N A T U R A L R E S O U R C E S

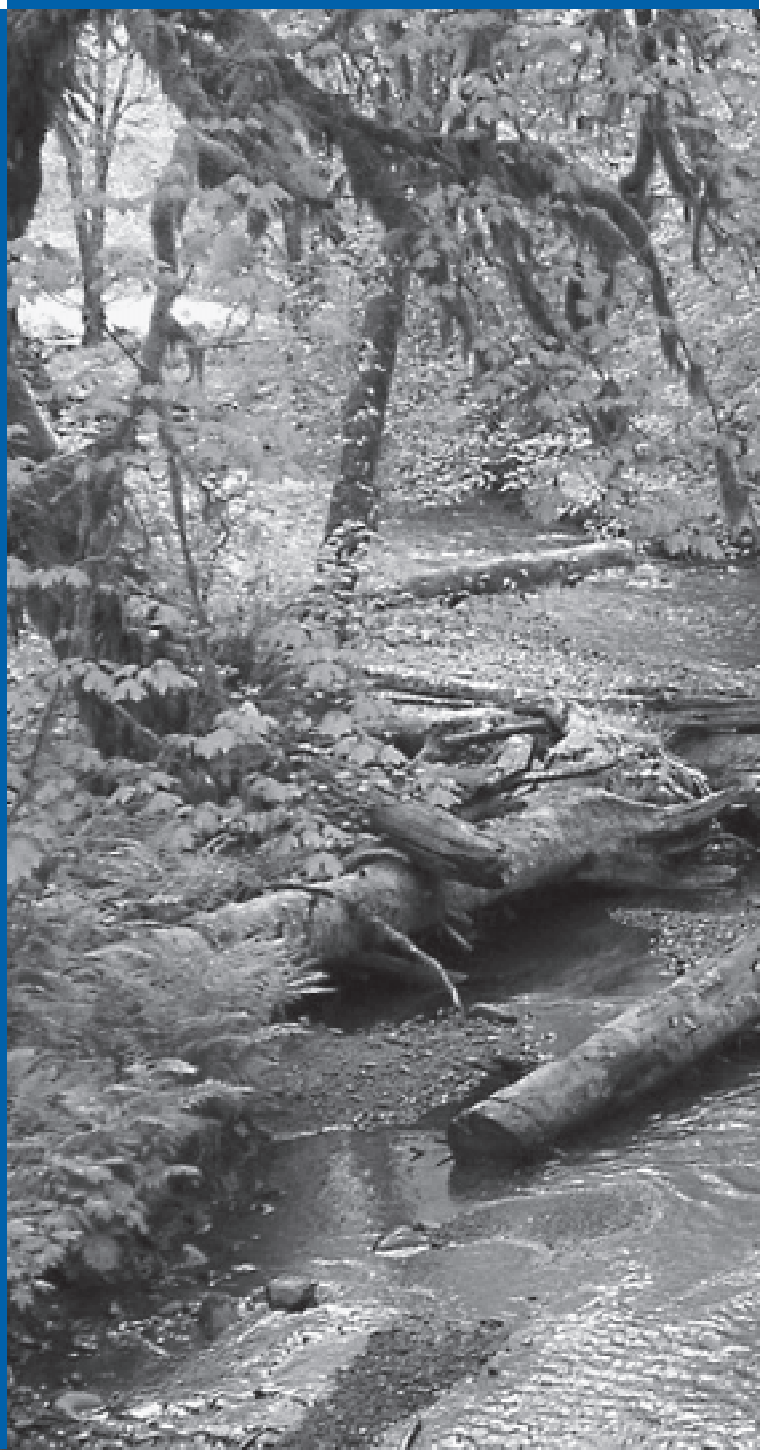
Implementation Procedures for the

HABITAT CONSERVATION PLAN

RIPARIAN FOREST RESTORATION STRATEGY

For Westside Planning Units excluding the Olympic Experimental State Forest

April 2006



WASHINGTON STATE DEPARTMENT OF
Natural Resources
Doug Sutherland - Commissioner of Public Lands

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We thank the Washington State Department of Natural Resources' Region and Division staff and many other external reviewers that commented on earlier drafts of this strategy. The authors would like to thank the following people for their significant contribution to either the concepts or the development of this conservation strategy:
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Photo Credits

Florian Deisenhofer	Cover photo
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Suggested citation

Bigley, R.E. and F.U. Deisenhofer. 2006 Implementation Procedures for the Habitat Conservation Plan Riparian Forest Restoration Strategy. DNR Scientific Support Section, Olympia, Washington.

WASHINGTON STATE DEPARTMENT OF
Natural Resources

DOUG SUTHERLAND
Commissioner of Public Lands

April 20, 2006

Dear Reader,

The Washington State Department of Natural Resources (DNR) has completed a strategy for restoring and protecting streamside forests on state trust lands in Western Washington. As directed in the trust lands Habitat Conservation Plan Conservation Strategy, DNR was to develop procedures detailing methods for making site-specific forest restoration decisions in the riparian areas.

I am pleased to inform you that DNR has completed this work through the creation of this document: *Implementation Procedures for the Habitat Conservation Plan Riparian Forest Restoration Strategy*, April 2006. The procedures cover five of the plan's Westside planning units, and help DNR restore and maintain freshwater habitat for salmonid species, and contribute to the conservation of other species that depend on aquatic and riparian areas.

The procedures will guide the management and restoration activities in the 300,000 acres of forested riparian and wetland areas across the 1.6 million acres of Westside forested state trust landscape. The objective of this restoration strategy is to use thinning activities to hasten the development of riparian forests toward long-term structurally complex, fully functional forests. The strategy focuses on: the growth of large, site-adapted conifer trees, down woody debris (on the forest floor), layering of the tree canopy, and important structural components such a large snags.

These procedures were developed in collaboration with the U.S. Fish and Wildlife Service and National Oceanic and Atmospheric Administration Fisheries Service. The Services also will be working with DNR as we move forward with a measured approach to restore those riparian forests that are most in need. The four Westside regions each will design and carry out a pilot restoration project in collaboration with the Riparian Forest Restoration Strategy Technical Review Committee and the two Services. Information gained from the pilot projects will be used to inform future riparian restoration activities.

In addition to the pilot projects, the first three years of this strategy will be considered the initial Implementation Period. At the end of this time, the Technical Review Committee will reconvene to address issues pertinent to the implementation of the Procedures for the HCP Riparian Forest Restoration Strategy and determine if refinements are necessary.

Ongoing research continues to support the value of riparian forests. Riparian ecosystems produce abundant natural resource values including habitat for salmon and numerous plant and animal

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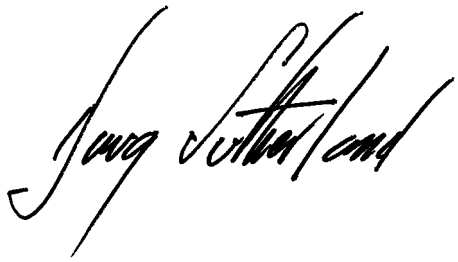
species. Myriad species rely on clean water, shade, large woody debris and nutrients for aquatic habitat, damp soil and logs for terrestrial habitat, and snags for cavity nesting birds. In addition, riparian forests help control flooding, and filter and clean the water that seeps through the landscape.

I greatly appreciate the time and work that DNR's team members devoted to this important effort, and the rigorous scientific contributions that the Technical Review Committee provided. They have given us a valuable product that will be useful in the conservation and restoration of this important riparian ecological community.

Sincerely,



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August 15, 2005

R. Bruce Mackey
Lands Steward
Washington State Department of Natural Resources
PO Box 47000
Olympia, WA 98504-7000

Dear Mr. Mackey:

The U.S. Fish & Wildlife Service and NOAA's National Marine Fisheries Service (NOAA Fisheries) (together, the Services) are writing to inform you and other interested parties that our staff has reviewed the August 2005 version of the Implementation Procedures for the Riparian Forest Restoration Strategy (RFRS) and find it is consistent with the elements outlined in your Habitat Conservation Plan HCP (State Lands HCP, approved by the Services January 1997). These riparian Implementation Procedures fulfill the requirements outlined in the HCP (IV. 61) and provide the promised guidance for site specific riparian management while not changing any existing HCP conservation strategies. In our view, implementing these riparian procedures as described will not lead to an increased level of incidental take authorized by the Services in 1997, or lead to an appreciable reduction in riparian ecosystem functions.

As described in the HCP, the Implementation Procedures document has been prepared by Department of Natural Resources (DNR) staff in close collaboration with the Services. This August 2005 document addresses substantive concerns with previous versions raised by the Services, Northwest Indian Fisheries Commission (NWIFC) and others. Based on our review, we believe that the procedures will meet the HCP riparian objectives: 1) to maintain or restore salmonid freshwater habitat on DNR managed lands, and 2) contribute to the conservation of other aquatic and riparian obligate species (HCP IV. 55 - 79).

Invariably, questions of implementation will arise with these riparian Implementation Procedures that we cannot now foresee. In that instance, we expect to continue our constructive interagency dialog to find solutions that meet the intent of the procedures and HCP objectives. If DNR or the Services believe it is necessary, the Technical Review Committee consisting of scientists from the DNR, the Services, the NWIFC, and the Washington Department of Fish and Wildlife will be convened to address the implementation issue.

In addition, the Services will continue to fulfill their government-to-government role with western Washington Tribes on the implementation of this HCP.

The 2009 Compliance Monitoring Report, as described in the Implementation Procedures, will provide an early opportunity to diagnose implementation issues and allow the Technical Review Committee to adapt the procedures, if needed, based on the latest observations and information. We believe this three-year Implementation Period integrates well with the HCP adaptive management process to give us a high level of confidence in the effectiveness of HCP implementation of riparian areas.

The Services have worked closely with your staff to understand the details of the riparian Implementation Procedures and the DNR has been receptive to our suggestions. We agree with DNR that this document is important to guide HCP implementers as they develop the site-specific forest prescriptions to achieve the desired future conditions of ecologically functional forests along streams and wetlands. Based on our review of the RFRS, the Services believe the August 2005 version of the Implementation Procedures for the Riparian Forest Restoration Strategy is consistent with the intent and goals of the riparian conservation strategy described in the HCP.

We look forward to working with the DNR on implementing and monitoring the effectiveness of the riparian procedures. Thank you for your attention and your staff's commitment to ensure the HCP is effectively implemented. If you have questions about this letter, please contact Matthew.Longenbaugh@noaa.gov, (360) 753-7761, or Mark_Ostwald@FWS.gov, (360) 753-9564.

Sincerely,

Steven W. Landino
Washington State Director
for Habitat Conservation

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Steve McConnell, NWIFC
Tami Riepe, DNR
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Paula Swedeen, WDFW

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Habitat Conservation Plan Science Section
Land Management Division

April 2006

WASHINGTON STATE DEPARTMENT OF
Natural Resources
Doug Sutherland - Commissioner of Public Lands

Preface

As directed by the Washington State Department of Natural Resources Habitat Conservation Plan (HCP), this document describes the goals and objectives for site-specific forest management decisions in the Riparian Management Zone (DNR 1997 IV. 61). Materials from this document will be reformatted for training and used by field foresters. The Department is replacing the 1999 Forestry Handbook procedure PR 14-004-150 with the procedure in Section 3 of this document, and implementing this Riparian Forest Restoration Strategy with this new guidance and field forester training.

Implementation of this Riparian Forest Restoration Strategy will be through the training of region-based specialists and the training of field personnel. The Technical Review Committee and the Federal Services will work with DNR as it moves forward with the measured approach to restore riparian forests on state trust lands. Each Westside region will carry out a pilot restoration project. Information from the pilot projects will be used to inform later riparian restoration activities.

These silvicultural activity prescriptions are to be applied to forested state trust lands managed under the HCP, mostly west of the Cascade Crest. Management of Riparian Management Zones (RMZ) in the Olympic Experimental State Forest (OESF) will continue under the guidance in the OESF management options defined in the HCP.

Strategies described in this document are required to be implemented in the field when RMZ restoration is being considered, unless alternate plans are approved in writing by the HCP Implementation Management or their designees, in consultation with the Region Manager or Region State Lands Assistant Manager.

Changes to this Riparian Forest Restoration Strategy can be made by written agreement between the appropriate agency representatives.

Non-riparian associated wetland management strategies are found in:

Bigley, R. E. and S. W. Hull. 2000. *Recognizing Wetlands and Wetland Indicator Plants on State Lands in Washington.* DNR Scientific Support Section, Olympia, Washington

Bigley, R. E. and S. W. Hull. 2000. Managing Wetlands on State Lands in Washington. DNR Scientific Support Section, Olympia, Washington 154 p.

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Context for the Riparian Forest Restoration Strategy

Introduction

With the creation of the 1997 Habitat Conservation Plan, the Washington State Department of Natural Resources (DNR, or Department) has charted a new course for forest management of 1.45 million acres of forested state trust land covered by the riparian conservation strategy. The Habitat Conservation Plan (HCP) agreement, signed with the Federal Services (U.S. Fish and Wildlife Service, and National Oceanic and Atmospheric Administration Fisheries), serves several purposes for DNR.

An HCP allows the applicant to develop a forward-looking strategy that establishes a balance between the protection of federally listed species and economic requirements, it ensures the applicant will mitigate the effects of 'take;' and it is a required component of an application for an Incidental Take Permit. The main purposes of the DNR's HCP, and the conservation strategies that are included, are as follows (Draft HCP EIS 1996):

- Produce the most substantial support over the long term, consistent with trust duties conveyed to DNR by the State of Washington.
- Ensure forest productivity for future generations.
- Reduce the risk of violating the Endangered Species Act on forestlands within the range of the northern spotted owl through sound, biologically based management.
- Reduce the likelihood of trust management disruptions due to future listings.

A key component of the HCP is the riparian conservation strategy that established Riparian Management Zones on all salmonid-bearing streams and along many small non-fish-bearing streams. This commitment, combined with the wetland protection in the riparian conservation strategy, directs the management objective on approximately one-third of all state lands managed under the Department's HCP.

The HCP's riparian conservation strategy defines the management goal for RMZs as the restoration of high quality aquatic habitat to aid in federally listed salmon species recovery efforts, and to contribute to the conservation of other aquatic and riparian obligate (dependent) species. To achieve this goal, the Department will use a combination of various types of active management through stand manipulation, and also the natural development of unmanaged stands. This will result in the restoration of structurally complex riparian forests that provide the ecological functions to meet the conservation objectives.

This Riparian Forest Restoration Strategy document defines the foundation and sideboards to develop site-specific riparian forest prescriptions to achieve the desired

future conditions that meet the Department's restoration objectives. Stand structure targets are defined to allow management alternatives to be assessed and the progress to be measured.

Riparian restoration as a management goal is relatively new to forestry in the Pacific Northwest. DNR's approach to achieving this goal uses site-specific Forest Management Unit objectives, pursued with silvicultural treatments to increase individual tree growth, vigor, and stability. This approach also is designed to promote species diversity, and enhance forest structural complexity that emulates the structure of forests shaped by natural disturbances. In evaluating a specific restoration activity, alternative silvicultural pathways will be considered—including a 'no treatment' alternative—and the respective impacts to the Riparian Management Zones will be analyzed.

This document is based on guidance provided by the 1999 Interagency Riparian Science Committee (Cederholm et al., 1999), which formulated recommendations to meet the HCP conservation objectives. Specific guidance from the Interagency Riparian Science Committee has been modified to clarify the management objectives, increase operational feasibility, and to establish consistency with upland management. This document will guide decisions in the riparian zones, including wind buffers (DNR 1997, IV. 61).

This document has four sections:

Section 1 gives context for the Washington DNR Riparian Forest Restoration Strategy and provides a definition of the management goals and objectives of riparian zone silvicultural activities. This strategy also defines the short- and long-term riparian conservation targets.

Section 2 provides specific guidance on the sequence of activities and silvicultural treatments to meet these conservation objectives.

Section 3 provides the Riparian Forest Restoration Procedures.

Section 4 offers a summary of detailed monitoring plans that have been developed to assess instream conditions and trends, and riparian silviculture. An adaptive management vision for future riparian ecosystem management also is described.

HCP Riparian Conservation Strategy Objectives

The DNR HCP for forested state trust lands identifies two objectives for the riparian conservation strategy for the five Westside planning units (DNR 1997, III. 60):

1. Maintain or restore salmonid freshwater habitat on DNR-managed forestlands, and
2. Contribute to the conservation of other aquatic and riparian obligate species — those species that depend solely or mostly on this environment.

Salmonid habitat is supported by a host of riparian ecosystem functions, therefore:

- Conservation objective (1) requires maintaining or restoring riparian ecosystem functions that determine salmonid habitat quality. Hydrological and geomorphological processes originating in upland areas also may affect salmonid habitat. Thus, objective (1) further requires that the adverse effects of upland management activities be minimized.

- Significant contributions to the conservation of other aquatic and riparian obligate species, conservation objective (2), will occur indirectly through forest management that maintains or restores salmonid freshwater habitat.

DNR's trust lands HCP is a multi-species HCP, and the large extent of riparian areas on state trust lands is believed to make a significant contribution to the conservation of other riparian obligate species through its connectivity and biodiversity.

The riparian conservation strategy should serve to reduce the risk of extinction for many unlisted species, in particular, those that have small home ranges and depend on riparian/wetland ecosystems or late successional forests. Habitat for a number of species including the unlisted species identified in the HCP (pages IV.158-169) should also benefit by this Riparian Forest Restoration Strategy.

Restoration of Ecological Functions through Riparian Forest Management

The habitat and supporting riparian ecosystem functions needed by salmonids are believed to be very diverse (DNR 1997, III. 60; Cederholm et al. 1999). In addition, contributions to the conservation of other riparian-obligate species add to that complexity (DNR 1997, III. 57). DNR's direction in its riparian zones is to restore this broad range of ecological functions. The main riparian ecosystem benefits include:

- Stream bank stability
- Regulation of nutrient load
- Stream shading
- Large woody debris recruitment
- Sediment filtering
- Down woody debris on the riparian forest floor
- Standing snags

For a more in-depth discussion of these ecological functions, please refer to the Scientific Committee Recommendations (Cederholm et al. 1999) or the Final Environmental Impact Statement on Alternatives for the Forest Practices Rules for Aquatic and Riparian Resources (Washington State Forest Practices Board, 2001).

The three characteristics most needed for riparian function are large conifer trees, a complex stand structure, and species composition that includes long-lived tree species that provide stability to stream banks, channels, and floodplains (Poulin et al. 2000).

Key Elements for Restoring Riparian Functions

Large trees are an essential requirement for watershed restoration. Large diameter trees with strong root systems provide critical structure for fish habitat and prevent chronic erosion of stream banks. Over time, large trees result in the deposition of large woody debris (LWD) in the stream. Habitat features resulting from channel modification by LWD are critical spawning, rearing and over-wintering habitat for salmon and other fish.

The ***stand structure*** of riparian forests is a result of the mosaic of site conditions near streams. Higher rates of disturbance from natural flooding and windthrow on wet soils

produce canopy gaps and patches of variably spaced trees throughout the stands. A mosaic of plant communities, including conifers, hardwoods and shrubs produce a complex forest stand structure and understory community. Light is often sufficient to allow conifers to reestablish while still supporting a well-developed shrub layer.

Forest composition is significant with respect to riparian restoration. Natural disturbance patterns and complex gradients of moisture regimes produce inherently diverse riparian forests. Stand composition varies depending on the different site conditions; restoration efforts are designed to encourage forest composition resembling unmanaged forest diversity.

Natural disturbance patterns and complex gradients of moisture regimes produce inherently diverse riparian forests.

This riparian management strategy will primarily use stand thinnings to hasten the development of riparian stands toward a mosaic of structurally complex riparian forests and restore riparian habitat functions while not appreciably reducing riparian ecosystem benefits in the short-term. In particular, this restoration strategy will focus on growing large, site-adapted conifer trees, contributing down woody debris (DWD) and instream large woody debris (LWD) to the riparian habitat, initiating canopy layering where appropriate and protecting existing structural components such as snags. For the purposes of this document, the long-term habitat restoration goal for riparian areas on state-managed lands will be to bring riparian forests to the Fully Functional forest stage. (See Appendix 1 for a list of definitions for the different stand development stages.)

Current Riparian Forest Conditions

Historically, Pacific Northwest forests were a mosaic of different forest types and ages, and large areas of old forest were common (Franklin et al. 1981). In general, stand development in the majority of stands that make up the Riparian Management Zone follow a similar successional path that is similar to upland forests. However, riparian areas are more frequently disturbed by fluvial processes and can have more diverse stands than other upland areas (Agee 1998). Upland forest habitat restoration can be tracked by stand development stages (Carey and Curtis 1996, Franklin et al. 2002). Figure 1 depicts the distribution of stand development stages from Carey and Curtis (1996) in the riparian land class for the six Westside planning units (including the OESF). The riparian land class includes stream and wetland riparian buffers plus their associated wind buffers.

This dense conifer overstory has excluded shrub-sized streamside vegetation.

In general, the distribution of stand development stages for riparian areas within the Westside HCP planning units reveals that more than 60 percent of riparian stands are in a development stage that suggests one or several of the riparian functions is impaired. Approximately 38 percent of the stands are in the Understory Development and Botanically Diverse stages, and are therefore considered to be providing most, if not all, riparian functions. Only 1 percent of the stands have reached the Niche Diversification and Fully Functional stages that resemble old growth.

Competitive Exclusion stages (including the Sapling, Pole, and Large Tree Exclusion Stage) characterize 56 percent of DNR-managed riparian

stands in Western Washington. These predominant development stages lack the very large trees and multiple canopy layers found in the later stages of stand development, and are usually deficient of large snags and significant amounts of down wood. Within competitive exclusion developmental stages, understory vegetation is generally severely depressed. If these closed canopy stands do not receive riparian restoration efforts, they are likely to remain at an incomplete level of ecological function for many decades due to slow rates of natural self-thinning and disturbance.

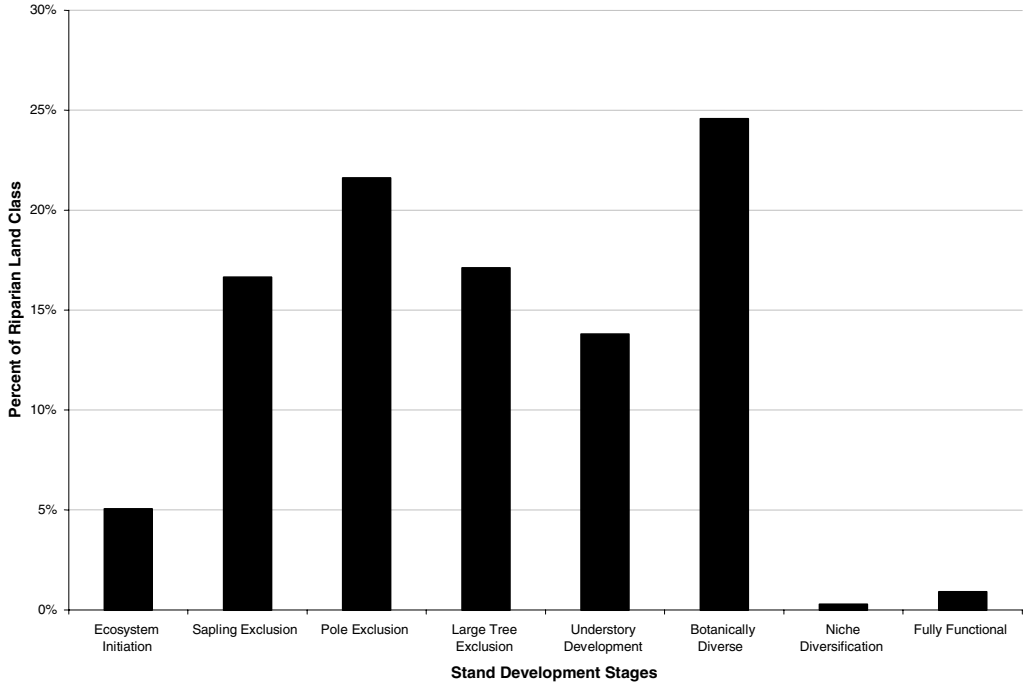


Figure 1. Distribution of stand development stages within riparian lands covered by DNR's HCP Riparian Conservation Strategy. See Appendix 1 for definitions of stand development stages. Data from modeled stand development stages based on Carey et al. 1996. Percentages are based upon the total riparian land class acreage, which includes modeled buffers for riparian stands adjacent to Type 1-4 streams and wetlands, plus associated wind buffers.

Riparian forest age classes are another way to illustrate the current condition of DNR-managed RMZs (Appendix 2). Currently, 32 percent of riparian forests are estimated to be less than 40 years of age. The majority (57 percent) is between 40 and 80 years of age. The remaining 11 percent are older than 80 years. Appendix 2 provides planning unit-specific estimates of the age class distribution of Westside state-owned forests within RMZs.

Riparian Restoration as a Management Goal

A general goal of restoration is to reestablish an ecosystem's ability to maintain its function and organization without continued human intervention (Gregory and Bisson 1997). Therefore, riparian forest restoration entails the cultivation of a forest that functions to supply materials essential to aquatic and riparian ecosystems and to mediate energy or mass transfers to aquatic ecosystems. This is often assumed to mean that the forest must possess a structure and species composition that resembles an unmanaged older forest. However, a succinct definition of the archetypal unmanaged riparian forest is elusive.

A more ecologically realistic approach to restoration recognizes that riparian forests are dynamic and diverse. Riparian silviculture should aim to maintain the range of conditions produced by natural disturbance regimes and encourage natural patterns of succession (Bisson et al. 1997, Gregory and Bisson 1997). Therefore, the goal of DNR's riparian management strategy is not to create a specific, well-defined older forest condition, but to shorten or eliminate the time period a riparian forest would spend in the development stages of competitive exclusion. At the same time, important structural features of the Fully Functional stage such as down woody debris, instream large woody debris and snags will be created to further hasten the development of riparian stands toward the long-term habitat restoration goal. Across the landscape, the Department's long-term goal is to return watersheds managed under the HCP to a properly functioning condition, wherever possible. This goal may not be achievable in watersheds where DNR manages less than 50 percent of the land base, or in watersheds where active restoration is severely constrained.

The Role of Management in Riparian Restoration

Riparian silviculture describes a suite of restorative management techniques that can be used to alter forest development in riparian areas for the purpose of improving instream and riparian habitat conditions (Oliver and Hinckley 1997; Berg 1995; Kohm and Franklin 1997). Restoration of riparian forests emphasizes thinning to accelerate diameter growth (on trees that are retained) and increase wind firmness and development of desired forest tree and understory species (Hayes et al. 1997, Gregory 1997, Rainville et al. 1985, Berg 1995, Chen et al. 1993, Emmingham and Maas 1994, Maas and Emmingham 1995, Emmingham and Hibbs 1997).

Stream cooled and shaded by overhanging trees and large down woody debris.

Current silvicultural research in riparian areas usually addresses the most common problem exhibited by salmonid habitat in managed watersheds—the capacity of forests to supply instream large woody debris. Aquatic ecosystems in managed forests lack the instream large woody debris essential for salmonid habitat, and riparian forests lack the capacity to supply LWD in the near future. The reasons for this situation are two-fold. First, past Forest Practices Rules have provided inadequate protection of riparian forests. As a result, the natural condition of riparian forests has been largely lost on DNR-managed lands. Second, decades ago, instream LWD was eliminated from many aquatic ecosystems through practices such as splash damming and the cleaning of streams for fish passage (Sedell et al. 1988).

In response to this lack of wood structures in streams and riparian forests, restoration has been promoted for managed forests throughout the Pacific Northwest, and riparian thinning is the primary tool through which restoration is to be accomplished. Riparian restoration poses challenges for which there is currently limited research as guidance. However, the Olympic Experimental State Forest (OESF) is already providing important insights into the early benefits of silvicultural treatments in riparian areas, such as moderate thinning treatments from below and LWD placement.

The long-term management goal for RMZs is to reach a desired future condition such as the Fully Functional stage. Reaching those desired riparian conditions, through natural processes, may take hundreds of years after stand replacement disturbances. Riparian

silviculture is intended to shorten the development time for a forest to reach the desired conditions. For example, little down woody debris or large woody debris in streams initially exists in young managed forests. In addition, small diameter down wood decays faster than young forests can make significant inputs. It is assumed that stand thinning designed to maintain the diameter growth of dominant trees combined with mandated contributions to down wood will greatly decrease the time before which Riparian Management Zones start to exhibit older forest stand characteristics.

The Scope of Potential Riparian Restoration and the Adaptive Management Process

The scope of this silvicultural management restoration that is needed can be gauged by the current condition of riparian forests (Figure 1) and the extent of waters subject to protection under the riparian conservation strategy. The extent of the rivers and streams (Table 1) emphasizes the importance of riparian restoration on forested state lands. Stream density in the DNR-managed Westside forested landscape is estimated at between about 3.8 miles of stream per square mile in the Straits Planning Unit, to about 7.8 miles of stream per square mile in both the South Coast and Columbia planning units.

This Riparian Forest Restoration Strategy has the potential to be carried out on most timber sales. Site operability and economic constraints may ultimately determine the extent to which riparian forest restoration is feasible. There is great potential for improvement to riparian ecosystems under the Riparian Forest Restoration Strategy. DNR is committed to conducting effectiveness monitoring of the RFRS (see Section 4). New information from DNR and other organizations involved in research and monitoring will play an important role in the future evolution of this strategy through the adaptive management process.

Table 1. Estimated miles of rivers and streams in the five Westside HCP planning units covered by the Riparian Forest Restoration Strategy. For this estimate, water types in this table are *upgraded* [1] from those defined by the Washington Forest Practices Emergency Rules WAC 222-16-030 (Washington Forest Practices Board November 1996)

HCP Unit	State Trust Land (acres)	Stream Miles by Water Type				Total Miles of Stream	Percent Stream Miles
		1	2	3	4		
North Puget	381,516	154	52	1,144	1,744	3,094	28%
South Puget	141,844	41	14	271	845	1,171	10%
Columbia	267,530	101	7	715	2,519	3,342	30%
Straits	110,222	21	17	210	383	631	6%
South Coast	232,931	78	25	711	2,102	2,916	26%
Total	1,134,043	395	115	3,051	7,593	11,154	100%
Percent		4%	1%	27%	68%	100%	
Estimated Acres of RMZ		**13,885**	**3,688**	**97,325**	**158,912**		

Data Source: DNR Data Sustainable Harvest Calculation Final EIS July, 2004

[1] Water types 1, 2, and 3 are waters that may contain salmonids. Type 4, 5 and 9 are smaller waters that do not have salmonids. Water types were upgraded by assuming all Type 4 streams would have Type 3-stream HCP protection. Type 5 and 9 waters were assumed to be Type 4 streams and have Type 4 stream HCP buffers. Buffer areas were calculated using an average site tree potential of 145 on each side of types 1, 2 and 3 streams. Streams designated as type 4 had a 100-foot buffer on each side. Types 1 and 2 streams had an additional 50-foot wind buffer on each side. Type 3 streams had a 25-foot wind buffer on each side.

Long-term Riparian Habitat Restoration Goal

Under the HCP, the long-term goal is to manage for structurally complex riparian forests—assumed to be equivalent to the ecological definition of old growth conditions (Old Growth Definition Task Group 1986) or the "Fully Functional" development stage (Appendix 1). This old growth-like forest condition may require 200 to 400 years to develop. Structurally complex riparian forest conditions are characterized by an overstory dominated by very large diameter trees, high leaf areas characteristic of multistoried stands, high rates of productivity resulting in large amounts of fine and coarse woody debris, and a well developed understory. It is assumed that these forests will best support all riparian ecosystem functions required for salmon habitat recovery.

The long-term target for Riparian Management Zones can be most simply illustrated by distribution of tree diameters.

The long-term target for Riparian Management Zones can be most simply illustrated by ranges of tree diameters. These diameter ranges would be expected to vary by, and within, a forest zone depending on the soil and climatic regime. Figure 2 represents a hypothetical example of the distribution of tree sizes in a competitive exclusion and structurally complex stand. Diameter distributions will vary by site class. Therefore, site characteristics need to be considered in designing restoration efforts.

The long-term goal for RMZs is based on the assumption that forests having structurally complex characteristics will support desirable aquatic habitat, and thus aid riparian-obligate species and salmon habitat recovery. This hypothetical diameter distribution provides a long-term target against which potential riparian forest restoration can be evaluated. However, this long-term riparian forest condition goal offers an insufficient measurement against which to evaluate short-term progress toward the goal.

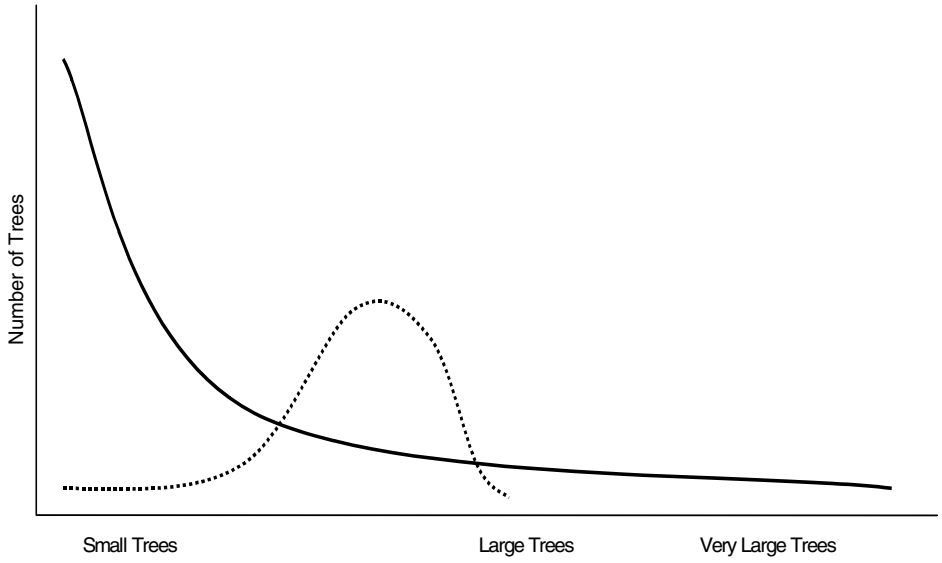


Figure 2. Hypothetical example of the distribution of tree sizes [diameter at breast height (DBH)] in a Competitive Exclusion condition (dashed line), a common current condition, and the diameter distribution of an older stand that would meet the management goal of the Fully Functional forest development stage (solid line).

Riparian Desired Future Condition

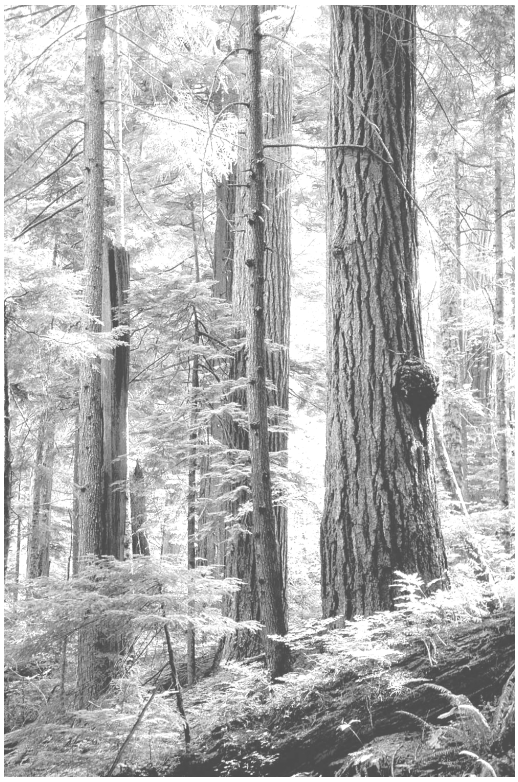
Managers need some measurable targets to assess opportunities and progress toward the long-term management objective. The riparian desired future condition (RDFC) provides that objective. The riparian desired future condition is divided into five categories representing the most important components for developing the Fully Functional forest development stage, and therefore the long-term restoration goal:

- Large conifer trees
- Complex stand structure
- Site-adapted tree species composition
- Down wood (DWD and LWD)
- Snags

The riparian desired future condition will result in riparian forests that resemble the Developed Understory to Niche Diversification stages (Appendix 1). Some elements of Fully Functional forest characteristics will begin to emerge in forests in this condition, but not all the elements of a structurally complex forest will be present. Specific, measurable threshold targets for developing the riparian desired future condition into Forest Management Unit objectives and for assessing management progress (Table 2) were developed from descriptions of the Developed Understory to Niche Diversification stages (Carey and Curtis 1996 and DNR 2004, page B-34). The RDFC is not a rigorously defined forest development stage, but rather a benchmark for which managers can measure progress toward a structurally complex forest that will have many of the minimal elements to support a broad range of riparian ecological functions. Depending of the site productivity, it may take hundreds of years to reach the forest complexity of the Fully Functional stage. Franklin et al. (2002) describes in detail the genesis of both horizontal and vertical complexity in living and dead tree structures that characterize older forests in the Pacific Northwest that would meet our management goal for riparian forests. DNR has elected to manage passively riparian stands that cannot be reasonably accelerated to the desired conditions.

Table 2. Riparian Desired Future Conditions threshold targets

RDFC Characteristics	RDFC Threshold Targets (Discrete Measurables)
Basal area	≥ 300 sq ft per acre
Quadratic mean diameter (Trees >7 inches DBH)	≥ 21 inches
Snags	Retain existing snags ≥ 20” DBH through no-cut zones Maintain at least 3 snags per acre
Large down wood	Maintain ≥ 2,400 cubic feet/ac Actively create down wood (contribute 5 trees from the largest thinned DBH class) during each conifer management entry
Vertical stand structure	Maintain at least two canopy layers (bimodal or developing reverse J-shaped diameter distribution)
Species diversity	Maintain at least two main canopy tree species suited to the site



Older forests have considerable heterogeneity in their structure.

Because the presence of large trees and a complex riparian forest stand structure are key to supporting riparian functions, it is logical to use tree size distribution (Fig. 3) as a central metric to measure initial progress toward the riparian desired future condition. However, a single stand structure for the riparian desired future condition objective is impossible to quantify. The RDFC will contain two or more canopy layers leading toward a diameter distribution that can generally be described as bi-modal to emerging reverse-J-shaped; the desired condition includes a basal area target of 300 square feet per acre and a quadratic mean diameter target of 21 inches (for trees greater than 7" DBH).

Initial stand composition will determine the appropriate silvicultural treatment, within the defined sideboards, to best reach the RDFC. In addition to specific threshold targets, descriptive objectives outlined in the specific treatments section (Section 2) based on current stand conditions are intended to further enhance stand structure and therefore decrease the time required to reach the desired riparian condition.

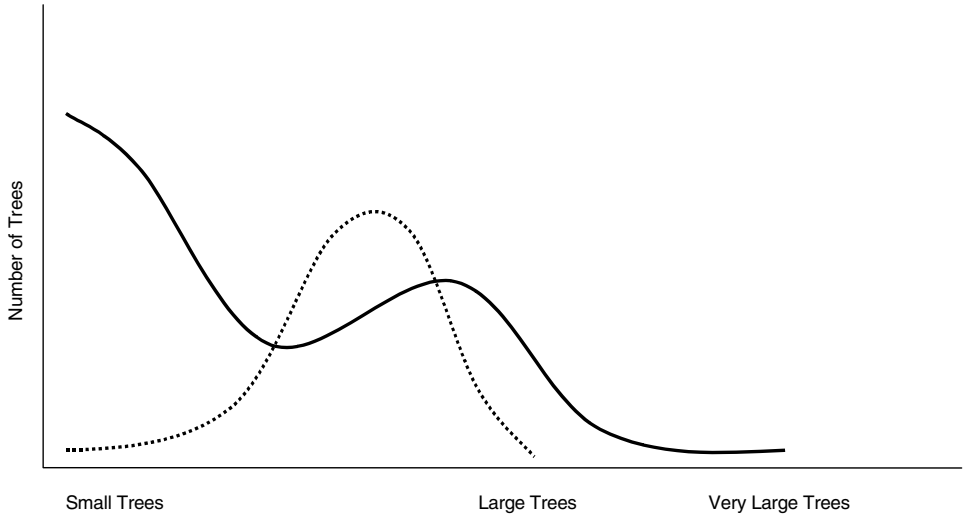


Figure 3. Hypothetical example of the tree diameter distribution for forest stands in the Competitive Exclusion Stage (dashed line) and for stands meeting the riparian desired future condition (solid line).

Down woody debris often is lacking from the forest floor of riparian forests due to their timber management history. Sedell et al. (1988) concluded that most of the down wood input to streams at young-growth sites came from red alder. The input of conifer debris is slow and does not increase until about 60 years after logging disturbance. This is probably due to the fact that red alder dominates the streamside vegetation while conifer basal area increases with distance from the stream (Pabst and Spies 1999). Several studies (McDade et al. 1990, Van Sickle and Gregory 1990) indicate that most down woody debris recruitment into the stream comes from within the first 30m (100') exponentially

decreasing with distance from the stream. Source distance of large woody debris varies also with stand age. In younger stands (<80 years), 50 percent of the input events take place within 3-4 m of the stream and 90 percent within 14 to 20 m (Meleason et al. 2002). Therefore, the first 25 feet, the no-harvest inner zone outside the 100-year flood plain, will provide a significant amount of the natural levels of down woody debris and large woody debris in younger stands that are the primary target of restoration treatments. Since the highest priority for restoration in this strategy is conifer young-growth sites, an opportunity exists to significantly enhance levels of conifer DWD and LWD during commercial harvest of trees in the area. The RDFC includes, therefore, provisions to start the additions of DWD to the forest floor of riparian areas or additions of LWD to streams where appropriate and feasible. When restoration treatments cease and recruitment of conifer LWD increases from greater distances from the stream channel, a source of large diameter conifer recruits will be available through early restoration thinning.

Down wood contributions to the RMZ are intended to jump-start fluvial processes and habitat complexity.

During a commercial harvest entry, a total of five trees per Riparian Management Zone acre will be dedicated toward dead wood goals (Exception: one tree per acre if the entry removes 15 trees per acre or less, as in a pole sale.) Placement and distribution of down woody debris should be consistent with the goal of increasing habitat complexity. Managers should strive to distribute this woody debris throughout the RMZ and increase instream large woody debris through directional falling of trees toward the stream. (A Hydraulic Project Approval from the Washington Department of Fish and Wildlife may be required for instream LWD placement.) The intentional and directional falling of live green trees from the largest thinned diameter class will place high quality DWD (decay resistant species, green wood, large diameters) where needed for forest restoration. It is assumed that these down wood levels also will be supplemented with natural mortality between restoration treatments. Provisions are also in place to develop a site-specific DWD strategy in the event of windthrow salvage. (See Operational Guidance under Salvage)

Snags are an important part of meeting the HCP riparian and upland conservation objectives. They provide important habitat for riparian species and serve as recruits for instream LWD. The number and size of snags varies greatly depending on stand history. As with down wood, the time required to develop forests to the riparian desired future condition is insufficient to develop snags consistent with Fully Functional forests. Rentmeester (2004) showed, however, that thinning from below increased production of large diameter snags (>50 cm) by 28-74 percent over a “no touch” silviculture and therefore enhanced potential of LWD recruitment.

Management guidance is provided to protect large existing snags (≥ 20” DBH, ≥16’ height) or areas that are unusually rich in snags within riparian forests. The falling of snags is part of standard safety practices. These safety practices are legally required and supercede wildlife habitat concerns. Therefore, no-cut zones within the riparian buffer are a necessary part of the conservation and restoration of snag habitat and snag dependent species. Active creation of snags is encouraged in all commercial harvest entries. Up to two of the five trees designated for dead down wood will be considered for snag creation either through topping with mechanical harvesting equipment (above 20’) or other means, such as girdling in older stands (age greater than 40) when less than 3 snags per acre exist. It is assumed that snags will develop naturally over time through abiotic or biotic disturbance. Other venues to create snags, for example through federal grants, may arise and are encouraged.

Riparian desired future condition management objectives allow for a flexible approach to meet desired long-term conditions. RMZs that have reached the RDFC are assumed to be on a trajectory toward the long-term goal of Fully Functional conditions. When an adequate stand diameter distribution (such as in Figure 3) and thus the quadratic mean diameter (QMD) threshold target have been reached, stands will be assumed to have reached the RDFC. Such stands will lack the tree size and, likely, the stand structure and forest composition of Fully Functional forests, but these characteristics are assumed to develop over time.

The Application of Riparian Restoration

When Riparian Restoration is Appropriate

There are two basic situations that might motivate restoration activities in riparian forests. These situations are characterized by different stand conditions and involve different silvicultural treatments.

The first situation occurs when a riparian conifer forest in the stem exclusion stage could be thinned to accelerate tree diameter growth, thereby decreasing the time until large diameter wood is available to be delivered to the stream, and advancing stand structure and composition toward the riparian desired future condition. A riparian forest of this type is typically a result of clear-cut timber harvest that occurred 20 to 50 years previously.

Thinning to accelerate diameter growth is a common silvicultural treatment. The response of stands to thinning is well understood. Nearly all silvicultural research on thinning has been conducted in these forests upland of the riparian areas. While there is little question whether trees will respond with the expected accelerated diameter growth, there are other unknowns, which are unique to forest management in riparian areas. For instance, there may be an increase in the rate of windthrow. Altering the rate of windthrow would change a critical interaction between terrestrial and aquatic ecosystems—that is, the recruitment of instream large woody debris. Windthrow risk is difficult to assess because the factors affecting it are very diverse. Physical characteristics (soils, topography, water table, weather, etc.) are the main forces influencing windthrow risk. Stand thinning could potentially increase windthrow risk and other riparian functions in the short-term, and will be subject to research and adaptive management.

Modeling of the proposed thinning treatments will help foresters design a relative density (RD) target for a specific stand considering the existing canopy structure and the potential gains in diameter growth, down wood contribution, and future diameter distribution. While activities involve site-specific (short-term) risk, such as elevated levels of windthrow or sediment delivery, it is important to consider that inaction also involves risk to the riparian habitat resulting from slower restoration rates. Inaction can greatly delay stand development toward the riparian desired future conditions, as well as reduce the ability of the riparian buffer to provide important ecological functions.

The second situation in which riparian restoration may be appropriate is when a riparian forest is dominated by deciduous trees, typically red alder. Such stands, with a hardwood basal area of greater than 50 percent, might be manipulated to bring about a "conversion" to coniferous trees. The ultimate goal is to cultivate a forest that contains large diameter conifers. It is thought that this type of restoration will be appropriate at many sites. The presence of old conifer stumps clearly shows that at one time a conifer forest occupied these sites; the red alder-dominated riparian area is likely the aftermath of past forestry practices. If left untreated, many of these red alder-dominated stands may be replaced by salmonberry, rather than conifers (Hibbs and Giordano 1996).

When Riparian Restoration is Unsuitable

Not all forests within Riparian Management Zones are capable of supporting conifer forests of the desired future condition. By policy, areas within the 100-year flood level and the inner 25-foot no harvest zone, are not candidates for restoration. Forests within the middle and outer riparian zone and wind buffers (DNR 1997 IV. 62) are potential restoration candidates.

Riparian forests on excessively wet and/or unstable soils or those subject to frequent disturbance are naturally dominated by hardwoods and should not be targeted for restoration. Site characteristics such as plant association and unstable slope determinations will be used to identify areas that are unsuitable for riparian restoration.

This riparian forest is growing toward a full function with components such as large conifer trees in a complex stand, site-adapted tree species and large down wood in and out of the water.

Stands that have already met the riparian desired future conditions quadratic mean diameter and basal area targets will not be eligible for restoration. These stands already resemble the Developed Understory to Niche Diversification stages for stand development, with the exception that not all elements of the structure may be present. Stands that have met these QMD and BA targets can receive management directed toward enhancing additional structural features such as snags or down wood. Additional commercial thinning of riparian areas that have reached the riparian desired future condition must have written concurrence by the Riparian Forest Restoration Strategy Technical Review Committee, may need to be addressed through the HCP amendment process, and are subject to the Adaptive Management phase of this strategy. See Section 4, "Implementation and Adaptive Management" for further information.

Scope of this Guidance

The following Riparian Restoration Strategy actions define the bounds of accepted treatments to advance riparian stands toward the riparian desired future condition. Once the decision is made to enter a Riparian Management Zone to carry out silvicultural activities, these guidelines are to be followed. Additional management within the RMZs, such as in-channel large woody debris placement, is discretionary. The following management guidance (Section 2) defines the criteria to conduct riparian restoration, and the criteria to develop restoration plans when operationally and economically feasible. These stand criteria need to be met when DNR is considering riparian restoration to increase the rate of stand development toward the desired future condition.

Section 2

Riparian Management Strategies

Riparian Management Zones and the Riparian Conservation Strategy

DNR's trust land Habitat Conservation Plan riparian management strategy consists of several parts (DNR 1997 IV.56). The prominent feature is the designation of Riparian Management Zones (RMZs) on specific stream types. The stream typing methodology described below will be followed when carrying out forest management activities in RMZs on HCP lands within the five Westside HCP planning units. All streams will be field verified (typed) before planning any restoration activities.

Typing of Streams

DNR and the Federal Services (U.S. Fish and Wildlife Service, and National Oceanic and Atmospheric Administration Fisheries) have agreed the Washington Forest Practices Board Emergency Rules (stream typing), November 1996 (WAC 222-16-030) meet the intent of DNR's trust lands HCP. This stream typing system will now be officially referenced as the "Water Typing System for Forested State Trust HCP Lands." In the future, DNR may modify its stream typing strategy as new information becomes available. Any eventual changes to the stream typing methodology would be subject to review and concurrence by the Federal Services.

DNR will implement all aspects of its riparian conservation strategy as well as other strategies that require stream typing using this water typing system. See Appendix 3 for the full text. The following is a summary of the pertinent details of the typing system. Use them as guidance for field methods such as stream width determinations.

Type 1. Streams inventoried and classified as "Shorelines of the State."

Type 2. Streams that are known to be used, or have been identified being used, by resident or anadromous fish species.

Type 3. Stream segments having a defined channel (with scour) of an average of 2 feet or greater in width between the ordinary high-water marks; and having a gradient of 16 percent or less; or

Stream segments having a defined channel (with scour) of an average of 2 feet or greater in width between the ordinary high-water marks; and having a gradient greater than 16 percent and less than 20 percent; and having greater than 50 acres in contributing basin size, based on hydrographic boundaries.

Type 1-3 streams are to be considered as fish bearing, and are assumed to be used by a significant number of resident and/or anadromous fish species.

These stream-typing characteristics may be modified on a site-by-site basis under the following circumstances:

(a) Waters have confirmed, long term, naturally occurring water quality parameters incapable of supporting anadromous or resident fish;

(b) Snowmelt streams have short flow cycles that do not support successful life history phases of anadromous or resident fish. These streams typically have no flow in the winter months and discontinue flow by June 1; or

(c) Sufficient information about a geographic region is available to support a departure from the characteristics listed above, as determined in consultation with the Department of Fish and Wildlife, Department of Ecology, the affected Tribes and other interested parties.

Type 4 Stream segments are non-fish-bearing and have a defined channel (with scour) of 2 feet or greater in width between the ordinary high-water marks; and having a gradient of 20 percent or greater.

Stream segments having a defined channel (with scour) of an average of 2 feet or greater in width between the ordinary high-water marks; and having a gradient greater than 16 percent and less than 20 percent; and having less than 50 acres in contributing basin size, based on hydrographic boundaries.

Type 5 Streams are significant stream segments that are less than 2 feet in width from the ordinary high-water marks and may be headwaters of streams, seeps or wet areas, or those stream segments that may go subsurface. Type 5 streams are to be considered as non-fish-bearing.

Application of Riparian Management Zones

When riparian ecosystems are encountered during forest management activities, the protection of the habitat of salmonids and riparian obligate species is of the highest priority. Riparian Management Zones will be left on Type 1, 2, 3, and 4 Waters; unstable slopes will be protected on all Type 1-5 Waters.

On Type 1-3 streams, DNR must maintain a proper RMZ width greater than or equal to the average height that an adjoining upland conifer stand would be expected to reach at age 100 years (breast height age) or 100 feet, whichever is greater, measured at a horizontal distance from the outer edge of the 100-year floodplain (see Determination of "Site Potential Tree Height" below). On any Type 4 stream, DNR must maintain an RMZ width of 100 feet or greater, measured at a horizontal distance from the outer edge of the 100-year floodplain.

All Type 5 Waters that flow through an area with high risk of mass wasting must be protected as per the unstable slope guidance. During the first ten years of the HCP, all other Type 5 streams (those not on areas associated with unstable slopes) must be protected "when necessary for water quality, fisheries habitat, stream banks, wildlife, and other important elements of the aquatic system" (DNR 1997 IV. 59 and 79).

Research to support the development of a long-term Type 5 stream conservation strategy is underway. By 2007, a long-term conservation strategy will have been developed for

Type 5 streams. In the interim, Type 5 streams should be afforded the following protection:

1. No equipment should pass across, within, or through these stream segments, where possible.
2. Trees should be directionally felled away from these stream segments.
3. Where operationally feasible, leave trees should be retained adjacent to these stream segments to provide protection of water quality, stream bank integrity, and wildlife habitat.

All of the RMZs are applied to both sides of the stream. Therefore, the total width of an RMZ may be two times the values listed in Table 3.

Additionally, wind buffers may apply. Wind buffers shall be applied to Type 1, 2, and 3 Waters in areas that are prone to windthrow. Wind buffers are applied in areas of moderate and high windthrow potential. Physical evidence of windthrow and windthrow models will guide the placement of wind buffers along Riparian Management Zones (DNR 1997 IV 59). To determine if wind buffers should be applied, foresters will rely on one or more of the following list of resources:

- Physical evidence of windthrow on or near the proposed restoration site
- Local knowledge and experience in this area in regards to windthrow potential
- Windthrow assessment guides such as the BC Ministry of Forestry Windthrow Handbook
- Consultation by region or division silviculturist

Table 3: Widths of buffers for one side of Riparian Management Zones.

Buffer Type	**Buffer Width by Stream Type (shows one side of stream only)**			
	1&2	**3**	**4**	**5[b]**
Riparian	*"site potential*[a] *tree height of mature conifer"* SI_{100}: avg. ~145 ft Minimum 100 ft Maximum 215 ft	*"site potential tree height of mature conifer"* SI_{100}: avg. ~145 ft Minimum 100 ft Maximum 215 ft	100 ft	*When necessary* *Guidelines pending*
Wind	*applied only in areas prone to windthrow*: 100 ft	*applied only to streams > 5 ft wide and only in areas prone to windthrow*: 50 ft	None	None
Total RMZ	Minimum 100 ft avg. ~145 ft Maximum 315 ft	Minimum 100 ft avg. ~145 ft Maximum 265 ft	100 ft	Unknown

[a] Site potential height of mature conifer is defined as the height of the tallest 40 trees per acre at 100 years (SI_{100})

[b] DNR is conducting research to investigate adequate protection of Type 5 Waters.

DETERMINATION OF "SITE POTENTIAL TREE HEIGHT"

Riparian Management Zone width is indexed by "Site Potential Tree Height" of mature conifers for Type 1-3 Waters. The Interagency Science Committee (Cederholm et al. 1999) defined the "Site Potential Tree Height" as the base age 100-year site index for the dominant conifer species. DNR will rely on the Forest Land Grading Program when mapped site index is based on the soil series, or at the Department's discretion, the Forest Resources Inventory System (FRIS) site index or measured site index to determine the "Site Potential Tree Height" using the SI_{50} at age 100.

Delineating Riparian Management Zones for Restoration

The state trust lands HCP specifies the subdivision of the riparian area into three zones and describes the functions of each zone (DNR 1997 IV. 59). Within the first 25 feet of a stream no harvest shall occur to primarily maintain stream bank stability. The next 75 feet of the RMZ are considered a "minimal harvest area" so that activities do not "appreciably reduce stream shading, the ability of the buffer to intercept sediment, or the capacity of the buffer to contribute detrital nutrients and large woody debris." The remaining portion of the RMZ (more than 100 feet from the active channel margin) is considered a "low harvest" area. These three zones will be referred to as the inner (first 25 feet), middle (up to 100 feet), and outer zone on Type 1-3 Waters, and as the inner (first 25 feet) and outer zone (up to 100 feet) on Type 4 Waters.

The operational guidance described in this document combines the middle and outer zone for Type 1-3 Waters. By managing the middle and outer zone together, DNR is striking a balance to provide both efficient operations and assurance of ecological function. The silvicultural prescriptions of the Riparian Forest Restoration Strategy are designed to meet the objectives outlined in the HCP for the middle zone. Furthermore, if the zone beyond 100 feet from the stream had to be identified and managed separately, that added effort and cost would likely delay effective riparian restoration at most sites.

Maintaining Ecological Function

The most important recognized functions of riparian areas include large woody debris recruitment, leaf and needle litter recruitment, stream shade, microclimate, stream bank stability, and sediment control (Scientific Committee Recommendations, Cederholm et al. 1999, Final Environmental Impact Statement on Alternatives for the Forest Practices Rules for Aquatic and Riparian Resources, Washington State Forest Practices Board, 2001, Policy for Sustainable Forests Draft EIS 2005). DNR believes that the largest measure of riparian ecological function will be provided by unmanaged riparian vegetation and soils within the 25-foot inner zone, and where present, the 100-year floodplain. The extent and intensity of site disturbance resulting from prescribed riparian restoration utilizing thinning and biodiversity pathway techniques in the middle and outer zones beyond 25 feet would, in all instances, be minimal and provide a high likelihood of attaining the goals set for ecological functions. Chan et al (2004) reported that they "were unable to detect significant effects of either buffer width or upland density management on streambed water temperature, or air temperature and relative humidity within the first 15 feet of the stream center," when conducting biodiversity pathway

thinnings in 40- to 60-year-old Douglas-fir riparian stands in western Oregon. When thinning to RD 35 or above, light levels were similar to those in unthinned stands, approximately 10 percent of light in the open. Newton et al. (1996; in Emmingham et al. 2000) also suggest that "thinning just outside a narrow no-cut buffer of 6–9 m (20–30 feet) would have minimal impact on stream shading (on the north side of streams)." Stream temperature is not influenced by direct solar radiation alone but by many factors such as latitude, altitude, season, channel width and depth, and groundwater flow (Forest Practices Board, Final EIS 2001). Cross (2002) developed a mathematical model suggesting that managing riparian forests for height was the most important management tool to influence direct solar radiation as diffuse radiation has no capacity to directly affect stream temperature. Therefore, DNR's proposed restoration activities involving thinning in riparian stands, which will retain the largest trees and residual densities generally greater than RD 35 outside a 25-foot inner zone will maintain shade and microclimates not significantly different from unthinned stands.

Thinning intensity and pattern need to be moderated by considering the risks of windthrow.

Riparian stands undergoing hardwood conversion, which involves the removal of hardwood species outside the inner zone while maintaining all conifers, is likely to continue to provide many riparian functions including stream bank stability, leaf and needle litter recruitment and sediment control. Other functions may be significantly impacted such as stream shading and microclimate. Temperature, critical to fish habitat, is influenced by many variables. "Average daily stream temperatures are regulated by many factors: ambient air temperature, relative humidity, groundwater influx, stream channel morphology (including discharge rate), and substrate composition (Adams and Sullivan 1989, Brown 1969, Byram and Jemison 1943, NCASI 2000, Patton 1974). Solar radiation has a relatively small impact on daily mean stream temperatures (Adams and Sullivan 1989). However, solar radiation is most responsible for deviations from average daily temperatures (Adams and Sullivan 1989, Ice 2001), and is almost the only factor that can be controlled by (active or passive) forest management" (RTI 2002).

The effectiveness of the inner zone buffer in providing stream shading will depend mainly on stream orientation and width, buffer location and height of the buffer. Conversions located on the north side of streams will have a minimal impact on stream shading as will conversions along small streams. Newton and Cole (1998) reported that "streams buffered only on the south side with 40' screens of shrubs and trees did not change temperature patterns from pre-logging conditions despite logging along half-mile reaches to the water's edge on the north sides" for seven low-elevation Westside streams in Oregon. Therefore, conversions will require a case-by-case analysis of the potential impacts to riparian functions, in particular stream shading. To mitigate potential significant negative impacts, the inner zone may be expanded beyond 25 feet or additional hardwood trees may be retained outside the 25-foot inner zone. Emmingham et al. (2000) recommend residual red alder spacing of not less than 30 feet and gaps no smaller than ½ acre to establish conifers without any additional, future release treatments.

Hardwood conversions will generally balance negative short-term impacts to riparian functions such as stream shading and changes in microclimate with long-term enhanced functionality of pool-forming, long-lasting LWD, enhanced shade and stream bank stability.

For all management scenarios, the 25-foot inner zone will be expanded on a site-specific basis as necessary to protect riparian associated wetlands and to maintain post-treatment

shading of streams and other functions such as root strength of leave trees. The most common situation will be one of low tree density within the riparian inner zone. Because of low tree density, some of the function that would normally be provided within 25 feet may have to come from beyond the 25-foot zone.

Site-Specific Management

All management within Riparian Management Zones must be site-specific, i.e., tailored to the physical and biological conditions at a particular site. Management activities in RMZs must maintain or restore the quality of salmonid and riparian obligate species habitats; but due to variation in site conditions, the intensity of management and site response is expected to vary. As in the case of upland thinning prescriptions, existing stand conditions and site characteristics such as plant association or plant association group will be used to tailor specific prescriptions and provide an ecological context for documenting treatment response. Restoration in riparian areas along stream reaches with temperature-sensitive fish species will provide adequate post-treatment shade for protecting water temperature. Site-specific management will necessarily protect important features and, in many situations, result in management of only part of the entire RMZ.

In addition, tribal staff, Department of Fish and Wildlife biologists, and Department of Ecology staff will have local habitat and species information that could be useful for developing site-specific riparian prescriptions. DNR field managers are encouraged to contact other agencies and Tribes for additional site-specific information.

Monitoring Riparian Restoration

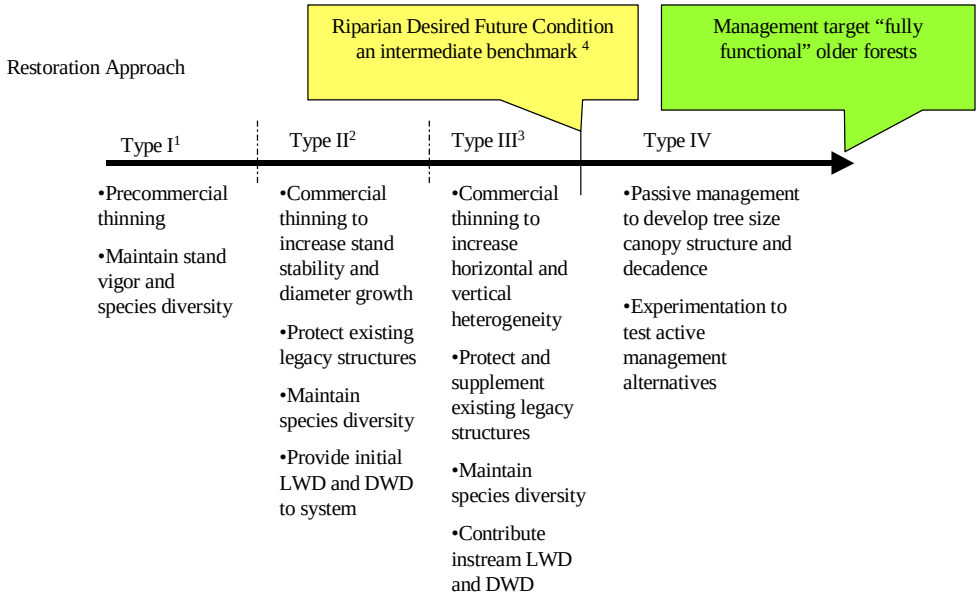
The trust lands HCP requires DNR to evaluate how well the riparian conservation objectives are met by the site-specific implementation of the riparian strategies (DNR 1997 V.1). Upon approval, this and other HCP strategies will be subject to compliance monitoring. DNR intends to apply commercial silvicultural treatments to a maximum of 1 percent of its riparian areas annually for the Westside planning units outside the OESF. Detailed riparian effectiveness monitoring plans have been drafted and will be reviewed by the Federal Services (Pollock et al. 2001, Wilhere and Bigley 2001a, 2001b). Scientifically valid monitoring of these activities will require controls and randomized sampling. Forestry activities will be randomly selected for monitoring, and a portion of the riparian buffer will be randomly selected to serve as an untreated control area. In 2009, DNR will provide a detailed implementation report to the Services on the status of the Riparian Forest Restoration Strategy. Section 4 provides a summary of the monitoring strategies and tactics.

Silvicultural Treatments

The long-term riparian habitat restoration goal is a structurally complex riparian forest, known as the Fully Functional forest development stage. Since this condition may evolve over centuries, DNR management is directed toward attainable intermediate objectives represented by the riparian desired future conditions threshold targets (Table 2). The main objective of silvicultural activities will be to put the RMZ on an accelerated trajectory toward the riparian desired future conditions. Figure 4 summarizes how different silvicultural treatments will move stands from the Sapling Exclusion Stage to the RDFC and

how passive management (Type IV stage) will then eventually lead to the long-term goal of Fully Functional forests. Management activities are classified by the stand development stages they will be taking place in: Type I treatments will be in non-commercial stands in the Sapling Exclusion Stage, Type II treatments in the Pole Exclusion Stage and Type III treatments in the Large Tree Exclusion or Understory Reinitiation Stage. Silvicultural treatments will be site-specifically designed to accelerate attainment of the desired stand condition and composition, and incorporate an assessment of risk. Silvicultural tools will include individual tree selection, thinning, group selection (small canopy gaps), down woody debris and snag creation, and patch cuts in hardwood-dominated stands. Prescriptions will take into consideration minimizing short-term impacts to riparian functions to achieve long-term, enhanced functionality. Management of riparian stands will only take place if management activities, within acceptable risk parameters, would decrease the time required to meet stand-specific riparian objectives in comparison to the no treatment option. Silviculturists will train field staff and/or conduct analyses for them.

When conducting riparian restoration activities, attention must be given to the promotion of spatial variability and species diversity within the riparian area. The goal is to attain a stand condition that contains vertical and horizontal heterogeneity and structural complexity similar to the stand conditions found in the Niche Diversification and Fully Functional stand development stages. It is recommended that the application of variable density thinning techniques be applied to the riparian area to promote heterogeneity in understory development, tree spatial and species variability, as well as maintain special landscape attributes (snags, wet areas, down woody debris).



[1] Stands with no or little existing structure in Sapling exclusion

[2]Stands with little existing structure in Pole exclusion

[3]Stands with some existing structure in Large tree exclusion and Understory Reinitiation

[4]Commercial thinning will cease before reaching the RDFC as restoration treatments have to accelerate the development towards the RDFC targets.

Figure 4. Illustration of DNR's Riparian Forest Restoration Strategy with different silvicultural treatments (Type I, II and III) to reach the riparian desired future condition, and passive management (Type IV) to reach the long-term objective of the Fully Functional forest development stage.

Pre-commercial Silviculture Treatments

It is expected that most riparian management entries will be conducted coincident with adjacent upland management entries, such as pre-commercial thinning, commercial thinning, individual tree selection, group selection, patch cutting, or final harvest. On a given site, conducting silvicultural activities in riparian stands coincident with adjacent upland activities will offer new management opportunities. It is anticipated that most riparian stands can be significantly advanced toward the riparian desired future condition with only one or two management entries. Should a stand require more than two commercial management entries within the 70-year HCP planning period, consultation with appropriate specialists and prior approval by the HCP Implementation Management and consultation with the Federal Services will be required. Silvicultural prescription guidelines are grouped into pre-commercial treatments and commercial prescription categories by forest type (conifer and hardwood).

The selection of site-adapted species is paramount in meeting the restoration objectives.

Riparian stands may require silvicultural treatments at a relatively young age. In fact, the first few years (Ecosystem Initiation Stage) might be the most important development phase toward meeting the riparian desired future conditions. DNR will need to consider:

- Adequate forest stocking through planting density,
- Site preparation,
- Species composition,
- Vegetation management (controlling competing vegetation), and
- Pre-commercial thinning (Type I thinning).

The selection of site-adapted species is paramount in meeting the restoration objectives. Type I thinning activities may take place inside the inner zone to the edge of the 100-year flood plain. Other non-commercial activities, such as underplanting, noxious weed control or supplementing of down woody debris or large woody debris instream may also take place in the inner zone.

Commercial Silvicultural Treatments

In general, commercial silvicultural treatments will take place in the riparian zones with trees in competitive exclusion stages of development. To facilitate development of silvicultural prescriptions for commercial treatments, DNR has identified two broad conditions under which riparian stands would be entered (discussed above). This would result in a total of five general management scenarios (Table 4, and Appendix 5). These five management scenarios were chosen because they represent the best opportunities for riparian forest enhancement activities compatible with other DNR upland management activities. This synchronized approach ensures that upland areas are not disturbed on multiple occasions.

Conifer stand prescriptions are delineated according to structural development stage, because objectives likely differ between the Pole Exclusion Stage and later stages (Large Tree Exclusion, Understory Reinitiation) of stand development. Silvicultural treatments in the Pole Exclusion Stage will primarily focus on accelerating diameter growth and maintaining species diversity and are referred to as Type II thinnings. Type II thinnings generally occur in stands below 40 years in age and represent plantations established after

regeneration harvest. Treatments in the later structural development stages, which will focus mainly on creating horizontal and vertical heterogeneity and structure, are referred to as Type III thinnings.

The Technical Review Committee has had extensive discussions regarding the use of stand age to determine an upper threshold when Type III thinnings would not be appropriate. The use of stand age to determine this threshold can be difficult to estimate and can be a deceiving measure for describing the conditions of a forest stand. While age class is useful for describing the conditions of an even-aged forest managed for timber production, it is not considered useful for describing the ecological conditions of a forest when managing for structural and biological diversity. However, to take a conservative approach when applying these Riparian Forest Restoration Strategies, the Technical Review Committee recommended Type III thinnings only occur in stands less than 70 years of age. If appropriate, thinning activities may occur in stands greater than 70 years of age with written approval from the HCP Implementation Manager and in consultation with the Federal Services. This approach to thinning older stands will be reviewed by the Technical Review Committee at the end of the three-year implementation period.

Each scenario contains certain levels of risks and opportunities, which will be outlined in the silvicultural prescription specific to each site and scenario. A given management scenario must be compared to the no treatment option to determine if progress toward the riparian desired future conditions will be made.

Table 4. Riparian management scenarios

Conifer Dominated Stands (Conifer Basal Area >50%)	**Hardwood Dominated Stands** (Conifer Basal Area <50%)
▪ No commercial treatments required – Riparian Stand on Pathway to RDFC	▪ No commercial treatments required – Riparian Stand on Pathway to desired future conditions
▪ Type II (little existing structure) RMZ Thinning with Upland Thinning	▪ Individual Conifer Release
▪ Type III (some existing structure) RMZ Thinning with Upland Thinning	▪ Conversion to Conifer Dominated Forest
▪ Type III RMZ Thinning with Upland Regeneration	

Disturbance of the inner 25-foot zone will be restricted to road crossings and yarding access, as specified in the operations guidance. Other activities, such as underplanting of shade tolerant conifers, noxious weed control, release of suppressed understory conifers or supplementation of down woody debris or large woody debris in or across streams may also take place in the inner zone. Restoration of in-channel salmonid habitat may take place in coordination with the DNR HCP Implementation Manager, and with written approval from the appropriate regulatory authority.

Site considerations influencing potential impacts to stream temperature, sediment delivery, and water temperature will be carefully evaluated. This will include contributing wetlands, groundwater inputs, east-west orientation, and elevation. Before conducting commercial silvicultural treatments in RMZs, a biologist or riparian strategy region designee should be consulted to assess potential impacts to riparian functions.

Specific Silvicultural Prescriptions

DNR's riparian restoration activities will focus on: 1) growing large conifer trees; 2) enhancing structural complexity; 3) attaining a site-adapted species composition dominated by conifers; 4) providing DWD and instream LWD; and 5) creating snags. Therefore, silvicultural activities will primarily consist of thinnings and down woody debris enhancements in conifer-dominated stands, and patch cuts (followed by planting of conifers) in hardwood-dominated stands. Experience from upland thinnings and riparian treatments in the OESF indicate that a moderate intensity of thinning, i.e., to residual RD levels of 35 to 40, will move riparian restoration toward interim conditions faster than light thinning, i.e., RD >40, and provide ecological benefits for approximately 15 to 20 years, depending on site class.

Insteam structural legacy trees often control stream fluvial processes and habitat structure.

Nevertheless, even with moderate thinning, some riparian stands may re-enter the competitive exclusion stages within one or two decades after treatment before they reach the riparian desired future condition. Where appropriate, small gaps may be used in conifer-dominated stands to hasten the development of a more complex vertical stand structure. Gaps are an uneven-aged management method to create structural heterogeneity and should be, in general, 0.25 acres in size or less. Gaps shall only be used outside the 100-foot zone from the 100-year flood plain. Patch cuts, in contrast, are an even-aged regeneration method and will only be used in the hardwood conversion scenario. Patch cuts will not exceed 2.5 acres and will be outside the inner riparian zone.

As previously stated, when conducting riparian restoration activities, attention must be given to the promotion of spatial variability and species diversity within the riparian area. The goal is to attain a stand condition that contains vertical and horizontal heterogeneity and structural complexity similar to the stand conditions found in the Niche Diversification and Fully Functional stand development stages. It is recommended that the application of variable density thinning techniques be applied to the riparian area to promote heterogeneity in understory development, tree spatial and species variability, as well as maintain special landscape attributes (snags, wet areas, down woody debris).

Commercial silvicultural treatments will remove merchantable trees after down wood targets are met. In the conifer prescription category (conifer basal area > 50 percent), the following pre-harvest conditions shall exist before considering an enhancement activity:

- Live crown ratios of residual trees are > 35 percent
- Height-to-diameter ratios of residual trees are < 90

Table 5 provides a general summary of activity prescriptions by stand composition and age. These numbers represent minimum management parameters not to be exceeded and do not represent management threshold targets. Management threshold targets are presented in Table 2.

Table 5. Minimum management parameters for prescriptions from the HCP Riparian Forest Restoration Strategies

Buffer Area	Coniferous Dominated	Deciduous Dominated
Inner Zone	No timber removal. Restoration limited to wood placement, underplanting, release of suppressed conifers, LWD creation and noxious weed control	
Middle Zone	▪ RD [a] > 35 (RD 30 with HCP Implementation Manager[1] approval) or at least 100 (75 in Type III thinnings) dominant and co-dominant tpa [b], whichever results in the greater number of residual trees ▪ d/D – ratio ≤ 1.0 [c] ▪ Maintenance of species diversity (including hardwoods) ▪ Designate 5 conifer trees per thinned RMZ acre from the largest diameter class(es) of the thinned trees for riparian habitat enhancement. In Type II thinnings (i.e., ≤40 years) fall all 5 trees to be left as DWD and LWD. In Type III thinnings consider topping 1 to 2 of the 5 designated trees above 20' or girdling for snag creation if stand is snag deficient. The trees to be felled shall be chosen from within 25 feet of the riparian forest management unit (FMU) boundary adjacent to the inner zone; and shall be felled toward the stream where feasible.	≥25 conifer tpa: Conifer Release <25 conifer tpa: Conversion
Outer Zone	Same as Middle Zone	Same as Middle zone
Wind Buffer	Same as Outer Zone	Same as Outer zone

[a] RD means relative density. RD = (basal area)/√(quadratic mean diameter). RD based on trees > 6" DBH

[b] tpa means tree per acre. It is simply the tree stem density > 6" DBH

[c] d/D-ratio means d is the average DBH of trees removed in thinning and D is the average before thinning. Used to characterize methods of thinning quantitatively: d/D = 1.0 means a proportional thinning, d/D > 1 means a thinning from above, d/D < 1 means a thinning from below.

Conifer-Dominated Riparian Scenarios

1. TYPE II RMZ THINNING IN CONJUNCTION WITH UPLAND THINNING

Description

Type II thinnings are defined as treatments taking place in stands that have more than 50 percent conifer basal area and are in the Pole Exclusion stand development stage. Generally, stand age is 40 years or less and the QMD (for trees > 3.5" DBH) averages 10 inches (DNR 2004 page B-34). Relative density is generally greater than 45. This age also coincides closely with the start of intensive plantation forestry and should contain exclusively planted second- or third-growth stands with little or no vertical and horizontal structure.

Activity Objective

The objective for these young, homogeneous stands is to accelerate individual tree growth, vigor, and stability. The goal also is to promote tree species diversity while

providing for short- and long-term riparian functions. In particular, where available, site-adapted species such as western red cedar and other shade tolerant trees will be retained as a component for further vertical canopy development. These trees will be important contributors to future stand structure. Snags that have a high likelihood of long-term function or that are rare on the landscape will be protected.

Activity Prescription Process

Activity objectives for the riparian and upland stands are usually compatible. Prescriptions will be based on site characteristics (including plant association groups) and existing stand characteristics. Verification will take place to ensure that site and stand characteristics for upland and riparian management areas are similar enough to warrant similar management. It is anticipated that similar, but modified prescriptions from the uplands will be applied to the middle and outer zones of the Riparian Management Zone. Some modifications may include the creation of small gaps, protecting some hardwoods—in particular big-leaf maple—or favoring certain tree species, such as western red cedar, and protecting Type 5 streams and riparian associated wetlands.

Younger stands in particular are dynamic and tend to respond quickly to treatments.

These stands typically produce competition-induced, small-sized down woody debris that decomposes within a decade and provides few ecological benefits. However, the down wood may be used as large woody debris in or across the water. Even small diameter down wood (<20 cm) can be functional in small streams (Beechie and Sibley 1997 in Lassettre and Harris 2001). Entering the riparian zone for restoration harvest provides an opportunity to contribute down wood from a larger size class to the riparian habitat that will be functional until the next entry or until larger down wood becomes available naturally.

Management Parameters

The following minimum management parameters shall be met post-treatment:

- Relative density >35 (RD 30 with HCP Implementation Manager approval), or at least 100 dominant and co-dominant trees per acre, whichever results in the greater number of residual trees
- d/D ratio ≤1.0 (d = mean diameter of cut trees; D = mean stand DBH before thinning)
- Maintenance of species diversity, including hardwoods

Designate five (5) conifer trees per thinned RMZ acre (outer and middle zones) from the largest diameter class of thinned trees to be felled and left as down woody debris. These trees are in addition to the minimum of 100 dominant and co-dominant (live) residual trees (> 6” DBH) required per acre. The trees to be felled shall be chosen from within 25 feet of the riparian forest management unit (FMU) boundary adjacent to the inner zone; and shall be felled toward the stream where feasible.

Evaluation

When the opportunity arises, this prescription will have the highest priority of all riparian restoration efforts. The benefits of thinning in stands in the Stem Exclusion Stage have been well documented (RTI 2003, Poulin et al. 2000). These stands generally provide excellent opportunities for riparian habitat enhancement, including the maintenance of high quality snags when they occur. Younger stands in particular are dynamic and tend to respond quickly to treatments. In addition, there is low risk of thinning-induced loss in the 5- to 10-year recovery period following thinning in these stands.

2. TYPE III RMZ THINNING IN CONJUNCTION WITH UPLAND THINNING

Description

Type III thinnings are defined as treatments in stands that have more than 50 percent conifer basal area and are in the Large Tree Exclusion development stage, or a later stage. Generally, stand age is greater than 40 years and the all-tree QMD (for trees > 3.5" DBH) is greater than 10 inches (DNR 2004 p. B-34). Type III thinnings will occur in stands less than 70 years of age. If appropriate, thinning activities may occur in stands greater than 70 years of age with written approval from the HCP Implementation Manager and in consultation with the Federal Services. This approach to thinning stands will be reviewed by the Technical Review Committee at the end of the three-year implementation period. For more information, see Implementation Period Commitments (page 46). Adjacent upland stands at this stage will be managed with a range of silvicultural tools including thinnings, partial cuts, and selective tree removals for a variety of objectives to:

- Provide habitat for certain species, such as the northern spotted owl,
- Lengthen rotation ages,
- Even out age class distributions in a landscape,
- Protect unstable areas,
- Or meet hydrological maturity goals.

Depending on their age, origin and development, these stands may contain more structural complexity than young plantations but still be lacking multiple canopies, and deficient in large live, deformed trees, and large down wood and snags.

Activity Objective

The objectives in these stands with low to moderate levels of structural complexity will be to accelerate individual tree diameter growth, maintain vigor and stability, promote tree species diversity, protect existing structural components, and enhance structural diversity while providing for short- and long-term riparian functions. In particular, snags, down wood, remnant trees, and advance regeneration will be protected as much as possible. A component of shade-tolerant tree species such as western red cedar, Sitka spruce and western hemlock, and some hardwoods (big-leaf maple) will be retained. Growing large, vigorous trees in the outer zone of the RMZ will be integral to minimizing risk of windthrow when the adjacent upland stand is regenerated in the future.

Activity Prescription Process

Activity objectives for the riparian and upland forest are likely to be pursued simultaneously. Prescriptions will be based on site characteristics (including plant association groups) and existing stand characteristics. Verification will take place to ensure that site and stand characteristics for upland and riparian management areas are similar enough to warrant similar management. In general, DNR anticipates applying similar—but modified—prescriptions to upland stands and middle and outer Riparian Management Zones.

DNR's goal in this riparian prescription is to safeguard the existing structures and components contributing to stand complexity. Thinning and group selection also is an opportunity to enhance or create a mosaic of thinned areas, "skips" (unthinned patches) and gaps, depending on existing stand structure. Skips will be placed around structures such as snags, existing accumulations of down wood, Type 5 streams, riparian wetlands,

and advanced regeneration. Small gaps (0.25 acre or less and more than 100' from the 100-year floodplain) could be created by removing red alder or diseased conifers, or may be used to enhance existing advanced regeneration. Some hardwoods and shade-tolerant, site-adapted species, such as western red cedar, will be retained. Prescriptions in this scenario will resemble variable density prescriptions applied in Dispersal and Nesting, Roosting, and Foraging Management Areas.

In order to move the stand toward the desired riparian forest condition target, dead down wood will be created to supplement natural mortality or down wood from an earlier harvest. Where feasible, DNR is to consider the creation of two snags per acre.

Management Parameters

The following minimum management parameters shall be met post-treatment:

- Relative density >35 (RD 30 with HCP Implementation Manager approval), or at least 75 dominant and co-dominant trees per acre, whichever results in the greater number of residual trees
- d/D – ratio ≤1.0 (d = mean diameter of cut trees; D = mean stand DBH before thinning)
- Maintenance of species diversity, including hardwoods
- A total of five (5) conifer trees per thinned RMZ acre (outer and middle zones) from the largest diameter class of the thinned trees shall be designated for riparian habitat enhancement. These five (5) trees are in addition to the minimum of 75 dominant and co-dominant live residual trees (>6" DBH) required per acre. Three to five of these trees shall be felled toward the stream to serve as instream large woody debris and down woody debris. The trees to be felled shall be chosen from within 25 feet of the riparian forest management unit (FMU) boundary adjacent to the inner zone; and shall be felled toward the stream where feasible. DNR will consider topping one or two of the designated trees at or above 20 feet in height or other suitable methods to create snags or cavities in live trees if stand is snag deficient.

Evaluation

When the opportunity arises, this prescription will have the second highest priority of all riparian prescriptions. Most stands will represent a low to moderate level of risk in terms of restoration success and provide opportunities for riparian habitat enhancement. The responsiveness of older stands to thinning has been previously demonstrated (Newton and Cole 1987). In general, windthrow risk is low due to upland forests protecting the riparian stand. However, thinning response and likelihood of windthrow will vary depending on species thinned, crown ratios, plant association group, and thinning intensity.

3. TYPE III RMZ THINNING IN CONJUNCTION WITH UPLAND REGENERATION HARVEST

Description

Type III thinnings are defined as treatments in stands that have more than 50 percent conifer basal area and are in the Large Tree Exclusion development stage, or a later stage. Generally, stand age is greater than 40 years and the all-tree QMD (for trees >3.5" DBH) is greater than 10 inches (DNR 2004 p B-34). Stands greater than 70 years of age are eligible for restoration, but require approval from the HCP Implementation Manager in consultation with the Federal Services. This approach to thinning older stands will be reviewed by the Technical Review Committee at the end of the three-year

implementation period. As described earlier, these stands will benefit from silvicultural treatments and the development of structural diversity can be accelerated. Depending on the timing of the regeneration activity, these stands will be similar to the stands described in the previous scenario. The major difference will be that the adjacent upland stand will be removed and the riparian forest will be exposed to the elements, especially wind.

Activity Objective

Objectives for activities in these young to intermediate-aged riparian stands with low to moderate levels of structural complexity will be the same as in the previous scenario. Older stands with high levels of structural complexity or snags might be on the way to the riparian desired future conditions and may be a lower priority for treatment or may not need any treatment.

Activity Prescription Process

The silvicultural objectives and prescriptions will be different for upland versus riparian forests. A natural resource specialist, such as a silviculturist or a biologist, should be consulted to help develop site-specific management. The prescription will contain similar structure-based thinning components as outlined in the previous scenario—to protect existing habitat components—and are subject to the same management parameters. Down woody debris will also be created at this opportunity to enhance riparian and instream habitat.

Management Parameters

The following minimum management parameters shall be met post-treatment:

- In areas of low windthrow risk: relative density >35 (RD 30 with riparian designee approval) of the dominant and co-dominant canopy, or at least 75 dominant and co-dominant trees per acre, whichever results in the greater number of residual trees.
- In areas of moderate and high windthrow risk: post-thinning relative density > 60 percent of the pre-thinning relative density of the dominant and co-dominant canopy, and relative density >40 or at least 75 dominant and co-dominant trees per acre, whichever results in the greater number of residual trees. Wind buffers (50’ or 100’) are part of the RMZ and shall receive the same treatment.
- d/D–ratio ≤1.0 (d = mean diameter of cut trees; D = mean stand DBH before thinning)
- Maintenance of species diversity (including hardwoods)
- A total of five (5) conifer trees per thinned RMZ acre (outer and middle zones) from the largest diameter class of the thinned trees shall be designated for riparian habitat enhancement. These five (5) trees are in addition to the minimum of 75 dominant and co-dominant live residual trees (>6” DBH) required per acre. Three to five of these trees shall be felled toward the stream to serve as instream large woody debris and down woody debris. The trees to be felled shall be chosen from within 25 feet of the riparian forest management unit (FMU) boundary adjacent to the inner zone, and shall be felled toward the stream where feasible. Consider topping one or two of the designated trees at or above 20 feet in height or other suitable methods to create snags or cavities in live trees if the stand is snag-deficient.

Areas with a moderate windthrow risk are areas of wind exposure where the adjacent regeneration harvest could channel winds into the RMZ. Areas with a high risk of windthrow are areas with slopes exposed to the south/southwesterly winter storm winds (and east winds near the Columbia River), high-water table with restricted rooting or soil cohesion, and stands with high height-to-diameter ratios and/or low live crown ratios. See section on wind buffers for details on making site-specific assessments on windthrow risk.

Evaluation

Uncertainty about the potential success of a restoration effort is considerably higher than in the two previously described scenarios, relegating this activity to a medium priority (see Appendix 4). The uncertainty is due to the variables in the amount of windthrow that might occur by potentially exposing treated stands to higher wind speeds. These stands often have not been previously thinned, and consist of trees that have adapted their crown ratios and roots to stand conditions of competition mortality. Therefore, they are relatively unprepared for cutting edges and are vulnerable to windthrow. Topographic variables and species composition also are factors in determining windthrow risk (Steinblums et al. 1984).

Little experience exists in thinning riparian stands in conjunction with adjacent upland regeneration harvests. DNR anticipates that this scenario will be successful in accelerating riparian stand development on certain sites with appropriate silvicultural treatments. A conservative approach will allow DNR to monitor its success and develop guidelines for site selection and silvicultural techniques to achieve riparian objectives in this scenario. Over time, as riparian stands receive early density management treatments, the risk of windthrow will decrease with upland regeneration harvest activities.

Hardwood-Dominated Riparian Stands

4. INDIVIDUAL CONIFER RELEASE

Description

"In hardwood-dominated riparian areas with overtopped conifers, conifers that have nearly grown through the hardwood canopy can be released by gap creation or thinning" (Hayes et al. 1996). This scenario occurs in stands where many conifers were established but never achieved overstory status. Most were out-competed by hardwoods—especially red alder—and remain suppressed. Stands where shade tolerant conifers are slowly overtaking culminated hardwood stands may also have this stand structure. In order to achieve a conifer-dominated RDFC, at least 25 viable conifers per acre should be present with reasonable chance of release.

The objective will be achieved by selectively removing hardwood trees overtopping or otherwise competing with conifer trees for resources (i.e., space, light).

Activity Objective

The objective for activities will be, by altering the stand composition, to create a horizontally and vertically more diverse stand that will be dominated by present or future conifers. The objective will be achieved by selectively removing hardwood trees overtopping or otherwise competing with conifer trees for resources (i.e., space, light). The Forest Management Unit objective includes release of conifers from the hardwood competition in order to accelerate their height, crown, and diameter development. As a result, the treatment will provide large, live trees, horizontal and vertical diversity, snags and down wood for the riparian ecosystem. Any existing structures such as snags and down woody debris will be protected.

Activity Prescription Process

This activity may take place in conjunction with upland thinning or regeneration harvest. The upland and riparian objectives and prescriptions are likely to be mutually achievable if riparian stand data is gathered to determine if a sufficient number of viable conifers (>25 per acre) are present. The prescription will either target individually marked trees for removal to release the selected conifers, or contain a certain cutting radius around each conifer. No conifers will be cut except for yarding corridors or skid trails. Hardwoods that are not competing with conifers will be left, except for yarding corridors or skid trails. A natural resource specialist, such as a silviculturist or a biologist, should be consulted to help develop site-specific management.

Viable conifers have the following characteristics:

- DBH >6”
- Live crown >30 percent
- Height to diameter ratio <100
- Free of root rot

These characteristics reflect minimum thresholds of “marginal” trees to be released as described by Emmingham et al. (2000). Higher live crown ratios and lower height to diameter ratios indicate more vigorous trees with greater potential for successful release.

Evaluation

Success with the release of suppressed conifers in riparian areas through patch cutting and thinning has been demonstrated in Oregon (Emmingham and Maas 1994, Emmingham et al. 2000). Previously overtopped conifers are more susceptible to thinning shock, and also may have heightened vulnerability to windthrow and ice damage. However, the risk of restoration failure in these types of stands is variable and condition specific. It is not anticipated that this will be a common riparian restoration activity. Due to a lack of experience, DNR will take a conservative approach and monitor success in order to refine silvicultural approaches as necessary.

5. CONVERSION OF HARDWOOD TO CONIFER-DOMINATED RIPARIAN STANDS

Description

Hardwood stands to be considered for conversion are generally 30 to 80 years old and may contain less than 25 viable conifers per acre. They contain a rich herbaceous and shrub understory and may contain some advance regeneration of conifers. Conversion may be a necessary tool in circumstances where it can be reasonably assumed that natural succession would lead to a shrub-dominated community. This process can also help accelerate the establishment of a structurally diverse, conifer-dominated stand.

Activity Objective

The objective for activities is to create a conifer-dominated stand that will develop into an older forest condition by eliminating the current hardwoods and establishing a mix of site-adapted conifer species.

Activity Prescription Process

This activity may take place in conjunction with upland thinning or regeneration. Pre-treatment survey data will be collected in the riparian zone to determine the number of

viable conifers per acre. If not enough viable conifers are present (<25 per acre), the following silvicultural prescription shall be followed:

- All hardwoods except 1-3 big-leaf maple per acre (if present) will be cut in patches. Each patch shall be 2.5 acres in size or smaller. Patch cuts shall be separated by uncut segments, which run for a minimum of 150 feet parallel to the stream. All live conifers must be retained in the patch cuts and advance conifer regeneration shall be protected where operationally feasible.
- Brush competition will be treated (manual cutting or chemical site preparation and/or release) and the number of site-adapted conifers required by a site-specific silvicultural prescription will be established. Vegetation management will continue until conifer trees are free to grow.
- Preferred tree species will be western red cedar, Douglas-fir, and Sitka spruce. It is anticipated that natural regeneration of hardwoods will occur and be a component of the future riparian stand.
- The size of the inner zone shall be expanded, where necessary to minimize the short-term impacts to riparian functions, especially shade, on a site-specific basis.
- A natural resource specialist (i.e., biologist, silviculturist) shall be consulted to help draft a site-specific management plan to ensure that the long-term restoration objectives will be met while minimizing the short-term impacts
- Hardwood stands shall not be converted if it is determined that:
  - The site is not conducive to conifer growth (i.e., based on physical criteria or the lack of conifer stumps).
  - The upstream/downstream forest landscape assessment reveals that the forest stand should be retained in the present condition in order to provide a mixture of conifer/hardwood conditions across the landscape. Restoration is deemed cost-prohibitive or impractical in light of the need for repeated brush control treatments.

Evaluation

Hayes et al. (1996) commented that “reshaping the landscape to increase the amount of conifer-dominated riparian areas may be a valid long-term goal, but this may have a number of currently unforeseen long-term consequences,” and a conservative approach should therefore be taken. Successful restoration of hardwood dominated stands to conifer stands may depend mostly on appropriate site selection, which is tied to a broader landscape perspective. Conversions are not appropriate on all sites, and some hardwood dominated riparian forests may be desirable.

Reforestation will be challenging, requiring close attention and above-average financial resources to control competing vegetation for several years. Successful restoration can only be accomplished through the application of sound silviculture to what promises to be a lengthy and costly restoration effort (Emmingham et al. 2000). The risk of restoration failure in these types of stands is moderate. Released conifers may be more susceptible to thinning shock, windthrow, and ice damage. Advance conifer regeneration, if present, may be damaged during logging.

Documentation of Silvicultural Activities

Documentation of silvicultural activities will follow the same guidelines developed for upland management activities. Riparian Management Zones will be delineated spatially as Forest Management Units (FMUs) in DNR's database. Planned riparian activities must be entered into DNR's Planning and Tracking (P&T) System for each riparian FMU. The entries must include all management activities until the stand reaches the final objective, the riparian desired future condition. Silvicultural prescriptions for individual riparian FMUs must include four essential elements to be recorded in P&T:

1. Current situation—describing the riparian stand condition relative to its objectives at the time the prescription is written.
2. FMU stand objectives—the long-term or ultimate management goals for the FMU, consisting of attributes described using action verbs, broken down into discrete and measurable threshold targets.
3. Threshold targets—representing the array of discrete and measurable components that constitute FMU objectives. For example, for the FMU objective "attain functional riparian forest conditions," the threshold targets might be described in terms of tree species, number of dominant/co-dominant trees, relative density, and amount of down woody debris. Threshold targets are important to silvicultural prescriptions because their achievement can be modeled, predicted, and monitored.
4. Activity objectives—desired immediate outcomes of activities (e.g., "pre-commercially thin to 300 stems per acre") undertaken to accelerate the attainment of FMU objectives.
5. Chronology of entries—describing in detail the current activity objective and riparian desired future condition.

Desired future condition provides a general vision of the state of riparian forests under the trust lands HCP (i.e., older forest condition). DNR has both a short-term and long-term concept of the desired future condition, which resembles the various stages of forest development and corresponding management intensities.

Desired future condition provides a general vision of the state of riparian forests under the trust lands HCP (i.e., older forest condition)

Forest Management Unit (FMU) objectives, threshold targets, and activity objectives are goal-oriented concepts that underlie the silvicultural prescription process (Figure 5). This Riparian Forest Restoration Strategy is fully supported by DNR's existing procedures for the documentation for silvicultural activities.

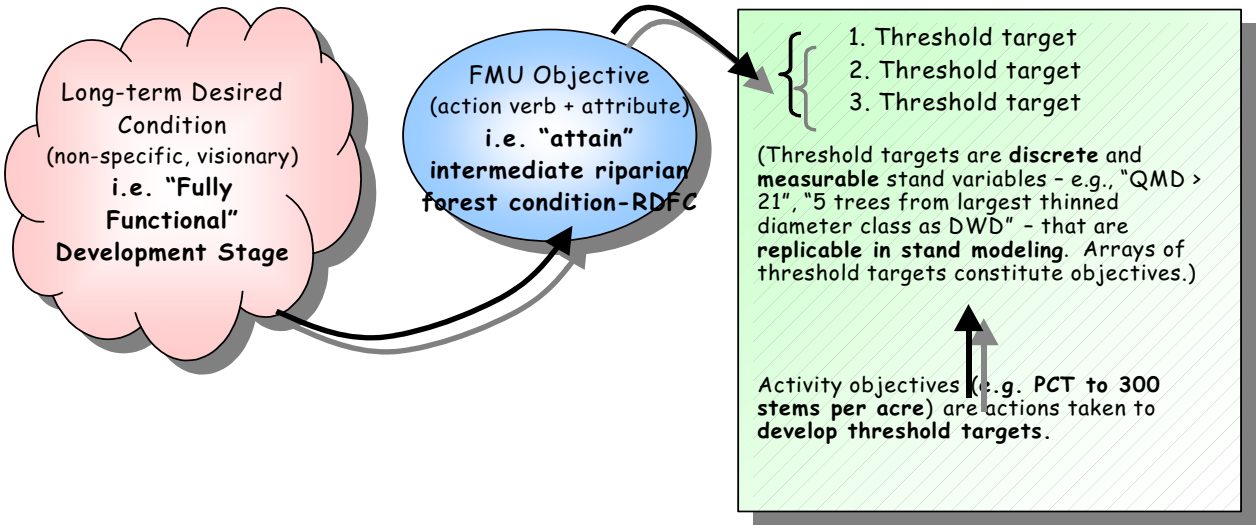


Figure 5. Relationship between the elements of various types of objectives.

Operational Guidance for Riparian Silvicultural Activities

This section clarifies allowable activities within Riparian Management Zones—in addition to the timber harvesting addressed previously—and expands on the discussion within the trust lands HCP (DNR 1997 IV. 73).

Roads

Roads for forest management and other activities will continue to be used and constructed within Riparian Management Zones. However, within riparian areas and on a case-by-case basis DNR intends to continue removing roads that are no longer necessary and that may be adversely affecting riparian function. The HCP provides some road guidance in the Road Network Management section (DNR 1997, IV 62). Any new road construction through RMZs should be minimized, and alternatives, including yarding systems, should be considered. When a road is constructed or reconstructed, the width of the right-of-way shall be minimized and if possible, the road should cross the stream at a right angle in order to minimize the amount of RMZ affected. Trees felled within the RMZ inner zone of Type 2-3 streams (25 feet on either side of the stream) for road construction, reconstruction or maintenance will be used for instream riparian enhancement, unless a biologist or engineer determines the site is unsuitable for wood placement. Placement of large woody debris in Type 1 streams should be done in consultation with the appropriate engineer and fisheries biologist.

- At each stream crossing, one (1) log from the largest cut conifer diameter class—in length at least two times the width of the ordinary high-water mark of the

stream—shall be placed across the stream on the down-stream side of the crossing.

- Three (3) root wads, if present, shall be placed additionally in or along the stream channel on the down-stream side of the crossing.
- All other grubbed stumps, when available, from within the inner zone shall be placed in a linear fashion at least 50’ from the road in the middle or outer zone of the RMZ.
- All other timber within the right-of-way inside the RMZ may be removed.
- If instream habitat enhancement is not feasible, an alternate plan shall be forwarded to the appropriate HCP Implementation Management. A decision will be made and documented within 14 days.

Cable Yarding

Cable yarding through the riparian zone is allowed if it can be demonstrated that, by doing so, haul road densities are reduced for individual sales or for the landscape, or when cable yarding will result in less risk of sediment delivery to the stream. When using cable systems:

- Yarding corridors shall be minimized, in quantities and in width.
- Full suspension shall be required in the inner zone of the RMZ.
- Yarding corridors should be on average 12 feet in width or less (10 feet where possible).
- Yarding corridors should be on average at least 100 feet apart (120 feet where possible).
- Yarding corridors should be located in natural voids, where possible, while avoiding wetlands and concentrations of snags.
- Trees that are damaged during these operations in the middle and outer zone of the RMZ will be allowed to remain on site as live trees, snags, or down woody debris, and can be counted toward the riparian enhancement targets.
- Trees that are cut or damaged in the inner zone of the RMZ shall remain on site and cannot be counted toward the riparian enhancement targets.

Pole Sales in Riparian Management Zones

Expanding pole sales that are taking place adjacent to RMZs to include part of the outer and middle zone is permissible as long as selective pole tree removal is consistent with restoration objectives for the stand. If the harvest removes an average of 15 trees per acre or less, designate and fall one (1) tree per acre from the largest removed DBH class as down woody debris to be left on site. If more than 15 trees per acre are removed, designate 5 trees per acre to be left as down woody debris in the riparian zone or large woody debris in or across the stream.

Mobile Yarding

Low ground pressure mobile equipment will be allowed for thinning. Terrain and timing restrictions will be imposed to minimize impacts to the RMZ. Skid trails shall be kept to

a minimum, in both quantity and width. Skid trails should be at least 100 feet apart and, where possible, less than 12 feet in width. With the exception for road construction, no ground equipment will be allowed within 25 feet of the inner zone (leaving a 50-foot buffer of undisturbed ground vegetation along the stream). When feasible, the trees that are to be removed will be directionally felled away from the inner riparian zone. On slopes greater than 10 percent, skid trails located within 100 feet of the inner zone should not be perpendicular to the stream; the skid trails should be at a 45-degree angle or less (parallel if possible). Where possible, to reduce soil compaction and rutting, ground-based equipment shall walk on a mat of logging slash. Skid trails within the RMZ are to be water barred.

Salvage

Catastrophic windthrow can occur within the RMZ where a majority or all of the trees in the zone may blow down. While windthrow provides down woody debris to the riparian landscape and large woody debris to streams, it can be a detriment to the goal of maintaining other riparian forest functions. Windthrow may result in a dense stand composed of less desirable tree species arising from natural regeneration. Such a stand would be susceptible to future windthrow or to a return to a shrub-dominated community.

This blowdown occurs in many forms and sizes. When it occurs and salvage operations are being designed, a site-specific restoration plan will be required. The plan shall contain a strategy on how to meet the riparian desired future conditions including specific details about reforestation and down woody debris levels. The site-specific restoration plan shall be submitted to the HCP Implementation Manager for approval in consultation with the Federal Services. Upon submission, a decision on the merits of the restoration plan will be made within 60 calendar days. Otherwise DNR will carry out the plan as proposed.

Legacy Trees

The goal of green tree retention requirements for wildlife is to create patterns of leave trees in the upland area. Green tree retention requirements are in addition to trees left within RMZs. Riparian trees do not count toward the eight trees and/or snags per acre required by the HCP.

Wetland Management

Riparian associated wetlands (periodically inundated areas of Type 1, 2, and 3 Waters) will not be subject to thinning. Wetlands that are not associated with Type 1, 2, and 3 streams are managed according to existing HCP strategies.

Non-timber Resource Management

In addition to being managed for timber, the five Westside HCP planning units will continue to be managed for non-timber resources. Non-timber resources and activities include, but are not limited to, road use permits, sand and gravel sales, leasing for special forest products such as boughs and brush, prospecting leases and mining contracts, oil and gas leases, grazing permits and leases, communication site leases, recreation sites, utility easements and other special permits, licenses, sales, and leases. Non-timber activities will be managed in ways that support the HCP riparian strategy goals and objectives, as well as other relevant commitments of the HCP and DNR guidance such as the Policy for Sustainable Forests.

As described in the HCP (DNR 1997, IV. 191), non-timber activities are defined as "no take," or insignificant (i.e., *de minimis*) at the levels of activities occurring January 1996. Starting on January 1, 1999, new or renewed permits, contracts, or leases for such activities include the commitments of the HCP, such that they will not increase the level of impact to the species covered by the HCP beyond a *de minimis* level. The determination of whether an activity will exceed *de minimis* levels is subjective and dependent upon the relative impact of the activity in relation to past activities. In general, the following guidelines should be applied to activities within Riparian Management Zones in order to remain below *de minimis* levels:

- Protect surface resources including soil and water.
- Protect the water from sediment delivery that might result from the activities.
- Minimize the amount and, therefore, the impact of non-restoration activities.
- Minimize the permanent loss of natural vegetation, function, and habitat.
- Avoid creating barriers to fish passage.

As stated previously in this document, the main group of riparian ecosystem benefits provided by Riparian Management Zones are: 1) stream bank stability, 2) nutrient load, 3) stream shading, 4) large woody debris recruitment, 5) sediment filtering, and 6) down woody debris on the riparian forest floor, and snags. All non-timber activities should strive to minimize the negative impacts to these riparian ecosystem benefits. If an activity must occur within an RMZ, consider mitigation measures to restore lost riparian function or benefits. Some mitigation opportunities are to:

- Replant exposed soils with native vegetation and trees,
- Place large or down woody debris in streams or in the riparian area,
- Create snags, and/or
- Add additional equivalent area to an RMZ.

Written exemptions will be requested from the Federal Services for the following activities within the required Riparian Management Zone along Type 1–4 streams: campgrounds, trail heads, surface disturbance activities from oil and gas leases or mining leases, rock and gravel pits, utility easements, and special forest product leases. If it is determined that any new instances of these activities must occur within an RMZ, the HCP Implementation Manager is to be contacted for consultation with the Services for approval. It may be necessary for other activities not listed above to occur within the RMZ. In those instances, condition the activity to meet the above guidelines and contact appropriate DNR Region or Land Management Division specialists for help in mitigation opportunities or assessment of *de minimis* levels.

Section 3

Riparian Forest Restoration Procedure

Following is the Washington State Department of Natural Resources procedure PR 14-004-150 intended to restore and protect stream and wetland riparian areas:

PROCEDURE **Department of Natural Resources**

Date: **April 2006**

Cancels: PR 14-004-150 IDENTIFYING AND PROTECTING RIPARIAN AND WETLAND MANAGEMENT ZONES IN THE WEST-SIDE HCP PLANNING UNITS, EXCLUDING THE OESF PLANNING UNIT (August 1999). Effective immediately

PR 14-004-150 IMPLEMENTATION PROCEDURES FOR THE HABITAT CONSERVATION PLAN RIPARIAN FOREST RESTORATION STRATEGY

APPLICATION Westside HCP Planning Units, Excluding the OESF Planning Unit

DISCUSSION

The riparian strategy for west-side planning units, excluding the OESF, has a two-fold objective of:

(1) maintaining or restoring freshwater habitat for salmonid species; and

(2) contributing to the conservation of other species that are dependent upon aquatic and riparian areas. This is accomplished by identifying riparian and wetland areas and ensuring that management activities within those areas adequately protect riparian function.

Riparian function can be viewed from both societal and ecological perspectives. From a societal perspective, riparian function includes the production of commodities and other services for human benefit. Salmon, wildlife, and timber are examples of the commodities produced by riparian ecosystems. The delivery of high quality water, flood control, and recreation is an example of services provided by riparian ecosystems. From an ecological perspective, riparian function can be viewed as providing habitat for numerous plant and animal species including clean water, shade, large woody debris and detrital nutrients for salmon habitat, damp soil and logs for terrestrial amphibian habitat, snags for cavity nesting birds, etc.

The Implementation Procedures for the Riparian Forest Restoration Strategy will be followed to identify and manage riparian and wetland zones. The riparian management

zone consists of a managed riparian buffer and, where appropriate, a wind buffer to protect the integrity of the managed riparian buffer. The riparian buffer has been designed to maintain/restore riparian processes that influence the quality of salmonid freshwater habitat and to contribute to the conservation of other aquatic and riparian obligate species. Consideration has been given to water temperature, stream bank integrity, sediment and detrital nutrient load, and large woody debris.

ACTION

1. The first step in implementing the Riparian Forest Restoration Strategy is to verify the accuracy of water-type information for all waters currently designated as Type 4 or 5 that are located within the boundary of the proposed activity. Among others, either or both of the following two methods may be used:

   a. Water type information may be verified through consultation with fisheries biologists from DNR, tribes, or other agencies.

   b. Water type information may be verified by certified and/or trained personnel using the protocol specified in WAC 222-16-030, Washington Forest Practices Board Emergency Rules (stream typing), November 1996 and the Forest Practices Board Manual.

   This stream typing system will now be officially referenced as the "Water Typing System for Forested State Trust HCP Lands". The "Water Typing System for Forested State Trust HCP Lands" complete provisions are in the table below:

Type 1	Type 1 Water means all waters, within their ordinary high-water mark, as inventoried as "shorelines of the state" under chapter 90.58 RCW and the rules promulgated pursuant to chapter 90.58 RCW, but not including those waters' associated wetlands as defined in chapter 90.58 RCW.
Type 2	Type 2 Water shall mean segments of natural waters that are not classified as Type 1 Water and have a high fish, wildlife, or human use. These are segments of natural waters and periodically inundated areas of their associated wetlands, which: (a) Are diverted for domestic use by more than 100 residential or camping units or by a public accommodation facility licensed to serve more than 100 persons, where such diversion is determined by the department to be a valid appropriation of water and the only practical water source for such users. Such waters shall be considered to be Type 2 Water upstream from the point of such diversion for 1,500 feet or until the drainage area is reduced by 50 percent, whichever is less; (b) Are diverted for use by federal, state, tribal or private fish hatcheries. Such waters shall be considered Type 2 Water upstream from the point of diversion for 1,500 feet including tributaries if highly significant for protection of downstream water quality. The department may allow additional harvest beyond the requirements of Type 2 Water designation provided the department determines after a landowner-requested on-site assessment by the department of fish and wildlife, department of ecology, the affected tribes and the interested parties that:

(i) The management practices proposed by the landowner will adequately protect water quality for the fish hatchery; and

(ii) Such additional harvest meets the requirements of the water type designation that would apply in the absence of the hatchery;

(c) Are within a federal, state, local, or private campground having more than 30 camping units: Provided, That the water shall not be considered to enter a campground until it reaches the boundary of the park lands available for public use and comes within 100 feet of a camping unit, trail or other park improvement;

(d) Are used by substantial numbers of anadromous or resident game fish for spawning, rearing or migration. Waters having the following characteristics are presumed to have highly significant fish populations:

i) Stream segments having a defined channel 20 feet or greater in width between the ordinary high-water marks and having a gradient of less than 4 percent.

(ii) Lakes, ponds, or impoundments having a surface area of 1 acre or greater at seasonal low water.

(e) Are used by salmonids for off-channel habitat. These areas are critical to the maintenance of optimum survival of juvenile salmonids. This habitat shall be identified based on the following criteria:

(i) The site must be connected to a stream bearing salmonids and accessible during some period of the year; and

(ii) The off-channel water must be accessible to juvenile salmonids through a drainage with less than a 5% gradient.

Type 3 Type 3 Water shall mean segments of natural waters that are not classified as Type 1 or 2 Water and have a moderate to slight fish, wildlife, and human use. These are segments of natural waters and periodically inundated areas of their associated wetlands which:

(a) Are diverted for domestic use by more than 10 residential or camping units or by a public accommodation facility licensed to serve more than 10 persons, which such diversion is determined by the department to be a valid appropriation of water and the only practical water source for such users. Such waters shall be considered to be Type 3 Water upstream from the point of diversion for 1,500 feet or until the drainage area is reduced by 50 percent, whichever is less;

(b) Are used by significant numbers of anadromous or resident game fish for spawning, rearing or migration. Guidelines for determining fish use for the purpose of typing waters are described in Appendix 3. If fish use has not been determined:

(i) Waters having the following characteristics are presumed to have significant anadromous or resident game fish use:

(A) Stream segments having a defined channel of 2 feet or greater in width between the ordinary high-water marks in Western Washington and having a gradient 16 percent or less;

(B) Stream segments having a defined channel of 2 feet or greater in width between the ordinary high-water marks in Western Washington and having a gradient greater than 16 percent and less than or equal to 20 percent; and having greater than 50 acres in contributing basin size in Western Washington;

(ii) The department shall waive or modify the characteristics in (i) above where:

(A) Waters are confirmed, long term, naturally occurring water quality parameters incapable of supporting anadromous or resident game fish;

(B) Snowmelt streams have short flow cycles that do not support successful life history phases of anadromous or resident game fish. These streams typically have no flow in the winter months and discontinue flow by June 1; or

(C) Sufficient information about a geographic region is available to support a departure from the characteristics in (i), as determined in consultation with the department of fish and wildlife, department of ecology, affected tribes and interested parties.

(iii) Ponds or impoundments having a surface area of less than 1 acre at seasonal low water and having an outlet to an anadromous fish stream.

(iv) For resident game fish ponds or impoundments having a surface are greater than 0.5 acre at seasonal low water.

(c) Are highly significant for protection of downstream water quality. Tributaries which contribute greater than 20 percent of the flow to a Type 1 or 2 Water are presumed to be significant for 1,500 feet from their confluence with the Type 1 or 2 Water or until their drainage area is less than 50 percent of their drainage area at the point of confluence, whichever is less.

Type 4 — Type 4 Water classification shall be applied to segments of natural waters which are not classified as Type 1, 2 or 3, and for the purpose of protecting water quality downstream are classified as Type 4 Water upstream until the channel width becomes less than 2 feet in width between the ordinary high-water marks. Their significance lies in their influence on water quality downstream in Type 1, 2, and 3 Waters. These may be perennial or intermittent.

Type 5 — Type 5 Water classification shall be applied to all natural waters not classified as Type 1, 2, 3, or 4; including streams with or without well-defined channels, areas of perennial or intermittent seepage, ponds, natural sinks and drainage ways having short periods of spring or storm runoff.

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2. After verification of water type information, or the decision to manage Type 4 or 5 Waters as Type 3, Step 2 in implementing the Implementation Procedures for the RFRS is to determine the boundary of the riparian management zones for the proposed activity. This step has three parts. First, the 100-year flood plain must be identified for all Types 1, 2, 3, and 4 Waters; it is from the outer edge of this area that the riparian buffer is measured. Second, the appropriate riparian buffer must be identified. Third, the need for a wind buffer must be evaluated and, if needed, located.

    a. Identify the 100-year flood plain for each Type 1, 2, 3, and 4 Water. Among others, any, or a combination, of the following methods may be used:

        i. Identify the 100-year flood plain using information from FEMA (Federal Emergency Management Agency) or flood insurance rate maps.

        ii. Identify the 100-year flood plain. One method that may be used is the following field location method, a modification of the information contained in the Forest Practices Board manual's The Standard Methods for Measuring Physical Parameters of a Stream (dated 7/95). Using this method, averages for stream reaches may be determined by:

            A. Establish the ordinary high water mark (OHWM) using vegetation or historical evidence.

            B. Divide the OHWM channel width into at least 4 equal sections.

            C. At the edge of each section, measure the depth from the elevation of the OHWM to the stream bottom.

            D. Calculate the average depth by adding all of the depths measured in C. above together, then dividing the total by the number of measurements.

            E. Calculate the 100-year flood plain elevation by adding the value calculated in D. above for the average depth to the elevation of the OHWM (doubles the average channel depth).

            F. Field-locate the intersection of the 100-year flood plain with each side of the channel bank using hand levels and level rods, or clinometers and measuring tapes,

            OR

            By calculating the distance from the OHWM to the 100-year flood-level intersection using ground slope measurements taken in the field. (Example: For a channel with bank slopes of 10% on each side and an average depth to OHWM of 1.2 feet, the distance is equal to rise over run, so divide 1.2 feet by .10 to yield a horizontal distance of 12 feet from the OHWM to the 100-year flood plain.

    b. Next, identify and measure the riparian buffer, using horizontal distance, from the outer edge of the 100-year flood plain or the boundary of the wetland (wetlands identified using the Forest Practices Board manual's Guidelines for Wetland Delineation, dated 6/93). The appropriate buffer width is dependent upon water type for streams, size for wetlands, and the site index of conifer stands one would expect to develop in the area.

        i. For Type 1, 2, and 3 Waters, and for all wetlands that are greater than 1 acre in size, the average width of the riparian buffer will be equal to or greater than

the average height an adjoining conifer stand would be expected to reach at 100 years of age (using site index, which may be determined by using one or more of the following methods: State Soil Survey data, Forest Resource Inventory System data (FRIS), on-site calculation from fixed or variable plots taken every 660 feet on a transect that parallels the stream with at least two dominant conifer trees per plot measured and site calculated using site table, or DNR Intensive Management Planning System (DNRIMPS) or other appropriate growth-and-yield model). Regardless of site index, the average width of the buffer will be no less than 100 feet.

ii. For Type 4 Waters, and for all wetlands between 0.25 and 1 acre in size, the width of the riparian buffer will be 100 feet.

c. The final step in identifying the riparian management zone is to evaluate the need and, if needed, the appropriate width and location for wind buffers to protect the integrity of the riparian management zone.

i. Determine if at least a moderate risk of windthrow exists for all Type 1 and 2 Waters, and for Type 3 Waters equal to or greater than 5-feet wide. Moderate is defined as 45 percent or more blowdown after 5 years and is determined using local knowledge, the Buffer Strip Survival Rate Worksheet (from Steinblums, Froehlich, and Lyons, Designing Stable Buffer Strips For Stream Protection), or other model approved by the State Lands Assistant. Where at least a moderate risk exists, apply a 100-foot (horizontal distance) wind buffer on Type 1and 2 Waters, and a 50-foot wind buffer on Type 3 streams greater than 5-feet wide. The buffer shall be located on the windward side of the stream.

ii. Type 3 Waters less than 5 feet wide, and Type 4 and 5 Waters will not have a wind buffer. Wetlands will not receive a wind buffer, except for those that meet the description of "off-channel habitat" as discussed in WAC 222-16-030 (dated 6/93), page 16-10 under (2) "Type 2 Water," which will be treated as Type 2 Waters.

3. Once the riparian management zone, and wetlands and their associated buffers, has been identified, proposed management activities will be evaluated based on Section 2 of the Implementation Procedures for the Habitat Conservation Plan Riparian Forest Restoration Strategy, attached.

End Procedure

APPROVED BY: _____

Gretchen Nicholas
Division Manager, Land Management Division
DATE: April 20, 2006

SEE ALSO:

DNR Habitat Conservation Plan, 1997

Implementation Procedures for the Habitat Conservation Plan Riparian Forest Restoration Strategy (April 2006)

Section 4

Monitoring Riparian Restoration

This section provides a general overview of the riparian management monitoring programs. Annual reporting to the Federal Services will document implementation (compliance) monitoring of the riparian strategy, as is the case with the implementation of other conservation strategies established in the state trust lands HCP. The specifics of reporting will be agreed upon by DNR and the Services and will likely include: the acreage of Riparian Management Zones to be treated by each management scenario, the planning units in which the activities are to occur, the stream type of adjacent riparian areas, as well as other statistics. DNR riparian forest effectiveness monitoring will be conducted in accordance with detailed scientific guidelines outlined in Riparian Silviculture (Wilhere and Bigley 2001a and 2001b) and Instream Conditions and Trends Effectiveness Monitoring (Pollock et al. 2001). Each specifies monitoring priorities, design, parameters to monitor, evaluation of results, and period of monitoring. Additional guidance may be developed for sediment and unstable slope monitoring.

Riparian restoration is a long-term goal that requires the manager to have a vision for the forest, and tailor treatments to the site's existing conditions and ecological potential.

Monitoring the effectiveness of these restorative actions requires measuring the response of vegetation to the treatments in the riparian areas, as well as measuring the physical and biological responses of stream channels and fish habitat. Several guidelines have been published recently for determining which parameters to monitor, and the appropriate methods for monitoring instream parameters such as water quality (MacDonald et al. 1991; Bauer and Ralph 1999; Kauffman et al. 1999). However, some aspects of monitoring design for restoration of riparian areas have not been well developed, and consistent criteria are lacking for determining the success of riparian restoration efforts. In particular, there has been little analysis of riparian silvicultural treatments on forest conditions, or on how associated changes affect instream habitat (Beechie et al. 2000; Pollock et al. 2001; Pollock et al. 2005).

DNR's Need for Riparian Effectiveness Monitoring

The trust lands HCP conservation strategies have been developed with the best available information. In many cases, however, the information has been less than complete. The

riparian forest strategies are intended to strike an acceptable compromise between ecological and economic values, and the center or locus of compromise is often surrounded by uncertainty. Both the RMZs and the silvicultural prescriptions for riparian forests are working hypotheses based on extensive experience in thinning upland forests, and initial results from the Olympic Experimental State Forest.

HCP riparian effectiveness monitoring for riparian silviculture has been designed to test sets of hypotheses (Wilhere and Bigley 2001b). These hypotheses comprise the principal assumptions about the form and function of watershed and riparian processes that are most likely to be affected by forest management activities, and that relate directly to attaining resource objectives addressed by monitoring. The testing of these hypotheses constitutes a major portion of DNR's riparian management monitoring program. The results will be used in DNR's adaptive management process to make necessary adjustments to activities that will better create the riparian desired future condition.

Riparian Silviculture Effectiveness Monitoring

Effectiveness monitoring for riparian silviculture is a means through which DNR will acquire the data needed to develop effective and cost-efficient silvicultural systems to conscientiously proceed with riparian forest management. Effectiveness monitoring (as defined in the HCP 1997, V. 2) will help DNR determine whether implementation of the riparian conservation strategies results in the anticipated habitat conditions. The definition focuses on habitat conditions but ignores cost-efficient management. However, conscientious stewardship of trust assets demands that effectiveness monitoring address both. Therefore, the purposes of effectiveness monitoring are to:

1. Determine whether DNR's management actions are effectively achieving desired habitat conditions; and
2. Identify and either improve or eliminate those actions that are not cost effective.

Detailed monitoring plans to meet their objectives have been prepared (Wilhere and Bigley 2001b).

Riparian Silviculture Risks in Relation to Monitoring

There is a moderate level of uncertainty when undertaking silvicultural operations in a riparian forest (Wilhere and Bigley 2001a and 2001b). Three types of risk are associated with riparian forest restoration. First, there is a risk of actually retarding rather than advancing community succession. For instance, removing an alder overstory could cause a profusion of understory plants, such as salmonberry, that would prevent the growth of conifer seedlings. Second, silvicultural treatment could temporarily increase the risk of forest destruction by windstorm or flood. This too could retard the rate of forest restoration. Third, thinning a conifer stand risks an undesired effect of creating a riparian forest that is too stable (Beechie et al. 2000). Thinning is done to reduce tree mortality and enhance tree vigor, so thinning could conceivably decrease rates of large woody debris delivery into streams for several decades. Any of the three risks described above could delay or prevent attainment of the RDFC. Effectiveness monitoring will help address questions related to each of these risks.

For the foreseeable future, the greatest uncertainties of riparian silviculture will be those associated with forest restoration. When the conservation strategy moves into the multiple-resource phase, new types of risks will emerge. These risks will be assessed and monitoring priorities re-examined when DNR is ready to enter the multiple-resource phase.

Questions Addressed by Riparian Silviculture Monitoring

To be highly cost-efficient, monitoring must address specific questions. A monitoring plan explicitly addressing questions is much more likely to yield useful information (Wilhere and Bigley 2001b). The most general question for effectiveness monitoring is 'Does the management of HCP riparian zones maintain or restore riparian forests?' Relative to the key functions for Riparian Management Zones, the question is 'Do HCP RMZs provide a quantity and quality of instream large woody debris that approximates those provided by unmanaged riparian ecosystems?' These questions encompass more specific questions about details of riparian forest ecology, riparian silviculture, and large woody debris recruitment processes. The key questions are:

- Which silvicultural prescriptions are most effective for restoring riparian forest structure?
- How does RMZ forest stand structure influence its function (i.e., supply adequate quantities of large woody debris, shade, nutrients, sediment filtering, etc.)?
- What is the rate of woody debris delivery from different types of RMZs?
- What is the structure and species composition of DNR-managed RMZs, and how do these compare to unmanaged riparian forests over time?

An active monitoring approach will be implemented as described in Wilhere and Bigley (2001a; 2001b) and Figure 6. Active monitoring design requires an untreated control area, before and after measurements, and carefully controlled treatments so that true replicates of treatments can be produced. Silvicultural prescriptions applied to the riparian buffer can be considered working hypotheses to be tested through effectiveness monitoring.

Variables chosen for monitoring will reflect information needed to answer questions about riparian silviculture and riparian forest ecology, especially those pertaining to large woody debris recruitment into and across streams. Monitoring will concentrate on variables that describe forest characteristics—structure and species composition—because these attributes are directly affected by silviculture, and they are only weakly affected by processes outside of the area. Some monitoring of large woody debris will be conducted, and the variables selected for monitoring are those that should minimize the effects of remote processes such as instream large woody debris transport from upstream.

Relationship of Monitoring to HCP Research

Questions about riparian ecosystem functions would best be answered through carefully designed research. This research needs to be compatible with effectiveness monitoring (i.e., controlled treatments with an untreated reference). However, because of the number of variables that must be measured in order to measure

functions, it may not be possible to address more subtle information such as the maintenance of microclimate, delivery of detrital nutrients, and delivery of small wood debris (less than 3 inches in diameter). Functions that can be cost-effectively addressed at all of the effectiveness monitoring sites are the recruitment of large woody debris and snags. The monitoring design (Wilhere and Bigley 2001b) specifies that additions to these riparian restoration prescriptions will be tested to demonstrate their utility and provide options for future management decisions.

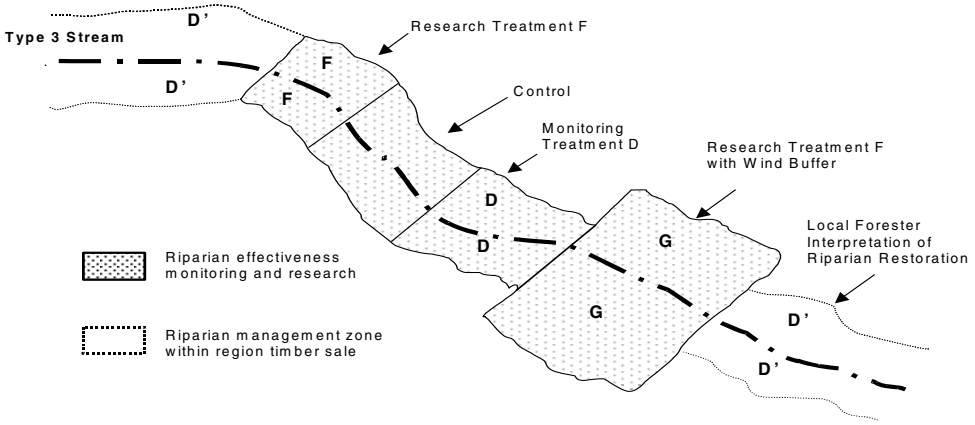


Figure 6. Configuration of riparian silviculture effectiveness monitoring and research plots.

Monitoring of Instream Conditions and Trends

Monitoring of restoration emphasizes stand development, species diversity, wind firmness and development of forest understory vegetation.

DNR has been working cooperatively to develop and implement the concepts in the HCP Salmon Habitat Conditions and Trends Monitoring (Pollock et al. 2001). Effectiveness monitoring for these conditions and trends was prepared collaboratively by the Northwest Fisheries Science Center's Environmental Conservation Division Watershed Processes Program, and DNR. This monitoring will describe changes in salmon habitat resulting from riparian conservation strategy activities. This will include instream habitat changes relating to adjacent riparian forest conditions.

The instream conditions and trends monitoring uses general habitat requirements for anadromous salmonid species and the current scientific literature to select quantifiable parameters and develop a statistically rigorous monitoring design. Several recent efforts, (e.g., Poole et al. 1997, Bauer and Ralph 1999) have provided valuable summaries of available information and interpretation of those data. In addition, several research groups (e.g., Oregon Department of Fish and Wildlife, U.S. Forest Service) currently are conducting similar assessments.

Instream conditions and trend monitoring is being conducted in close collaboration with DNR to ensure that the Salmon Habitat Conditions and Trends monitoring guidance is consistent with other riparian effectiveness monitoring modules required by DNR's HCP and management objectives.

Hypotheses for Riparian Effectiveness Monitoring

It is assumed that improvements to instream habitat will occur as deciduous and young conifer forests within riparian ecosystems develop into older conifer forests. This is a predicted outcome of the HCP, which suggests that instream habitat will improve as riparian forests become older. It is assumed that the two primary means by which older forests will improve instream habitat are: the provision of additional shade, and organic material—particularly large woody debris. The shade should lower stream temperatures, while the instream large woody debris should create more pool habitat.

The monitoring guidelines propose specific hypotheses linking instream conditions to upslope management activities. Observed trends in instream conditions may result from changes in upslope management (i.e., road and unstable slope management), thus in order to make broader interpretations, instream monitoring efforts will necessarily have to be linked to monitoring modules. In order to build a capacity for integrating and facilitating a more rapid connection between DNR's various monitoring modules, specific hypotheses are suggested to link road and unstable slope management strategies to improvements in instream conditions.

Implementation and Adaptive Management

DNR has made a commitment through this Riparian Forest Restoration Strategy to a wide range of actions to actively promote the development of structurally complex forests to benefit the habitat of aquatic- and riparian-dependent species (see Appendix 6 for a summary of those commitments). The Department also has committed to a training and implementation schedule that will ensure that managers are well trained and have continued support as they implement this strategy (see Appendix 7).

DNR recognizes that the science and understanding underlying the monitoring and evaluation of riparian restoration efforts are rapidly evolving (Pollock et al. 2005). DNR anticipates that the understanding will change over the life of the trust land HCP regarding watershed processes, natural disturbance rates and patterns, riparian forest functions, and the effects of management practices on aquatic and riparian systems. As this new information is acquired, DNR will learn how to better and more efficiently modify forest management activities, and to mitigate the effects of the activities on protected species and aquatic resources. It is the intention of DNR that restoration activities (i.e., thinning and hardwood conversion activities) will be applied annually to no more than approximately one percent of the Westside Riparian Management Zones (excluding the OESF).

Initial Implementation of the Riparian Forest Restoration Strategy

To address concerns and questions still remaining regarding the proposed Riparian Forest Restoration Strategy in the very short-term, the first three years will be an initial Implementation Period for effective riparian restoration. By December 2009, DNR will

produce a compliance monitoring report that will include at least the following information:

- Total acreage of Type I, II, and III riparian thinnings and hardwood treatments,
- Riparian silvicultural prescriptions outlining the residual RD and trees per acre,
- Stream type associated with riparian prescriptions,
- Untreated riparian acres due to site conditions (wetlands, unstable slopes, etc.), and
- Riparian restoration activity acreages treated by HCP planning unit.

At this time, the Riparian Forest Restoration Strategy Technical Review Committee will re-convene to address issues pertinent to the implementation of the strategy and determine if refinements are necessary.

For the foreseeable future, the main management objective for riparian forests will be restoration. This period is called the "restoration phase" of the HCP Riparian Conservation Strategy.

Currently, DNR believes that silviculture can be an effective tool for accomplishing this objective. Eventually, most riparian forests should attain a structure and species composition that is considered restored. At that time, economic objectives for riparian silviculture will be appropriate. Management for the simultaneous objectives of fish and wildlife habitats and forest commodities hold considerable appeal for the schools and other state beneficiaries who depend on DNR-managed state trust land for revenue. Future silvicultural systems may be effective tools for accomplishing these multiple objectives, called the "multiple-resource phase" of the conservation strategy.

A credible policy of multiple-resource management in riparian ecosystems must be based on valid scientific information, and effectiveness monitoring is one means of acquiring such information.

Implementation Period Commitments

The following non-standard localized activities described below will apply during the Implementation Period of this strategy (until January 1, 2009), and will require joint concurrence between the DNR trust lands HCP Implementation Manager and Federal Services (NOAA Fisheries and USFWS). After January 1, 2009, decisions will then be made regarding further implementation of these activities and the future need for interagency approval processes.

If DNR determines this approach is needed, it will coordinate with the Federal Services on a joint concurrence letter between the three agencies. The Services will have 60 working days to respond back to DNR, either with signing the concurrence letter, or notifying DNR otherwise.

Site-specific riparian activities that require joint concurrence between DNR and Federal Services:

1. Type II and Type III thinning to a RD 30.
2. Specific forest practice activities for salvage logging in riparian areas.
3. Conducting more than two commercial silvicultural restoration treatments within the same portion of the riparian area during the 70- to 100-year term of the HCP.
4. Conducting a Type III thinning in stands greater than 70 years of age. This approach to thinning older stands will be reviewed by the Technical Review Committee at the end of the three-year initial Implementation Period.
5. Specific non-timber resource activities (see non-timber section).

Changes to the stream typing methodology or the Riparian Forest Restoration Strategy also will require concurrence between the three agencies. However, the level of analysis and discussions between the agencies for these changes would be expected to be more comprehensive and systematic than addressing the site-specific issues addressed above.

Adaptive Management

The threshold for initiating adaptive management discussions will be tied either to the rejection or the acceptance of one or more of the testable hypotheses associated with a particular resource objective (Wilhere and Bigley 2001b). In cases in which the monitoring program establishes that the resource objectives are not being achieved (or conversely, that the existing prescriptions could be relaxed and still achieve the desired outcomes), discussion will be initiated with the Federal Services to address possible cause and effect relationships that could be responsible for the monitoring observations.

Adaptive management changes consistent with the restoration goal will be made to this Riparian Forest Restoration Strategy when implementation and/or effectiveness monitoring indicate that the objectives outlined in the RFRS and the HCP Riparian Conservation Strategy are not being met. It is anticipated that applied research led by DNR and others could result in innovations that will increase the Department's ability to implement the strategy with higher efficiency and less potential of short-term adverse habitat impacts. Adaptive management areas of interest for the Riparian Forest Restoration Strategy are listed in Table 6. These areas will be added to the research priorities in the HCP research and adaptive management plan (Bigley and Wilhere, 2001). Other subjects and their priority may be added or changed by mutual agreement. Changes to this Riparian Forest Restoration Strategy may be made by written agreement between the appropriate agency representatives.

The riparian forest affords the opportunity for long-term management of structural legacy trees, such as this snag that offers foraging for primary excavators such as woodpeckers.

Considering that active riparian management on DNR-managed state trust lands has not taken place to date, adaptive management that addresses refinements to management activities allowed in the Riparian Management Zones within the first decade of the HCP does not apply. DNR agrees that using the adaptive management process as outlined in the HCP's Implementation Agreement, management activities allowed within the RMZs will be refined during the entire term of the Habitat Conservation Plan.

Table 6. Summary of adaptive management subjects for the Riparian Forest Restoration Strategy.

Subject area	Priority
▪ Evaluate the need for increased site-specificity of thinning targets and prescriptions	1
▪ Evaluate windthrow associated with different thinning levels and site types	1
▪ Evaluate potential impacts of salvage operations on riparian function and plan for future salvage contingencies	1
▪ Evaluate Large Woody Debris recruitment rates within RMZ's associated with active restoration vs. natural self-thinning	1
▪ Evaluate the economics of hardwood thinning and conversion to conifer-dominated stands	2
▪ Evaluate the feasibility and value of thinning beyond the RDFC desired riparian condition	2
▪ Evaluate options for management of Large Woody Debris recruitment including the tipping of live trees	2
▪ Evaluate on a Watershed Administrative Unit scale the influence that the rate and extent of riparian restoration may have on stand development and possible negative short-term impacts on stream habitat.	2
▪ Evaluate options for snag creation and long-term management	2
▪ Evaluate the role of canopy gaps in providing riparian function	2

Appendix 1

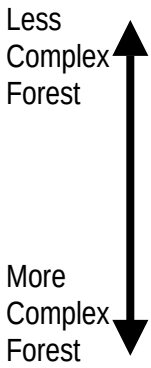
Stand Development Stages

The following table provides a summary of the DNR 2004 stand development stages. These are based on Carey et al. (1996) and Carey and Curtis (1996).

Stand Development Stage	Description
Ecosystem Initiation	Establishment of a new forest ecosystem following death or removal of overstory trees by wildfire, windstorm, insects, disease, or timber harvesting. Varying rates of retention of biological legacies (e.g., understory trees, large snags and down wood, soil microbes and invertebrates, fungi and non-vascular plants, etc.) influence the rate at which the stand develops into a Fully Functional forest in the future.
Sapling Exclusion	Trees fully occupy the site (canopy cover exceeds 70 percent) and start to compete with one another for light, water, nutrients, and space. Most other vegetation is precluded and many trees become suppressed and die.
Pole Exclusion	The high density and uniform size of relatively short trees creates dark understory conditions and low levels of biological diversity. Suppression mortality of smaller trees leads to the creation of small snags.
Large Tree Exclusion	Continued suppression mortality reduces tree density and creates small openings where scattered pockets of ground vegetation become established. Small snags created during the Pole Exclusion Stage fall, creating small down logs.
Understory Developement	Understory of herbs, ferns, shrubs, and trees develops after death or removal of some dominant trees; time has been insufficient for full diversification of the plant community.
Botanical Diversity	Organization and structure of the living plant community becomes complex with time, but lack of coarse woody debris and other biological legacies precludes a full, complex biotic community.
Niche Diversification	The biotic community becomes complex as coarse woody debris, cavity trees, litter, soil organic matter, and biological diversity increase; diverse trophic pathways develop; wildlife foraging needs are met.
Fully Functional	Additional development provides habitat elements of large size and interactions that provide for the life requirements of diverse vertebrates, invertebrates, fungi, and plants.

The stand development stages used in this document are adapted from DNR (2004), which is based on Carey et al. (1996). DNR's classification system summarizes forest stand structures using three major categories with eight more detailed stand development stages. The following chart illustrates the stand development stages.

Summarized Stand Development Stages

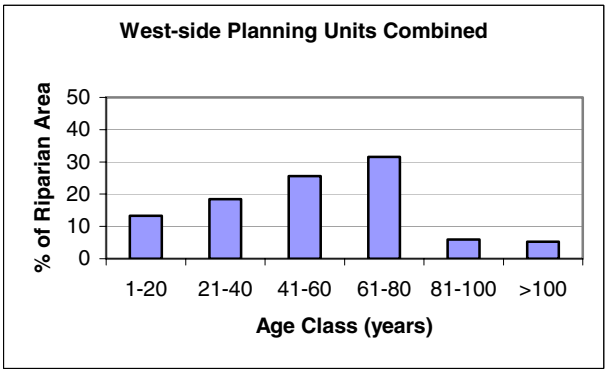


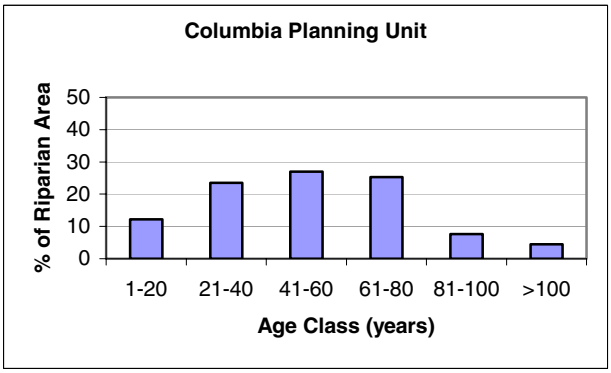
Summarized Stand Development Stage	Stand Development Stage
Ecosystem Initiation	Ecosystem Initiation
Competitive Exclusion	Sapling Exclusion
	Pole Exclusion
	Large Tree Exclusion
	Understory Reinitiation
Structurally Complex	Botanical Diversity
	Niche Diversification
	Fully Functional/ Old Natural Forests

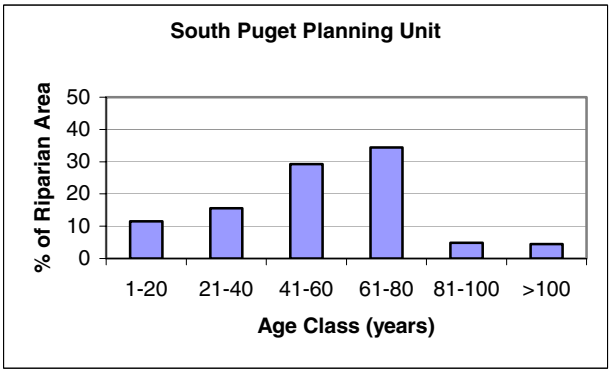
Appendix 2

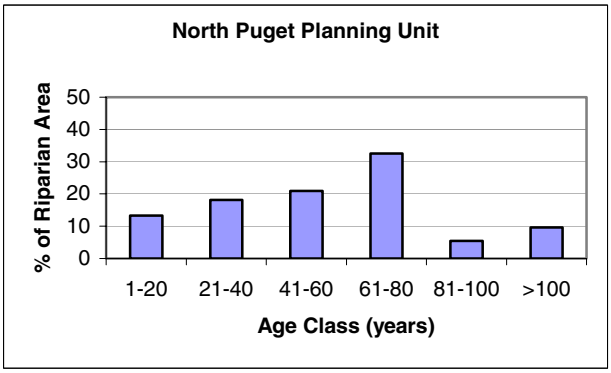
Riparian Management Zone Age Class Distributions

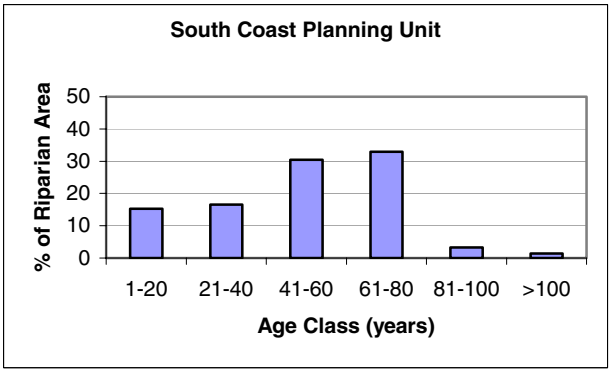
Approximate age distribution of riparian forests on DNR-managed forestlands in the five Westside HCP planning units are described below. Forest ages are actually for upland stands adjacent to riparian areas. However, because forest practices rules did not require Riparian Management Zones (RMZs) on streams before 1987, riparian forests are approximately the same age as the upland forests, wherever stands are more than about 12 years old. For stands between 0 and 20 years, about half have narrow RMZs containing older trees. Data are for forests along Type 1, 2, 3, and 4 streams.

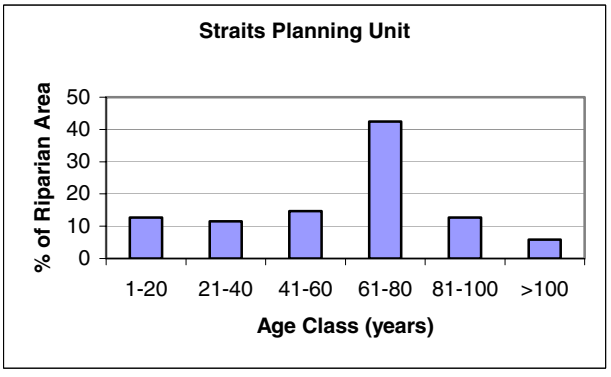












Appendix 3

Water Typing System for Forested State Trust HCP Lands

(Washington Forest Practices Board Emergency Rules, November 1996 Washington State Register, Issue November 1996)

(1) **"Type 1 Water"** means all waters, within their ordinary high-water mark, as inventoried as "shorelines of the state" under chapter 90.58 RCW and the rules promulgated pursuant to Chapter 90.58 RCW, but not including those waters' associated wetlands as defined in Chapter 90.58 RCW.

(2) **"Type 2 Water"** shall mean segments of natural waters, which are not classified as Type 1 Water and have a high fish, wildlife, or human use. These are segments of natural waters and periodically inundated areas of their associated wetlands, which:

(a) Are diverted for domestic use by more than 100 residential or camping units or by a public accommodation facility licensed to serve more than 100 persons, where such diversion is determined by the Department to be a valid appropriation of water and the only practical water source for such users. Such waters shall be considered to be Type 2 Water upstream from the point of such diversion for 1,500 feet or until the drainage area is reduced by 50 percent, whichever is less;

(b) Are diverted for use by federal, state, tribal or private fish hatcheries. Such waters shall be considered Type 2 Water upstream from the point of diversion for 1,500 feet including tributaries if highly significant for protection of downstream water quality. The Department may allow additional harvest beyond the requirements of Type 2 Water designation provided the Department determines after a landowner-requested on-site assessment by the Department of Fish and Wildlife, Department of Ecology, the affected Tribes and the interested parties that:

(i) The management practices proposed by the landowner will adequately protect water quality for the fish hatchery; and

(ii) Such additional harvest meets the requirements of the water type designation that would apply in the absence of the hatchery;

(c) Are within a federal, state, local, or private campground having more than 30 camping units: *Provided*, that the water shall not be considered to enter a campground until it reaches the boundary of the park lands available for public use and comes within 100 feet of a camping unit, trail or other park improvement;

(d) Are used by substantial numbers of anadromous or resident game fish for spawning, rearing or migration. Waters having the following characteristics are presumed to have highly significant fish populations:

(i) Stream segments having a defined channel 20 feet or greater in width between the ordinary high-water marks and having a gradient of less than 4 percent.

(ii) Lakes, ponds, or impoundments having a surface area of 1 acre or greater at seasonal low water.

(e) Are used by salmonids for off-channel habitat. These areas are critical to the maintenance of optimum survival of juvenile salmonids. This habitat shall be identified based on the following criteria:

(i) The site must be connected to a stream bearing salmonids and accessible during some period of the year; and

(ii) The off-channel water must be accessible to juvenile salmonids through a drainage with less than a 5 percent gradient.

A canopy gap caused by root disease next to this Type 3 (potentially fish-baring) stream has allowed the understory shrub layer to reestablish.

(3) **"Type 3 Water"** shall mean segments of natural waters, which are not classified as Type 1 or 2 Water and have a moderate to slight fish, wildlife, and human use. These are segments of natural waters and periodically inundated areas of their associated wetlands which:

(a) Are diverted for domestic use by more than 10 residential or camping units or by a public accommodation facility licensed to serve more than 10 persons, which such diversion is determined by the Department to be a valid appropriation of water and the only practical water source for such users. Such waters shall be considered to be Type 3 Water upstream from the point of diversion for 1,500 feet or until the drainage area is reduced by 50 percent, whichever is less;

(b) Are used by significant numbers of anadromous or resident game fish for spawning, rearing or migration. Guidelines for determining fish use are described in the *Forest Practices Board Manual.* If fish use has not been determined:

(i) Waters having the following characteristics are presumed to have significant anadromous or resident game fish use:

(A) Stream segments having a defined channel of 2 feet or greater in width between the ordinary high-water marks in Western Washington and having a gradient 16 percent or less;

(B) Stream segments having a defined channel of 2 feet or greater in width between the ordinary high-water marks in Western Washington and having a gradient greater than 16 percent and less than or equal to 20 percent, and having greater than 50 acres in contributing basin size in Western Washington;

(ii) The Department shall waive or modify the characteristics in (i) above where:

(A) Waters are confirmed, long term, naturally occurring water quality parameters incapable of supporting anadromous or resident game fish;

(B) Snowmelt streams have short flow cycles that do not support successful life history phases of anadromous or resident game fish. These streams typically have no flow in the winter months and discontinue flow by June 1; or

(C) Sufficient information about a geographic region is available to support a departure from the characteristics in (i), as determined in consultation with the Department of Fish and Wildlife, Department of Ecology, affected Tribes and interested parties.

(iii) Ponds or impoundments having a surface area of less than 1 acre at seasonal low water and having an outlet to an anadromous fish stream.

(iv) For resident game fish ponds or impoundments having a surface are greater than 0.5 acre at seasonal low water.

(c) Are highly significant for protection of downstream water quality. Tributaries which contribute greater than 20 percent of the flow to a Type 1 or 2 Water are presumed to be significant for 1,500 feet from their confluence with the Type 1 or 2 Water or until their drainage area is less than 50 percent of their drainage area at the point of confluence, whichever is less.

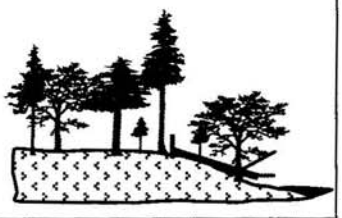
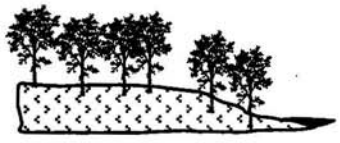
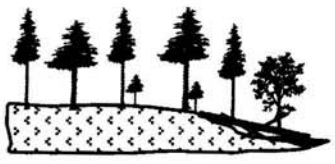
(4) **"Type 4 Water"** classification shall be applied to segments of natural waters which are not classified as Type 1, 2 or 3, and for the purpose of protecting water quality downstream are classified as Type 4 Water upstream until the channel width becomes less than 2 feet in width between the channel width becomes less than 2 feet in width between the ordinary high-water marks. Their significance lies in their influence on water quality downstream in Type 1, 2, and 3 Waters. These may be perennial or intermittent.

(5) **"Type 5 Water"** classification shall be applied to all natural waters not classified as Type 1, 2, 3 or 4; including streams with or without well-defined channels, areas of perennial or intermittent seepage, ponds, natural sinks and drainage ways having short periods of spring or storm runoff.

Type 5 non-fish-bearing streams.

Appendix 4

Riparian Management Scenarios Summary

Stand Condition	Restoration Objective and Priority	Desired Stand Development
Conifer-Dominated Stands: **Type II RMZ Thinning in Conjunction with Upland Thinning** 	Accelerate individual tree growth, vigor, and stability. Promote species diversity with priority on retaining a component of shade tolerant tree species. Promote future heterogeneity in stand structure. Creation of dead down wood to enhance riparian habitat. **Highest Priority**	
Conifer-Dominated Stands: **Type III RMZ Thinning in Conjunction with Upland Thinning** 	Accelerate individual tree growth, vigor, and stability. Promote species diversity, protect existing structural components. Promote heterogeneity in stand structure. In particular snags, down wood, remnant trees, and advance regeneration will be protected. Creation of dead down wood and instream large down wood to enhance riparian habitat. **Second Highest Priority**	
Conifer-Dominated Stands: **Type III RMZ Thinning in Conjunction with Upland Regeneration Harvest**	Same as above with the addition of protecting the stand from excessive windthrow. **Medium Priority**	
Hardwood-Dominated Stands: **Individual Conifer Release** 	Release established conifers from hardwood competition. Protect any existing structures such as snags and DWD. **Low Priority**	
Hardwood-Dominated Stands: **Conversion** 	Create an older forest stand condition dominated by conifers by eliminating the current stand and establishing a mix of site-adapted conifer species. **Low Priority**	

Appendix 5

Modeled Riparian Management Scenarios

The Washington State Department of Natural Resources' stand development projections for conifer-dominated scenarios using potential silvicultural treatments were envisioned in the Riparian Forest Restoration Strategy. Modeled are the following two scenarios for a 70-year planning period (approximately the span of the HCP):

Type II RMZ thinning with upland thinning: Stands with a conifer basal area greater than 50 percent that are in the Pole Exclusion stand development stage or below; ages are generally below 40 years, the Quadric Mean Diameter (QMD) is less than 10, and relative density (RD) generally greater than 45.

Type III RMZ thinning with upland thinning: Stands with a conifer basal area greater than 50 percent that are in the Large Tree Exclusion or Understory Reinitiation stand development stage; ages are generally more than 40 years of age, the QMD is greater than 10, and relative density is variable. The scenarios in this example are designed to illustrate one version of the possible implementation of the strategy. Each activity is careful not to overstep the minimum relative density of trees per acre allowed within the negotiated range.

For each scenario, an example stand with the following species mixture was modeled: Douglas-fir-dominated stand containing 8 percent red alder, 40 percent western hemlock and 52 percent Douglas-fir.

Each scenario is modeled with three alternate paths during the 70-year time period of the HCP: no treatment, one, and two thinning treatments to various residual relative density levels. Starting age of the stand for the Type II treatment is 40 years (Scenario A), for the Type III treatment, 50 years (Scenario B).

The projections were modeled with the Forest Vegetation Simulator (FVS) West Cascades variant. For each stage in the 70-year stand development period, the following parameters are presented:

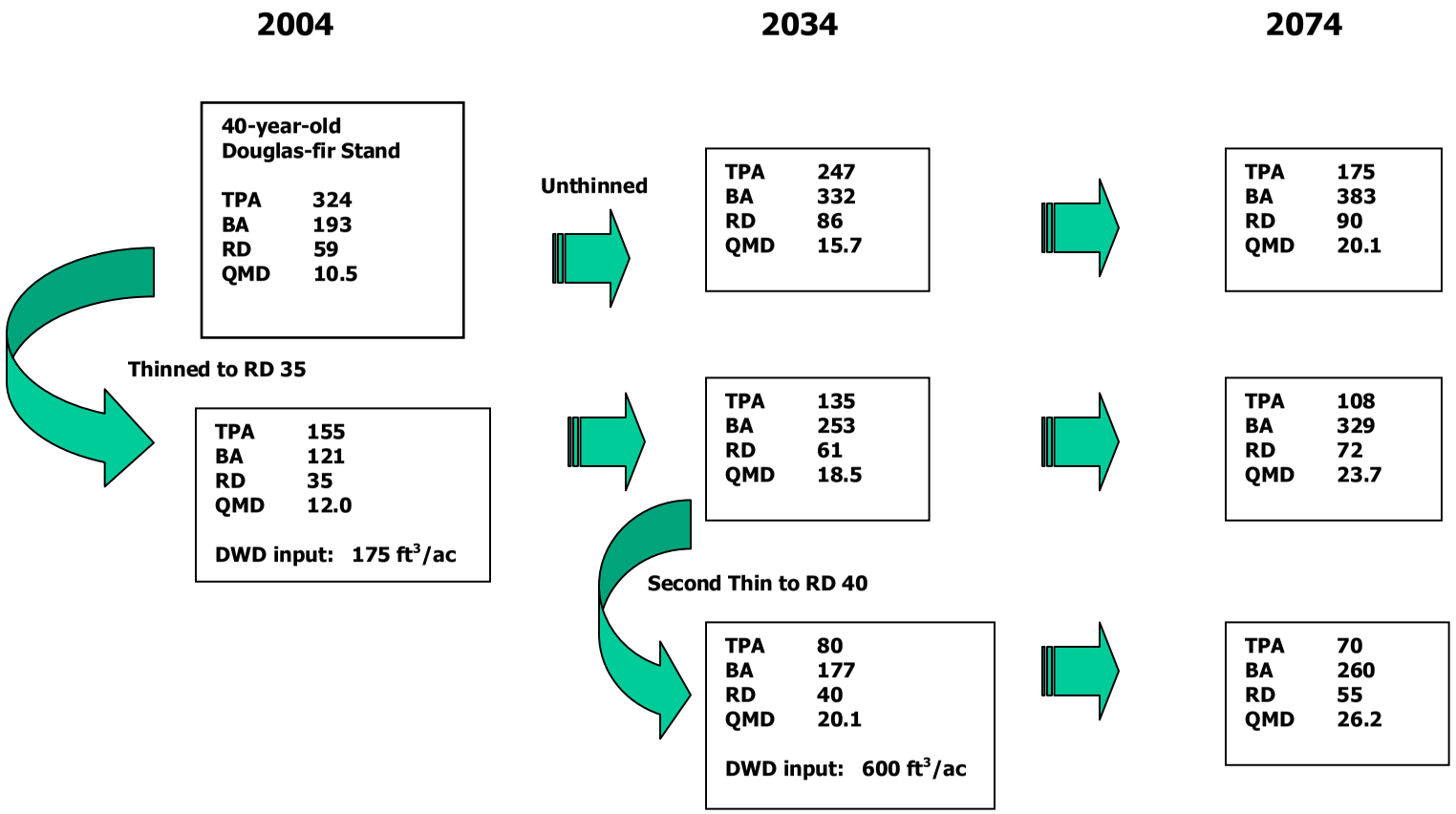
- TPA (Trees per acre)
- BA (Basal area per acre)
- RD (Relative density)
- DBH (Diameter at breast height 4.5 feet)
- QMD (Quadric mean diameter) of trees 4.5 inches DBH and larger
- DWD (Down woody debris) input in cubic feet per acre* since beginning of simulation (5 trees per acre from the largest thinned DBH class per harvest entry into stand)

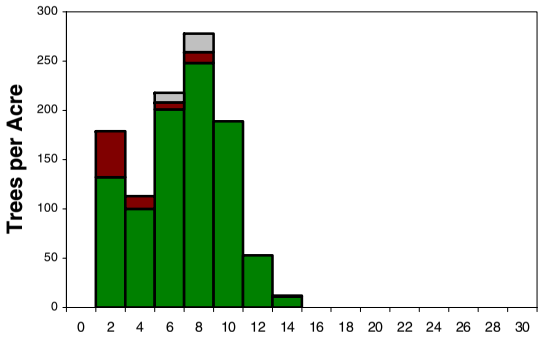
- Conifer regeneration is naturally highly variable and is included in these simulations. The survivorship of the conifer regeneration is controlled by FVS.
- For scenario “A” selected diameter distributions are shown to illustrate advancement toward the RDFC and long-term management objectives.

* Calculations based on “Cubic-foot volume table for second-growth Douglas-fir on Forest Survey Standard” in J.R. Dilworth. 1970. Log scaling and timber cruising. OSU, Corvallis, OR.

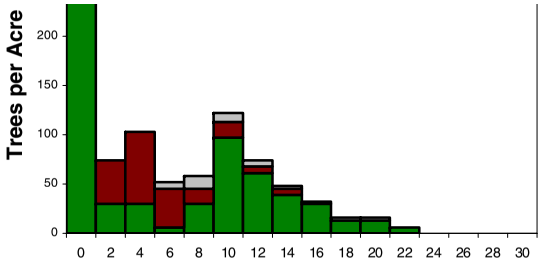
Appendix 5 continued

Management Scenario A. Type II RMZ thinning represented by a Douglas-fir stand 40 years of age

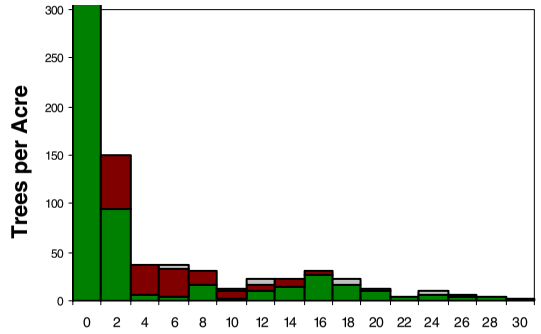




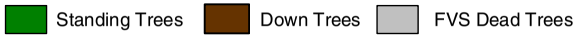
Diameter distribution for management scenario ‘A’ in 2004, shows the initial unthinned stand as ‘trees per acre by 2-inch diameter’ classes. The initial stand represents an unthinned stand in the Pole Exclusion development stage.



Diameter distribution for management scenario ‘A’ in 2034, 30 years after being thinned to Relative Density 35. Also using ‘trees per acre by 2-inch diameter’ classes, stand diameter distribution is starting to resemble that of the Riparian Desired Future Condition (Figure 3).

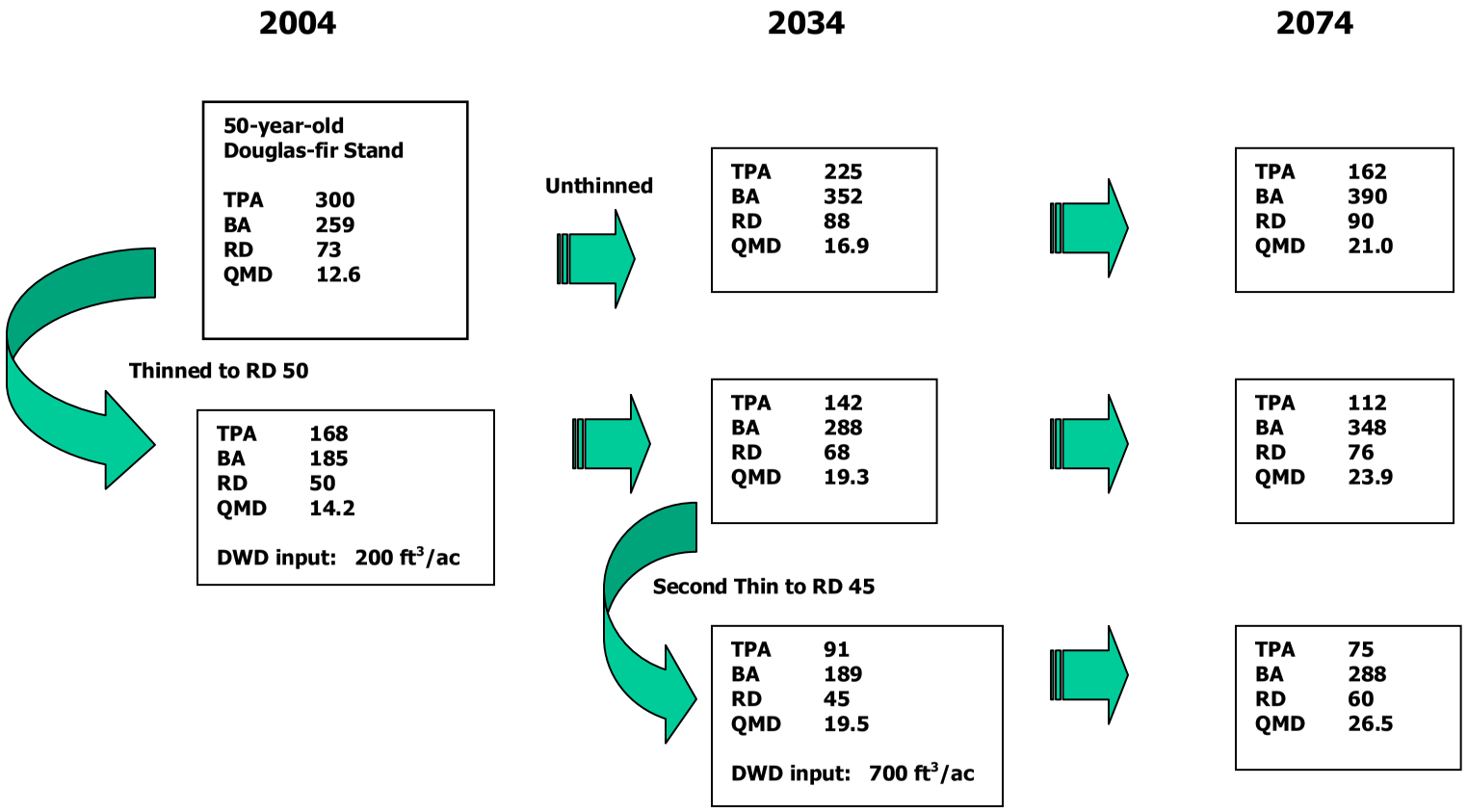


Diameter distribution of management scenario ‘A’ in 2074, 70 years after being thinned to RD 35 and 40 years, after a second thinning to RD 40. Stand diameter distribution is starting to resemble that of the long-term goal for riparian forests (Figure 2).



Appendix 5 continued

Management Scenario B. Type III RMZ thinning represented by an unmanaged Douglas-fir stand 50 years of age



Appendix 6

Summary of Riparian Forest Restoration Strategy Commitments

Under the Washington State Department of Natural Resources' trust lands Habitat Conservation Plan (HCP), Riparian Management Zones (RMZ) are to be restored to create high quality aquatic habitat to aid federal salmon recovery efforts, and to contribute to the conservation of other aquatic and riparian obligate species. This goal will be achieved with a combination of active management through forest stand manipulation and the natural development of unmanaged forest stands. Over time, the strategy is designed to restore structurally complex forests providing all ecological functions that meet the conservation objectives.

Appendix 6 is a summary of the major commitments contained within the Implementation Procedures for the HCP Riparian Forest Restoration Strategy (RFRS). This summary may not discuss all the commitments of the strategy and is not meant to be a substitute for the full RFRS document. Please note that HCP commitments such as the determination and application of riparian buffers are not listed here.

- This Implementation Procedure for the Riparian Restoration Strategy replaces the 1999 Forestry Handbook procedure PR 14-004-150 and is to be implemented through training of region Riparian Resource Designees and field personnel. Training is to include the Federal Services, and implementation will take place in a phased approach. Full implementation will start in fiscal year 2007.
- The strategies outlined in this document apply to lands managed under the HCP west of the Cascade crest, with the exception of the Olympic Experimental State Forest (OESF). Strategies described in this document are required to be implemented in the field when forested Riparian Management Zone restoration is being considered, unless alternate plans are approved in writing by the HCP Implementation Management or their designees, in consultation with the appropriate DNR Region Manager or Region State Lands Assistant Manager.

DNR will implement all aspects of its riparian conservation strategy as well as other strategies that require stream typing using the Washington Forest Practices Board Emergency Rules, November 1996 (WAC 222-16-030). This stream typing system will now be officially referenced as the "Water Typing System for Forested State Trust HCP Lands."

- The restoration objective is the Riparian Desired Future Condition (RDFC). The RDFC will result in riparian forests that resemble the Developed Understory to Niche Diversification stages and have at minimum a basal area of 300 square feet and a quadratic mean diameter (QMD of trees 7 inches and greater DBH) of 21 inches.
- Before deciding on a specific riparian restoration approach, DNR staff will consider alternative silvicultural pathways, including a no treatment alternative, and will analyze the respective potential impacts to the Riparian Management Zone.

- Management of riparian forest stands will only take place if management activities—within acceptable risk parameters—would decrease the amount of time required to meet stand-specific riparian objectives compared to the no treatment option.
- Forest stands that already have met the Riparian Desired Future Condition quadratic mean diameter and basal area targets will not be eligible for restoration.
- The middle and outer riparian zones are condensed into one zone for operational purposes.
- Where necessary, the 25-foot inner riparian zone will be expanded on a site-specific basis to maintain post treatment shading of the stream and other environmental functions.
- All management within Riparian Management Zones will be site-specific, i.e., tailored to the physical and biological conditions at a particular site.
- During commercial restoration activities, a total of five (5) trees per acre of the RMZ will be dedicated toward dead wood goals (exception: one tree per acre if the harvest entry removes 15 trees per acre or less) before merchantable trees will be removed. Large existing snags (20” DBH, 16’ height) or areas that are unusually rich in snags within riparian forests will be protected.
- Conifer-dominated stands (conifer basal area >50 percent) will be restored using thinning and uneven-aged management techniques such as small canopy gaps. Canopy gaps will be used outside 100 feet of the 100-year flood plain and be 0.25 acres in size or smaller, where appropriate. Thinning will result in residual riparian forest relative densities greater than 30 (thinning below RD 35 to RD 30 will require HCP Implementation Manager approval in consultation with the Federal Services) or at least 100 trees per acre (75 trees per acre in stands of the Large Tree Exclusion or later forest stand development stages), whichever results in the greater number of residual trees. Thinning will be from below or across the diameter range, retaining the largest trees and the existing tree species diversity.
- Type III thinnings will occur in stands less than 70 years of age. If appropriate, thinning activities may occur in stands greater than 70 years of age with written approval from the HCP Implementation Manager and in consultation with the Services. This approach to thinning older stands will be reviewed by the Riparian Forest Restoration Strategy Technical Review Committee at the end of the three-year Implementation Period.
- Windthrow risk assessments will determine the need for wind buffers. Wind buffers will be treated the same as the middle and outer zone. In areas of moderate and high windthrow risk, post-thinning RD of the dominant and co-dominant canopy will be greater than 60 percent of the pre-thinning RD, and RD will be greater than 40, or at least 75 dominant and co-dominant trees per acre, whichever results in the greater number of residual trees.
- Hardwood-dominated stands (hardwood basal area > 50 percent) will be restored using individual tree release (if more than 25 viable conifers per acre are present) or even-aged regeneration in the form of patch cuts. Patch cuts will be less than 2.5 acres in size and separated by 150-foot no-harvest buffers. No conifers will be cut during restoration of hardwood-dominated stands except for operational reasons. A natural resource specialist will be consulted to help draft a site-specific management plan, ensuring that restoration objectives will be met.
- If more than two commercial management entries are planned for a riparian stand within the 70- to 100-year HCP planning period, prior approval by the HCP Implementation Manager in consultation with the Federal Services will be required.

- For all commercial prescription categories, no restoration harvest activities will be allowed in the inner zone, until they are addressed through the adaptive management process.
- Pre-commercial management activities and non-commercial restoration activities (creation of large woody debris, underplanting, release of suppressed conifers, and noxious weed control) may take place inside the inner zone to the edge of the 100-year flood plain.
- Disturbance to the inner riparian zone during commercial activities will be restricted to road crossings and yarding access.
- Roads will continue to be used and constructed within Riparian Management Zones for forest management and other activities. Trees felled within the RMZ inner zone (25 feet on either side of the stream) with respect to road construction, reconstruction or maintenance will be used for instream riparian enhancement, unless a biologist or engineer determines the site is unsuitable for wood placement. At each stream crossing, one (1) log from the largest cut conifer diameter class—and in length at least two times the width of the ordinary high-water mark of the stream—will be placed across the stream on the down-stream side of the crossing. Three (3) root wads, if present, will be placed additionally in or along the stream channel on the downstream side of the crossing. All other grubbed stumps from within the inner zone, when available, will be placed in a linear fashion at least 50 feet from the road in the middle or outer zone of the RMZ. All other timber within the right-of-way inside the RMZ may be removed. If instream habitat enhancement is not feasible, an alternate plan will be forwarded to the appropriate HCP Implementation Manager.
- Full suspension yarding will be required in the inner zone of the Riparian Management Zone. Yarding corridors will be kept to a minimum in numbers and width.
- Low ground pressure mobile equipment will be allowed for thinning in the RMZ. Terrain and timing restrictions will be imposed to minimize impacts. No ground equipment will be allowed within 25 feet of the inner zone (leaving a 50-foot zone of undisturbed ground vegetation along the stream) except for road construction. The quantity and width of skid trails will be kept to a minimum in numbers and width. Trees that will be removed will be directionally felled away from the inner zone when feasible. Wherever possible, ground-based equipment will ‘walk’ on a mat of logging slash to reduce soil compaction and rutting. Skid trails within the RMZ will be water barred.
- During these operations, trees that are damaged in the middle and outer zone of the Riparian Management Zone will be allowed to remain on site as live trees, snags, or down woody debris, and can be counted toward the riparian enhancement targets. Trees that are cut or damaged in the inner zone of the RMZ will remain on site and cannot be counted toward the riparian enhancement targets.
- For the purpose of blowdown salvage, a site-specific plan will be required. The plan shall contain a strategy on how to meet the Riparian Desired Forest Condition, including a specific reforestation plan and a plan addressing down woody debris levels. The site-specific restoration plan will be submitted to the HCP Implementation Manager for approval in consultation with the Federal Services.
- Riparian associated wetlands (periodically inundated areas of Type 1, 2, and 3 Waters) will not be subject to thinning.
- Non-timber activities will be managed in a way conducive to the HCP Riparian Forest Restoration Strategy goals and objectives. Written exemptions will be requested from the Federal Services for the following activities within the required RMZ of Type 1-4 streams:

campgrounds, trail heads, surface disturbance activities from oil and gas leases or mining leases, rock and gravel pits, utility easements, and special forest products leases.

- New information from DNR and other research and monitoring sources will play an important role in the future evolution of this strategy through the adaptive management process.
- Upon approval, this strategy will be subject to compliance and effectiveness monitoring, as are the other HCP strategies. Annual reporting to Federal Services will document implementation compliance monitoring of the riparian strategy.
- Adaptive management changes consistent with the restoration goal will be made to this Riparian Forest Restoration Strategy when implementation and/or effectiveness monitoring indicate that the objectives outlined in the RFRS are not being met. Changes can be made by the exchange of letters by the appropriate agency representatives.

Implementation Period Commitments

The following non-standard localized activities described below will apply during the Implementation Period of this strategy (until January 1, 2009), and will require joint concurrence between the DNR HCP Implementation Manager and the Federal Services (NOAA Fisheries and USFWS). After January 1, 2009, decisions will be made regarding further implementation of these activities and the future need for interagency approval processes.

If DNR determines this approach is needed, DNR will coordinate with the Federal Services on a joint concurrence letter between the three agencies. The Federal Services will have 60 working days to respond back to DNR, either with signing the concurrence letter, or notifying the Department otherwise.

Site-specific riparian activities that require joint concurrence between DNR and Federal Services:

1. Type II and Type III thinning to a RD 30.
2. Specific forest practice activities for salvage logging in riparian areas.
3. Conducting more than two commercial silvicultural restoration harvest treatments within the same portion of the riparian area during the 70- to 100-year term of the HCP.
4. Conducting a Type III thinning in stands greater than 70 years of age.
5. Specific non-timber resource activities (see non-timber section).

Changes to the stream typing methodology or the Implementation Procedures for the Riparian Forest Restoration Strategy will also require concurrence between the three agencies. However, the level of analysis and discussions between the agencies for these changes would be expected to be more comprehensive and systematic than addressing the site-specific issues addressed above. See Section 4 of this document for changes applied to the RFRS due to adaptive management.

Appendix 7

Field Training and Implementation Schedule

The Implementation Procedures for the Riparian Forest Restoration Strategy will be carried out through the Washington State Department of Natural Resources' region-based specialists that can provide a readily accessible resource for the local managers, and serve as the nexus for ongoing consultation and updating of the field procedures. Training sessions will be conducted for field personnel designing forest management activities.

The training session is intended to provide field managers with a sound context for the evaluation and prioritization of restoration activities in riparian areas. Additionally, the training will provide guidance on the design and implementation of appropriate site-specific silvicultural prescriptions for the restoration of riparian management areas.

The training plan will be implemented through a number of planned activities identified as follows:

APPROXIMATE DATE	PLANNED ACTIVITY
August 2005	Riparian Forest Restoration Strategy approved by Federal Services
May 2005	Identify region Riparian Resource Designees[1] for the implementation of the Riparian Forest Restoration Strategy
May 2005	Provide training to region Riparian Resource Designees. This will most likely comprise of a week long, in the field, training session. The cadre of instructors will include: ▪ DNR Silviculturists and Biologists ▪ USFWS and NOAA Fisheries Scientists ▪ USFWS Fisheries Biologist ▪ DNR Division Training Designees
Fiscal Year 2006	Riparian Forest Restoration Strategy field trials Implement Monitoring and Adaptive Management
Fiscal Year 2007	Riparian Forest Restoration Strategy full implementation

[1]Region Riparian Resource Designees will be those staff members in the regions who are experienced in the application of silvicultural prescriptions designed for a specific outcome or forest condition, i.e., region silviculturists, forest scientists, foresters with silviculture expertise, etc.

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