Section 1

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.

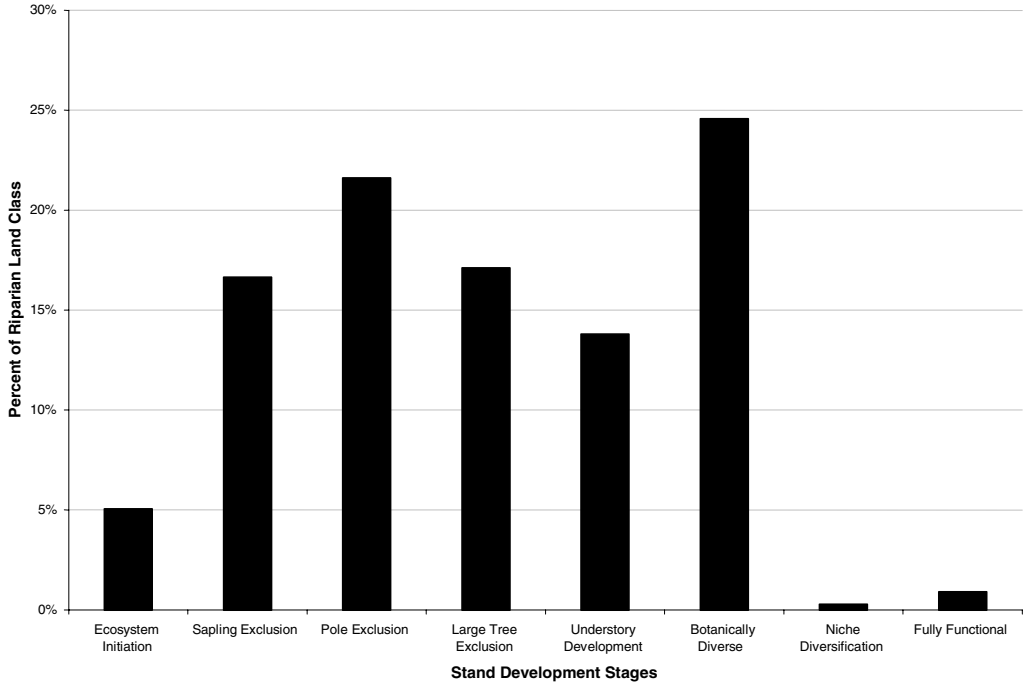


Figure 1. Distribution of stand development stages within riparian lands covered by DNR's HCP Riparian Conservation Strategy. See Appendix 1 for definitions of stand development stages. Data from modeled stand development stages based on Carey et al. 1996. Percentages are based upon the total riparian 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.

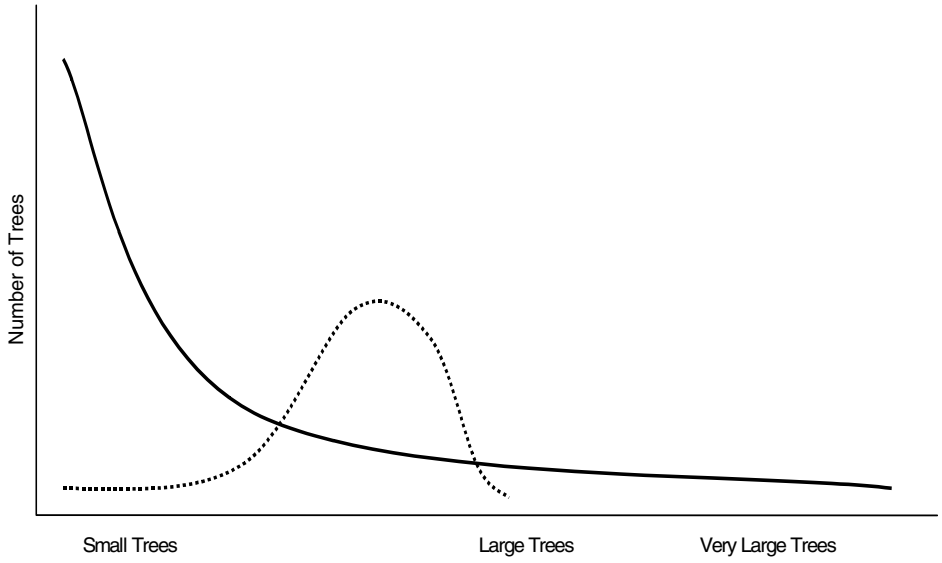


Figure 2. Hypothetical example of the distribution of tree sizes [diameter at breast height (DBH)] in a Competitive Exclusion condition (dashed line), a common current condition, and the diameter distribution of an older stand that would meet the management goal of the Fully Functional forest development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

Riparian Desired Future Condition

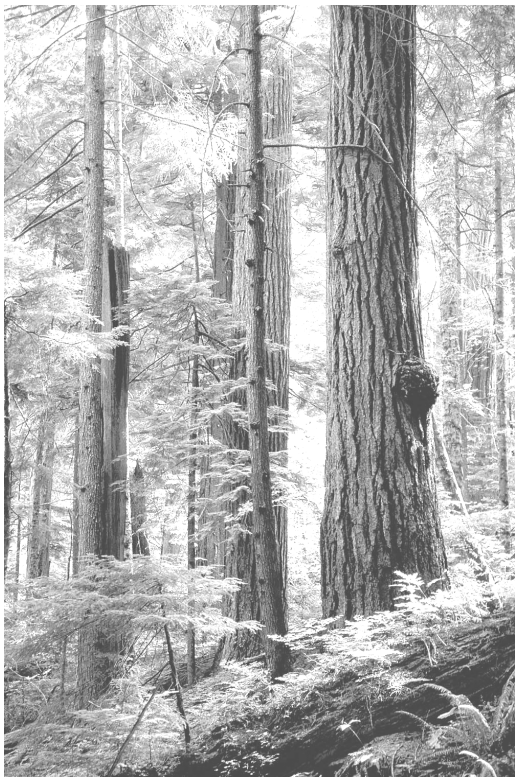
Managers need some measurable targets to assess opportunities and progress toward the long-term management objective. The riparian desired future condition (RDFC) provides that objective. The riparian desired future condition is divided into five categories representing the most important components 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.

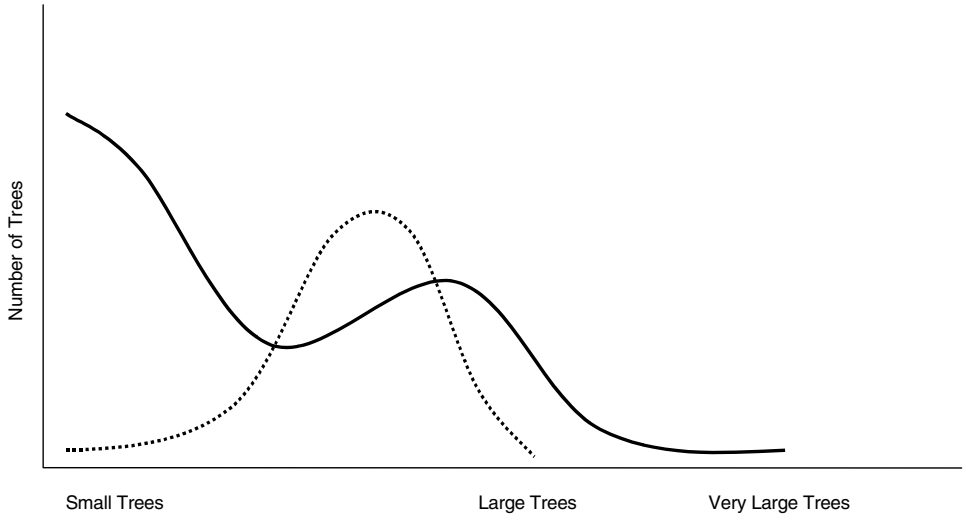


Figure 3. Hypothetical example of the tree diameter distribution for forest stands in the Competitive Exclusion Stage (dashed line) and for stands meeting the riparian desired future condition (solid line).

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.