitats was certainly a major concern.

Forests and Fish rules had four main components: RMZs, mandatory road maintenance and abandonment plans, more rigorous review of activities on unstable slopes, and strengthened protection of wetlands. The RMZ rules addressed five riparian ecosystem functions: bank stability, leaf litter fall and nutrients, sediment filtering, shade, and recruitment of large woody debris (LWD). The RMZ rules were designed to achieve a "desired future condition" (DFC) in the RMZ which was described as stand conditions of a mature riparian forest with a stand age equal to 140 years (DNR 1999). DFC was operationally defined as a stand's basal area at age 140 years. It varied by site class and ranged from 190 to 285 ft2/acre. Performance targets were established for each riparian function. The targets for stream shading and sediment delivery to streams were "virtually all available shade" and "virtually none," respectively. The target for both recruitment of LWD and litter fall was "85% of recruitment potential for a stand on the trajectory toward DFC conditions; additional recruitment from trees in the outer zone" (DNR 1999).

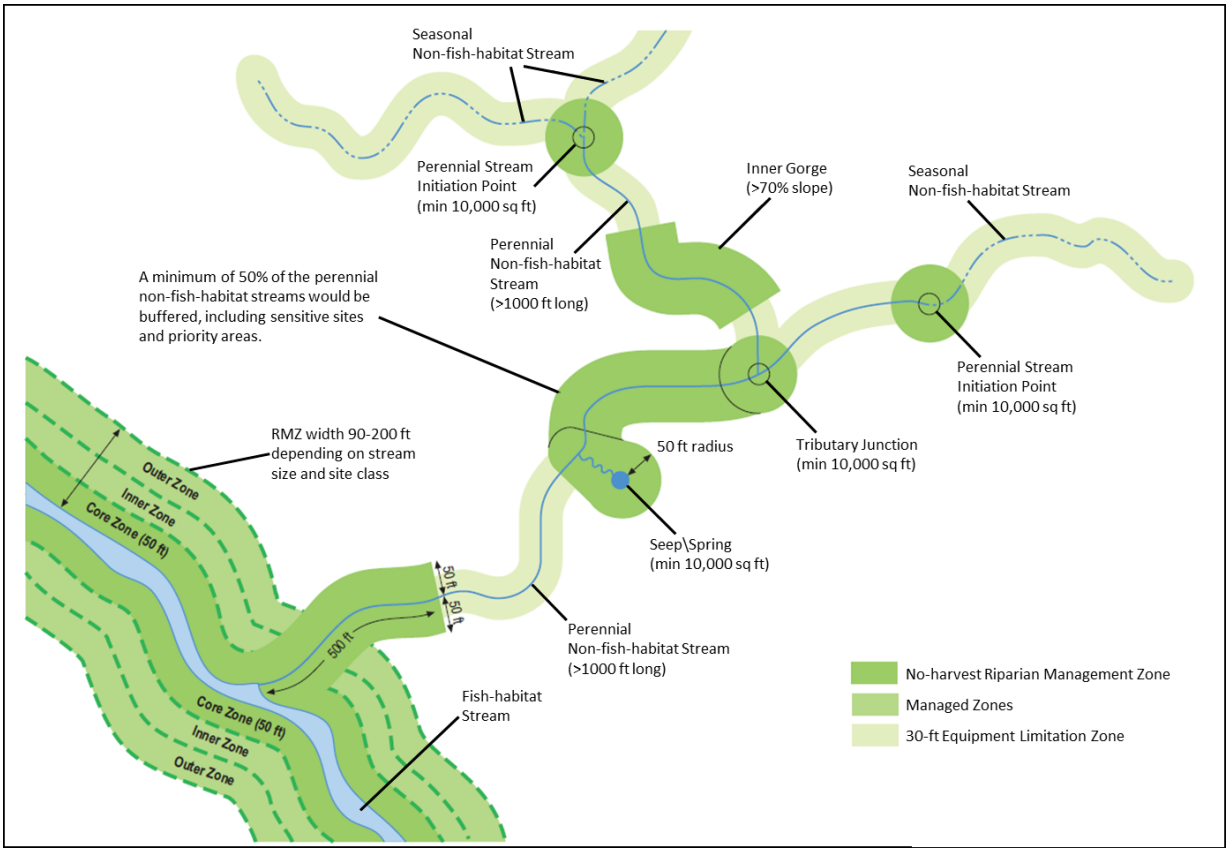

Figure A4-4. Riparian management zones of the Forests and Fish HCP for western Washington (CH2M Hill 2000).

The new rules required RMZs on all fish-bearing streams and on at least 50% of the length of perennial non-fish-bearing streams in western Washington.[15] The width of the RMZ on fish bearing streams equaled the potential height of a 100-year old tree in the riparian area (DNR 1999, DNR 2005). Depending on site productivity class the RMZ width could range from 90 to 200 feet on fish-bearing streams[16]. The RMZ in western Washington consisted of three subzones (Figure A4-4): a 50 ft wide, no-harvest, core zone adjacent to the stream channel; an inner zone 30 to 84 ft wide, depending on site class, where allowable timber harvest was based on the residual basal area needed to meet DFC, but residual tree density could not be less than either 20 or 57 trees/acre, depending on their spatial arrangement; and an outer zone were harvest must leave at least 20 trees/acre (DNR 2005). The subzone widths were based, in part, on a tree's effective height, which refers to the portion of a tree's bole that contributes large woody debris (Fairweather 2001). By definition, large wood has a minimum diameter of 4 inches, and therefore, only that portion of a

[15] Because of differences in forest types between western and eastern Washington, there were differences in the Forests and Fish rules between western and eastern Washington. For simplicity we describe only the Forest and Fish rules for western Washington which are similar to those for eastern Washington.

[16] The DNR state trust lands HCP and the Forests and Fish HCP both used the 100-year site-potential tree height for riparian buffer/RMZ widths. However, site-potential tree heights for the trust land HCP range from 86 to 215 ft and site-potential tree heights for the Forests and Fish HCP range from 90 to 200 ft. The difference is due to the sources for site index curves. The trust land HCP used King (1966) and Forests and Fish used McArdle et al. (1961). The trust land HCP set the minimum buffer width at 100 ft, and therefore, the Forests and Fish RMZ is 7 to 10 percent narrower than riparian buffers of the state trust land HCP.

tree's bole greater than 4 inches in diameter is large wood. The effective height concept facilitated compromise on subzone widths (Fairweather 2001).

On perennial non-fish-bearing streams, the RMZ is a 50 ft wide no-harvest zone over 50% of the stream's length, and at sensitive sites, such as stream confluences, a circular buffer with radius of 56 ft is required. Along seasonal, non-fish-bearing streams all timber may be harvested, but a 30 ft wide equipment limitation zones is required (DNR 2005).

The Forests and Fish Report recommended more structure to TFW's adaptive management program (Figure A4-5). "To impose accountability and formality of process", the Report gave explicit directions to the CMER committee about how to conduct their business, and the Report was also very clear that "scientists will assist policy makers with technical questions but will not make policy." In addition, the Report recommended a full-time Adaptive Management Program Administrator and an independent Scientific Review Committee. Lastly, it described a process for "closing the loop", i.e., using scientific research to improve the forest practices rules, and a process for dispute resolution, i.e., "if the loop fails to close" (DNR 2013). Perhaps most importantly, the Report recommended substantial, stable, long-term funding of the adaptive management program. Between 2001 and 2015, state funding for the program averaged about $4.1 million per year, and between 2001 and 2011 federal funding averaged $2.2 million per year (DNR 2011; D. Hitchens, DNR, pers. comm.).

One of the first uncertainties to be addressed by CMER was the basal area targets for DFC. The basal area targets for the original Forests and Fish Rules were based on yield tables in a 40-year old technical bulletin for fully stocked, upland stands (Fairweather 2001). The resulting basal areas varied by site class and ranged from 190 to 285 ft^2/acre for sites classes V through I, respectively. A study sponsored by the CMER committee (Schuett-Hames et al. 2005) measured the characteristics of 112 unmanaged, mature, riparian forest stands on site classes II through V. They found that the live conifer basal area in riparian areas was significantly greater than the original DFC estimates and that there were no significant differences in basal area among site classes. The ultimate outcome of that study was a revised DFC target equal to 325 ft^2/acre for all site classes.

The Forests and Fish Report was the result of negotiation and compromise achieved through a mix of science, stakeholder values, and politics. The two most obvious compromises are the description of DFC and the width of the RMZ. A stand age of 140 years was agreed to because it is halfway between 80 years, the youngest age of a mature forest (*sensu* Spies and Franklin 1991), and 200 years, the youngest age of an old-growth forest (Fairweather 2001). Old-growth forest was considered the ideal future condition by stakeholders on one side of the negotiation, and mature forest was thought to be suitable future condition on the other side. Compromise landed all stakeholders exactly in the middle.

Like DNR's HCP for forested trust lands, the site-potential height as defined by Forests and Fish is less than the full potential height. The Forests and Fish RMZ width was based on the 100-year Site-Potential Tree Height, but Douglas-fir, the most common tree species in managed forests of western Washington, may not achieve full height until 400 years or older (McArdle et al. 1961). The site-potential height of a 100 year old Douglas fir is about 75% that of a 400 year old Douglas fir (McArdle et al. 1961). In theory and empirically, full riparian function for LWD recruitment

requires a no-harvest RMZ with width equal to or greater than the full potential effective height of trees in the riparian area (McDade et al. 1990). The performance target for LWD recruitment, i.e., "85% of recruitment potential" implicitly acknowledges the Report's compromise on RMZ width and the LWD recruitment function of riparian area.

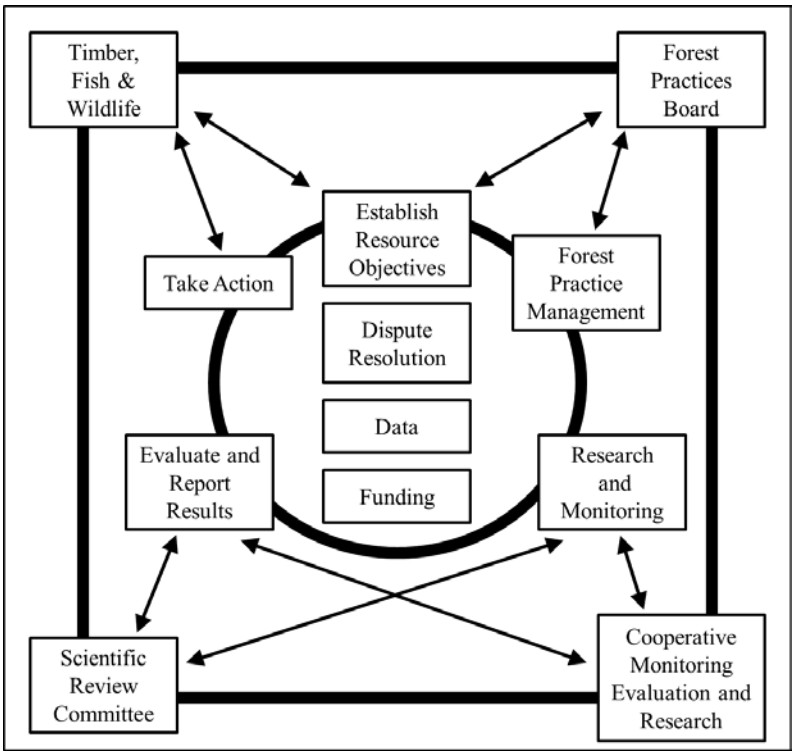

Figure A4-5. Adaptive management process from the Forests and Fish Report (DNR 1999). Four committees or boards (corners of the diagram) interact to establish goals and objectives, develop and implement research and monitoring projects, evaluate results of research, and take action to modify management practices or objectives as necessary to meet goals.

The Forests and Fish Report was controversial. Three state agencies, three federal agencies, nearly all treaty tribes in Washington, the timber industry, and small non-industrial forest owners reached agreement about the Report, but all environmentalist groups and three tribes were dissatisfied with it and withdrew from the negotiation process. Commercial fishers and the League of Woman Voters also opposed the new forest practice rules (McNulty 2000). Two prominent scientists at the University of Washington, Jim Karr and David Montgomery, published an op-ed in the Seattle Times that criticized the Report's poor use of best available science (Montgomery and Karr 2005). Despite this opposition, the state legislature and Governor Locke passed the new rules as part of the Salmon Recovery Act of 1999. NMFS found that the Forests and Fish HCP satisfied the five issuance criteria of Section 10 (NMFS 2006a) and issued to DNR a 50-year incidental take permit that covered 16 federally-listed subspecies of salmon (NMFS 2006b).

A4.2.4 Case Study Summary

The case studies describe three massive conservation plans for fish and riparian-dependent species that cover 12.3 million acres of federal, state, and private managed forests in Washington State. The plans have several things in common. First, all of the plans were motivated by a crisis or impending

crisis. In all three cases, the crisis was created by a violation or potential violation of federal laws that could halt or significantly disrupt commercial timber harvest. In all three cases, the ultimate response to the crisis was a two to three year intensely focused effort that produced a multi-species conservation plan which complied with federal laws and enabled commercial timber harvest. The historical lesson may be that crisis creates the necessity for innovative strategies (or plans) and an opportunity to find the acceptable balance between habitat conservation and commodity production.

Second, each plan was the result of visionary and determined leadership. President's Clinton's Northwest Forest Conference was unprecedented. Not since Theodore Roosevelt had a President of the United States been so closely involved in forest management issues. In fact, the Northwest Forest Plan was originally referred to as the President's Forest Plan.[17] Commissioner Belcher changed the entrenched culture of a government bureaucracy (Belcher 2001). Before Belcher, endangered and threatened species were thought of as extra burdens that interfered with DNR's primary mission; after Belcher, fish and wildlife habitats became required outcomes of forest management. TFW—a collaborative, stakeholder-driven process for developing forest practices rules—led to the Forests and Fish Report, and TFW may have been impossible without the leadership of Billy Frank Jr. and Stewart Bledsoe.

Third, the goals of each plan were largely based on existing laws, regulations, and treaties. The NWFP had to comply with the ESA and NFMA's viability standard while trying to attain the "high-level" timber harvest encouraged by the Multiple-Use Sustained-Yield Act. DNR'S HCP for forested trust lands had to comply with the ESA while fulfilling the common law obligations of a trustee. The Forests and Fish HCP had to comply with the ESA and Clean Water Act, satisfy the economic viability declaration of Washington's Forest Practices Act, and avoid litigation under Boldt Phase II.

Fourth, existing laws and regulations created conflicts amongst cultural values and forced an examination of the trade-offs. The ESA, NFMA's viability standard, and Clean Water Act express society's desire for environmental protection but the Multiple-Use Sustained-Yield Act, DNR's trust mandate, and Washington's Forest Practices Act express society's desire for economic gain from timber harvest. All three plans were forced to balance these conflicting desires, however, because each plan addressed different regulations, the results were different.

Fifth, each plan had both riparian and watershed components. That is, each plan implicitly recognized that riparian reserves, buffers, or management zones alone are inadequate for effective conservation of aquatic ecosystems, and therefore, each plan included watershed-scale conservation actions, in particular, actions to address the adverse watershed-scale impacts of roads.

Sixth, each plan promised adaptive management. Adaptive management can be defined as the systematic acquisition and application of reliable information to improve management over time (Wilhere 2002). Adaptive management is often invoked in conservation plans as the way to deal

[17] The Northwest Forest Plan was originally titled "The Forest Plan for a Sustainable Economy and a Sustainable Environment." The only names on the front cover of the plan's formal announcement were President William J. Clinton and Vice President Albert Gore Jr. That document refers to the plan as "the President's Plan."

with uncertainties and for improving a plan as we learn more through monitoring and research. In the three case studies, adaptive management also provided a mechanism for resolving an impasse in the courts or in negotiations. The expectation of "faithfully carried out" adaptive management was part of Judge Dwyer's reasoning for approving the Northwest Forest Plan. The Services approved DNR's HCP for forested trust lands because the HCP includes contractual obligations for research, monitoring, and adaptive management that should over time resolve various uncertainties that arose during HCP negotiations. The negotiations that led to the Forests and Fish Report were successful because they established a rigorous adaptive management process that all participants believed would lead to continual improvement of the Forests and Fish HCP. The revision of DFC basal area targets validated their belief. In effect, adaptive management allowed opposing factions in TFW to reach an agreement with the understanding that over time information generated by CMER would resolve unsettled disputes about necessary and sufficient forest practices regulations.

Finally, the riparian buffer of DNR's HCP for forested trust lands and the RMZ of the Forests and Fish HCP were similar in several respects. First, the widths of the riparian buffer and RMZ on fish-bearing streams equaled the 100-year Site-Potential Tree Height. Second, the riparian buffer and RMZ consisted of three subzones with no timber harvest allowed in the zone adjacent to the stream channel, more timber harvest allowed in the middle zone, and even more harvest allowed in zone farthest from the channel. Third, the widths of the riparian buffer and the RMZ were narrower on non-fish-bearing streams than on fish-bearing streams. The differences between the two HCPs can be attributed to 1) their different goals, and 2) the lack of stakeholder negotiations in the state trust lands HCP versus the centrality of stakeholder negotiations in the Forests and Fish HCP.

There are also significant differences amongst the three plans (Table A4-1). The most obvious differences among the three plans are the widths of riparian reserves and RMZs. On fish-bearing streams, the riparian reserve width of the Northwest Forest Plan ranges from roughly 200 to 540 ft (i.e., two times the height of the tallest dominant trees, 200 years old or greater), RMZ width of the DNR state lands HCP ranges from 100 to 315 ft (i.e., 100 ft or the site-potential height of a 100 year old tree [King et al. 1966], whichever is greater, plus a 50 or 100 ft wind buffer), and RMZ width of the Forests and Fish HCP ranges from 90 to 200 ft (i.e., the site-potential height of a 100 year old tree [McArdle et al. 1961]). On non-fish-bearing streams, the riparian reserve width in the Northwest Forest Plan ranges from roughly 100 to 250 ft, RMZ width in the DNR state lands HCP is 100 ft on streams more than 2 ft wide, and RMZ width in the Forests and Fish HCP is 50 ft over 50% of the length of perennial streams in western Washington. In addition, the amount of timber harvest allowed is quite different. No harvest is allowed within riparian reserves of the NWFP; from 10 to 45 percent of timber volume could be harvested from the RMZ of DNR's HCP, with most harvest occurring in the wind buffer; and roughly 30 to 60 percent of trees could be harvested from the RMZ of the Forests and Fish HCP, with most harvest occurring in the outer zone (S. McConnell, 2007, unpublished data)[18].

[18] Amount of timber harvest allowed in RMZs under Forests and Fish HCP estimated with data collected for the following report: McConnell, S. 2010. An overview of the DFC model and an analysis of westside Type F Riparian Prescriptions and projected stand basal area per acre. CMER 10-1002. Forest Practices Division, Washington Department of Natural Resources, Olympia, WA.

The widths of riparian reserves and RMZs were different, in part, because the plans had different statutes or regulations to comply with. For example, much of the difference between the riparian reserve widths of the Northwest Forest Plan and the riparian buffer widths of DNR's state trust land HCP may be attributed to the different requirements of NFMA's viability standard and the ESA's section 10. "Viable populations" of all native vertebrate species in the planning area is a much higher standard than "not appreciably reduce the likelihood of the survival and recovery" of only those species covered by an HCP. For federally listed populations, the former may require extensive habitat restoration, but the latter may allow some habitat destruction. That is, an HCP allows the likelihood of survival and recovery to be reduced but not appreciably (Wilhere 2009). The NFMA's "higher bar" for population viability led to greater protection of riparian areas. In comments submitted through the SEPA/NEPA process for DNR's state trust land HCP, environmentalist groups suggested that the riparian reserve widths of the Northwest Forest Plan be the minimum standards for DNR's HCP. This request failed to recognize the dramatically different requirements of the federal laws that governed the two plans.

DNR's RMZs were wider than the RMZs of the Forests and Fish HCP, in part, because DNR has an HCP covering all animal species on state forestlands and the Forests and Fish HCP covers only fish and seven amphibian species. Another reason the DNR HCP RMZs are wider than the Forests and Fish HCP RMZs may be the difference between DNR's trust mandate and a corporation's fiduciary duty toward shareholders. The former compels risk-averse prudence and precaution for preservation of the trust estate, and a judgment that lower rates of financial return are an acceptable trade-off for greater security. The latter entails maximizing shareholder income, and therefore, a "viable forest products industry" may require much higher rates of financial return.

Differences amongst the plans may also be related to ownership because land ownership influences public attitudes towards forest management (Howe et al. 2005). For instance, two separate random telephone surveys in the southeastern United States found that wood production was considered less important for public forests than for private forests (Tarrant and Cordell 2002), and that 50% of respondents believed clearcutting should be allowed on private land while only 14% believed it should be allowed on public land (Bliss 2000). The differences in public opinion regarding forest management on public versus private lands may be explained by the protective "ownership" which many citizens feel for public lands and an inclination to respect the property rights of private landowners. Furthermore, attitudes toward public land management exhibit national versus regional dichotomies. A national poll, taken near the zenith of the spotted owl wars, found that 76% of respondents believed remaining old-growth forest on federal lands should be protected, but a poll of Oregon citizens found 51% held that belief (Shindler et al. 1993). The difference in responses may be explained by local concerns about regional timber-based economies. These surveys report the public's attitudes, which arise from personal values and beliefs (Allen et al. 2009). Because stakeholder representatives and government officials are members of the general public, they may express attitudes similar to the general public. Perhaps differences in the amount of habitat protection provided by DNR's HCP for state trust lands and the Forests and Fish HCP were based, in part, on attitudes regarding the management of private and public forests. Likewise, differences in the amount of habitat protection provided by DNR's HCP for state trust lands and the NWFP may have been based, in part, on attitudes regarding the management of state forests, which has

significant, direct impacts on funding for local schools, and attitudes on the management of federal forests, which has inconsequential, diffuse impacts on nationwide constituency.

The most important differences among the three plans may be the processes used to develop them. The NWFP and DNR's HCP for forested trust lands were top-down processes led by government agencies and had little direct stakeholder participation. The federal and state aquatic/riparian conservation strategies were both developed by government agency staff behind closed doors. Stakeholder involvement in the NWFP occurred through the federal courts, and environmentalist groups were very effective at altering forest management on federal lands through numerous lawsuits. Stakeholder involvement in DNR's HCP for state forestlands was limited to public review and comment required by NEPA and SEPA. The NEPA/SEPA process resulted in no substantive changes to the riparian conservation strategy of DNR's HCP for state trust lands. In contrast, the Forests and Fish Report was a bottom-up process. That is, the process was driven by the stakeholders who worked cooperatively. A government agency, DNR, facilitated the TFW process, but the final Report was based on consensus amongst the participating stakeholders and government agencies.

A4.3 The Role of Values in Riparian Habitat Conservation

The three conservation plans were developed over a short period of time from 1992 to 1999, and consequently, the science on aquatic and riparian ecosystems available to each of the plans was nearly the same. For instance, all three plans cite McDade at al. (1990), a study on source distances of LWD that was arguably the most influential study in determining the riparian reserve, riparian buffer, and RMZ widths of the three plans. All three plans claim to use best available science, and yet the widths are different. Why?

The Seattle Times op-ed by Montgomery and Karr (2005) reframes the question. They ask, "no-cut zones around rivers and streams under the state [Forests and Fish] HCP are narrower and less extensive than zones required under federal logging rules and other approved habitat-conservation plans…Does the best available science really change at property boundaries?" The answer is that the science does not change at the boundaries, but societal values do.

Laws and regulations (statutes and rules) are one expression of society's values (Doremus 2003, Allen 2009). The ESA, for example, declares "species of fish, wildlife, and plants are of esthetic, ecological, educational, historical, recreational, and scientific value to the Nation" and sections of the Act prohibiting take of endangered or threatened species express society's strong desire to preserve all wild species. The goal of the Clean Water Act—"to restore and maintain the chemical, physical, and biological integrity of the Nation's waters" (33 U.S.C §1251)—implies society's belief in the importance of clean water. On the other hand, the Multiple-Use Sustained-Yield Act expresses society's desire to for a predictable, sustainable timber supply from national forests, and Washington's Forest Practices Act express society's desire for economic gain from timber harvest. In Washington State, laws and regulations governing forest management were different for federal, state, and private lands, and consequently, the conservation strategies/plans for aquatic and riparian habitats were different too.

In all three case studies, constraints imposed by conflicting laws and regulations created a crisis or impending crisis, but those constraints did not dictate a single course of action. Laws and

regulations only established boundaries of a decision space, i.e., the variety of potential solutions. Visionary leadership can expand the size of the decision space. Frank and Bledsoe, for instance, foresaw that a collaborative stakeholder-driven process could lead to better outcomes for all sides, and Commissioner Belcher envisioned what the previous commissioner could not—an HCP for spotted owls, marbled murrelets, salmon, and many other species covering 1.6 million acres. Navigating the decision space is influenced by the values held by stakeholder groups and political leaders. Clinton and Belcher were Democrats who held strong pro-environmental values that held sway over plan development. Consequently, the conservation plans crafted during their administrations tested the boundaries of the decision space by making substantial leaps in the level of protection afforded riparian and aquatic habitats. In contrast, the Forests and Fish HCP was developed through a multi-stakeholder process, and while it too made a substantial leap in forest practices regulations for private forest lands, necessary compromises amongst stakeholders resulted in less protection than the other two plans.

The three plans were built upon a foundation of existing laws, regulations, and treaties. However, the ESA, NFMA's viability standard, and Washington Forest Practices Act contain vague language, and the interpretation of vague or ambiguous statutes can be influenced by normative values or ideology (Eskridge et al. 2006). The NMFA's viability standard, for instance, says, "habitat shall be managed to maintain viable populations", but "viable" has no generally agreed upon scientific definition and it is not defined in federal regulations. Consequently, scientists on FEMAT defined "viable" as an 80% likelihood of a stable, well-distributed population over 100 years. Eighty percent was a curious choice because the vast majority of scientific papers use viability (or survival probability) thresholds of 90% or greater (e.g., Schaffer 1981, Carroll et al. 1996, Reed et al. 2003, Traill et al. 2007). Scientists were allowed to choose the viability threshold, but selecting a viability threshold is not a strictly scientific judgment. A viability threshold is an expression of acceptable extinction risk, and acceptable risk is ultimately based on values (Wilhere 2008). Therefore, 80% reflects the FEMAT scientists' interpretation of President Clinton's values as expressed through his five principles for the NWFP; the scientists' interpretation may be very different than that of policy makers or society in general.

Had a different threshold been chosen by the scientists, then the amount of habitat protected by the NWFP may have been very different. An economic analysis by Montgomery et al. (1994) illustrates the potential consequences of selecting a higher viability threshold. Montgomery et al. examined the costs of saving the northern spotted owl from extinction. They estimated that the reduction in timber sales revenue for an 82% survival probability was $21 billion per year and the reduction for a 95% survival probability was $46 billion per year—more than twice the cost (equivalent to $38.2 and $83.7 billion, respectively in 2015). In theory, a similar type of trade-off analysis could be done for salmon and the protection of riparian areas.

Montgomery et al. (1994) was not available when Alternative 9 was chosen, however, the Secretaries were well aware of the trade-offs and the substantially greater cost of a more environmentally protective alternative. They chose the alternative that complied with federal law and was consistent with President Clinton's values as expressed through his five principles for the NWFP. Selection of the viability threshold was not a purely objective decision; it was a subjective decision about acceptable risk, and other subjective values such as economic philosophy, improving

the social welfare of the nation's citizens (i.e., encouraging job growth), and environmental ethics undoubtedly influenced that decision.

Each of the three riparian conservation strategies had to comply with statutes and/or regulations that forced ecological and economic trade-offs. All three strategies reduced economic returns in order to maintain or restore ecological functions, however, with the possible exception of the NWFP, all ecological functions will not be fully maintained or completely restored. Specifically, DNR's trust lands HCP says it will provide 90% of the natural level of in-stream LWD on fish-bearing streams and 80% on non-fish-bearing streams wider than 2 ft, and the Forests and Fish HCP states a performance target of 85% of LWD recruitment potential for a stand on the trajectory toward DFC. The HCPs do not provide full ecological function for LWD for three reasons. First, the ESA does not require full function. The third HCP issuance criterion allows the likelihood of a species' survival and recovery to be reduced but not appreciably. The Services must have determined that the reduction in LWD function projected by these two HCPs met the third criterion. Second, the Forest Practices Act declares that forest practices rules must maintain a viable timber industry. The Washington Forest Practices Board must have believed that either: 1) the 85% performance target for LWD function was compatible with timber industry viability, and a higher performance target would have imposed a greater, unacceptable risk to industry viability, or 2) at the 85% performance target the marginal cost of an incremental increase in LWD function became unreasonable. Third, compromise is part of any equitable negotiation amongst stakeholders, and the compromises of the Forests and Fish Report resulted in a complex, multi-faceted deal that included a level of LWD function that was less than 100%. Most tribal, state, and federal government representatives negotiating with the timber industry must have believed the Forests and Fish Report would lead to lawful and fair forest practices regulations.

A4.4 Management Implications

The most important management implication of the case studies is that WDFW should not unilaterally issue management recommendations for the width of riparian buffers or RMZs. As the case studies demonstrate, decisions on RMZ widths for managed forests in Washington State have not been and cannot be based on science alone. Science is essential for developing habitat conservation strategies or plans, but the foundation for any such strategy or plan is normative values, including ecological, economic, and social values. Science may profoundly influence personal and societal values, but science should not be allowed to displace the preeminent role of values in making environmental policy (Wilhere 2012).

In general, habitat management recommendations are developed to meet particular goals. WDFW's goals are expressed through the agency's legislative mandate: to preserve, protect, perpetuate, and manage Washington's fish and wildlife (RCW 77.04.012),[19] but WDFW's goals represent only one side of a multi-sided set of goals reflecting the values of tribes, local governments, and various

[19] The first of paragraph of WDFW's mandate says, "Wildlife, fish, and shellfish are the property of the state. The commission, director, and the department shall preserve, protect, perpetuate, and manage the wildlife and food fish, game fish, and shellfish in state waters and offshore waters" (RCW 77.04.012). WDFW's mandate also states, "Nothing in this title shall be construed to infringe on the right of a private property owner to control the owner's private property."

stakeholders. Many economic and social values are outside the scope of WDFW's mandate, and hence, other entities (tribes, local governments, stakeholders) must speak to those goals. As the case studies show, some goals for RMZs will be negotiated and the conflicting goals of certain statues, such as the ESA and Washington Forest Practices Act, may require a balancing of ecological and economic trade-offs. Therefore, WDFW believes a collaborative process facilitated by local or state governments within an adaptive management framework is the most likely avenue to achieving rationale, equitable, and durable conservation strategies, plans, or regulations for riparian areas.

In recognition that successful habitat conservation often requires a balancing of diverse societal values through community partnerships, WDFW has adopted the following conservation principles (WDFW 2013):

A. We practice conservation by managing, protecting and restoring ecosystems for the long-term benefit of people, and for fish, wildlife and their habitat.

B. We are more effective when we manage fish, wildlife and their habitats by supporting healthy ecosystems.

C. We work across disciplines to solve problems because of their connections among organisms, species and habitats.

D. We integrate ecological, social, economic, and institutional perspectives, into our decision-making.

E. We embrace new knowledge and apply best science to address changing conditions through adaptive management.

F. We collaborate with our conservation and community partners to help us achieve our shared goals.

These conservation principles reflect the agency's values and will guide WDFW's conduct as it strives to fulfill its legislative mandate.

When dealing with complicated environmental management issues fervent declarations to "follow the science" or "go where the science leads us" are often heard (Gregory et al. 2006). When science is invoked in this way, the implication is that science, and science alone, will lead managers, policy makers, or politicians to the best policy. However this is a myth based on a misunderstanding (Wilhere 2008, Boyle 2010). Science provides only part of the information needed for policy decisions. The other essential ingredient is values—ecological, economic, and social. Policy makers must consider both science and values to decide which actions will create a world that is consistent with our values. The phrase "follow the science" should be replaced with "follow our values and be informed by science." Policy decisions should "follow our values," but, as the case studies show, society's values sometimes conflict, as do the values held by different stakeholder groups. When determining the acceptable width of riparian buffers political processes are necessary to reach compromise or consensus. Politicians, stakeholders, and citizens (including scientists) should resolve conflicts collectively through well-informed, deliberative democratic processes.

Although values have a preeminent role in making environmental policy, science, of course, is also essential. Science played a similar role in all three case studies. First, scientists assembled and summarized the best available science pertaining to the ecological functions and management of riparian areas. This first step is the main purpose of this PHS riparian document. For each of the plans, assembling the best available science often entailed assembling the best available scientists into multi-disciplinary teams of experts. Second, scientists worked with managers and policy makers to develop a set of reasonable policy options for riparian area management. This document could provide much of the ecological basis for development of policy options; however, there are economic and social aspects to riparian area management that this document does not cover. Third, scientists evaluated the impacts of each policy option and reported their findings to policy makers. All three plans conducted in-depth assessments of ecological impacts—primarily through environmental impact statements (USDA and USDI 1994b, DNR 1998, NMFS and USFWS 2006c)—but the quality of economic and social assessments varied greatly. The DNR state trust lands HCP conducted the most detailed economic assessment and the Forests and Fish HCP did the least, perhaps because of the proprietary nature of timber company financial data. Nonetheless, information on potential economic impacts was critical to the policy decision of all three plans. Only the NWFP did a social assessment (FEMAT 1993). WDFW believes that rational, equitable, and durable conservation strategies, plans, or regulations must be based on the best available scientific information that encompasses ecological, economic, and social sciences. Therefore, the information provided by this document should be complemented by economics and other social science research related to riparian area management.

The case studies show that the foundation for large-scale riparian conservation strategies or plans has been existing laws, regulations, and treaties. Some of the most important clients for this document are city and county governments revising critical area ordinances (CAOs) under Washington's Growth Management Act (GMA; RCW 36.70A). Riparian areas would be considered fish and wildlife habitat conservation areas under the critical area definitions (RCW 36.70A.030), and state regulations promulgated pursuant to the Growth Management Act require protection of critical areas (WAC 365-190-080). "Protection" is defined as "preservation of the functions and values of the natural environment,"[20] and "preservation" means "may not allow a net loss" (WAC 365-196-830). This document describes and discusses the ecological functions and ecological values (i.e., benefits) of riparian areas as understood by science.

Like Washington's Forest Practices Act, the GMA has goals for both environmental protection and economic development that could conflict (RCW 36.70A.020). For instance, the GMA directs city and county governments to "maintain and enhance" "productive" timber and agricultural industries. In 2011, the Washington State Legislature established a new approach to watershed-based, collaborative planning that promotes both agricultural and environmental stewardship through incentives—the Voluntary Stewardship Program (RCW 36.70A.700). The purpose of the Voluntary Stewardship Program is to protect critical areas while maintaining agricultural viability. The Forests and Fish Report suggests that an economically viable timber industry requires some

[20] This use of the word "value" denotes features, components, or qualities of the environment or ecosystems. It refers to things that are thought to be beneficial or important.

loss of ecological function in riparian areas. What compromises might result from the Voluntary Stewardship Program remains to be seen.

All three case studies developed riparian conservation strategies that complied with the ESA. When revising CAOs for riparian areas, local governments may wish to consider potential liabilities under the ESA. Based on the success of the Forests and Fish HCP, local governments and landowners under their jurisdiction could avoid legal entanglements with the ESA through an HCP. In California, numerous city or county governments have successfully developed multi-species HCPs for residential or commercial development (e.g., Jones and Stokes 2006, ICF 2012). HCPs are expensive to develop and implement, but a multi-jurisdiction HCP, involving numerous city and county governments, may be a practical, efficient way to reduce costs.

One goal of the Forests and Fish Report—support a harvestable supply of fish—was motivated by the potential for Boldt Phase II litigation by treaty tribes. The recent "culvert case" covering parts of western Washington (*United States v. Washington* 2013) held state government liable for habitat degradation that violated treaty fishing rights. The court's permanent injunction for fixing culverts that block fish passage will cost Washington State government at least $2.4 billion (Lovaas 2013). In the future, city and county governments might also face Boldt Phase II litigation. However, a multi-stakeholder process that includes tribal governments and reaches consensus on riparian conservation strategies might enable city or county governments to avoid costly litigation and its aftermath.

Finally, the importance of adaptive management cannot be overstated. Adaptive management allowed each plan to move forward despite uncertainties and disagreements. The key parties to each HCP recognized that parts of the negotiated agreement could not be permanent and that a process should be instituted to enable changes as needed. Government agencies, tribes, and stakeholders knew that habitat conditions resulting from the conservation plans were difficult to predict. In fact, identifying the greatest uncertainties were part of the negotiations and led to priorities for research and monitoring. The Forests and Fish HCP is an especially good model for adaptive management because it implemented a rigorous, highly structured process for developing a well-funded research program and using the results of that research to improve aquatic and riparian habitat conservation over time.

A4.5 Acknowledgments

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Table A4-1. Comparison of the three major riparian conservation strategies in Washington State. Buffer widths are applied to both sides of stream.

		Northwest Forest Plan	Habitat Conservation Plan for Washington's Forested State Trust Lands	Forests and Fish Report (Habitat Conservation Plan for Washington Forest Practices Rules)§
Lead Agency		U.S. Forest Service and Bureau of Land Management	Washington Department of Natural Resources	Washington Department of Natural Resources
Year Approved		1994	1997	2000*
Area covered (acres)		1.8 million in Washington	1.4 million	9.3 million
Goals		• Compliance with environmental laws (i.e., ESA, NFMA‡) • Long-term health of late-successional ecosystems • Maximizing economic benefits	• Compliance with ESA • Maximizing support to the trust beneficiaries over the long term	• Compliance with ESA • Meet requirements of CWA • Support harvestable supply of fish • Economically viable timber industry
Riparian buffer width	Fish-bearing	Two Site-Potential Tree Heights (≥ 200 years old) or 300 ft whichever is greater	<u>Type 1, 2, and 3 waters</u> • One Site-Potential Tree Height (100 yrs old) or 100 ft whichever is greater • 50 or 100 ft wind buffer when moderate potential for windthrow	<u>Type S and F waters</u> • One Site-Potential Tree Height (100 years old)
	Not fish-bearing	One Site-Potential Tree Height (≥ 200 years old) or 150 ft whichever is greater	• Type 4: 100 ft • Type 5: protected when necessary	• Type Np: 50 ft on 50% of length • Type Np & Ns: 30 ft ELZ
Riparian buffer management		No timber harvest	<u>3 management zones</u> • 0-25 ft: no harvest • 25-100 ft: harvest ≤ 10% by volume • >100 ft: harvest ≤ 25% by volume	<u>3 management zones</u> • Core (0-50 ft): no harvest • Inner: BA must meet DFC target • Outer: retain 20 trees/acre
Other aquatic conservation measures		• Protection of key watersheds • Watershed analysis • Watershed restoration	• Wider buffers on wetlands • Hydrologically mature forest • Improved road management	• RMAPs • Rigorous review of unstable slopes • Increased wetland protection

* The Forest and Fish Report was finished in 1999, the forest practice regulations pursuant to the Forests and Fish Report were approved by the Washington Forest Practices Board in 2000. The habitat conservation plan was approved by in 2006.

‡ Abbreviations: ESA -Endangered Species Act; CWA-Clean Water Act; NFMA-National Forest Management Act; ELZ-equipment limitation zone; BA = tree basal area in ft^2/acre; DFC-desired future condition; RMAP-road maintenance and abandonment plan.

§ Rules for western Washington only; area covered is for all of Washington. For simplicity, we describe only the rules for western Washington which are similar to those for eastern Washington.

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