Additional information on the Riparian Forest Restoration Strategy is provided in the following areas:

1. What the Riparian Forest Restoration Strategy Provides

In accordance with our riparian conservation strategy objectives, the Riparian Forest Restoration Strategy (RFRS) provides the framework to develop site-specific riparian forest prescriptions to achieve desired future conditions. Stand structure targets were developed to provide a means to assess management alternatives and measure progress.

This riparian management strategy will primarily use stand thinnings to hasten the development of stands towards a mosaic of structurally complex riparian forests and restore habitat functions while not appreciably reducing short-term ecosystem benefits. 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 sna*gs.

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2. Components of the Restoration Strategy

Long-Term Goal

The long-term goal is to manage for structurally complex riparian forests--assumed to be equivalent to the ecological definition of old growth conditions or the Fully Functional development stage.

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 the time period a riparian forest would spend in the competitive exclusion development stages. At the same time, important structural features of the Fully Functional stage such as DWD, LWD, and snags will be created to further hasten the development of riparian stands towards the long-term habitat restoration goal.

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, produces 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.

Riparian Desired Future Condition

The Riparian Desired Future Condition (RDFC) provides managers with measurable targets. The RDFC is not a rigorously defined forest development stage, but rather a benchmark against which managers can measure progress toward a structurally complex forest containing many of the key elements necessary to support a broad range of riparian ecological functions. This condition is divided into five categories (large conifer trees, complex stand structure, site-adapted tree species composition, down wood, and snags) representing the most important components for developing the Fully Functional forest. Elements of Fully Functional forest characteristics will begin to emerge in forests that represent the RDFC. The following table outlines the specific, measurable targets for developing the RDFC.

RDFC Characteristics	RDFC Threshold Targets (Discrete Measureables)
Basal area	at least 200 sq. ft. per acre (46 sq. m. per hectare)
Quadratic mean diameter for trees >7 inches (18 cm) dbh	at least 21 inches (53 cm)
Snags	Retain existing snags at least 20 inches (51 cm) dbh through no-cut zones. Maintain at least 3 snags per acre (7.4 snags per hectare).
Large down wood	Maintain at least 2,400 cubic feet/acre (168 cubic m/hectare). 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.

The time it takes a stand to reach the *Fully Functional* stage depends on a number of factors, including site productivity and stochastic events. The development process towards the Fully Functional stage may span hundreds of years. Because one of the goals of the RFRS is to manage stands to accelerate their trajectory towards the riparian desired future condition, stands that cannot be reasonably accelerated to the desired conditions will be managed passively.

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3. Scope of Implementation

The riparian strategy for the Habitat Conservation Plan covers 1.2 million acres (486,000 hectares) of DNR-managed forest land west of the Cascade crest in Washington. It is estimated that riparian areas encompass 20-30% of these lands. The overall extent of the riparian system varies greatly by landform and climate. The Riparian Forest Restoration Strategy (RFRS) has the potential for implementation on most timber sales in western Washington containing riparian areas

Stand condition, 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 RFRS. New information from research and monitoring will play an important role in the future evolution of this strategy through the adaptive management process.

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 floodplain and the inner 25 feet (7.6 meters) no harvest zone are not candidates for active restoration. 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. For the time being, stands that have already met the riparian desired future conditions quadratic mean diameter and basal area targets will not be eligible for active restoration.

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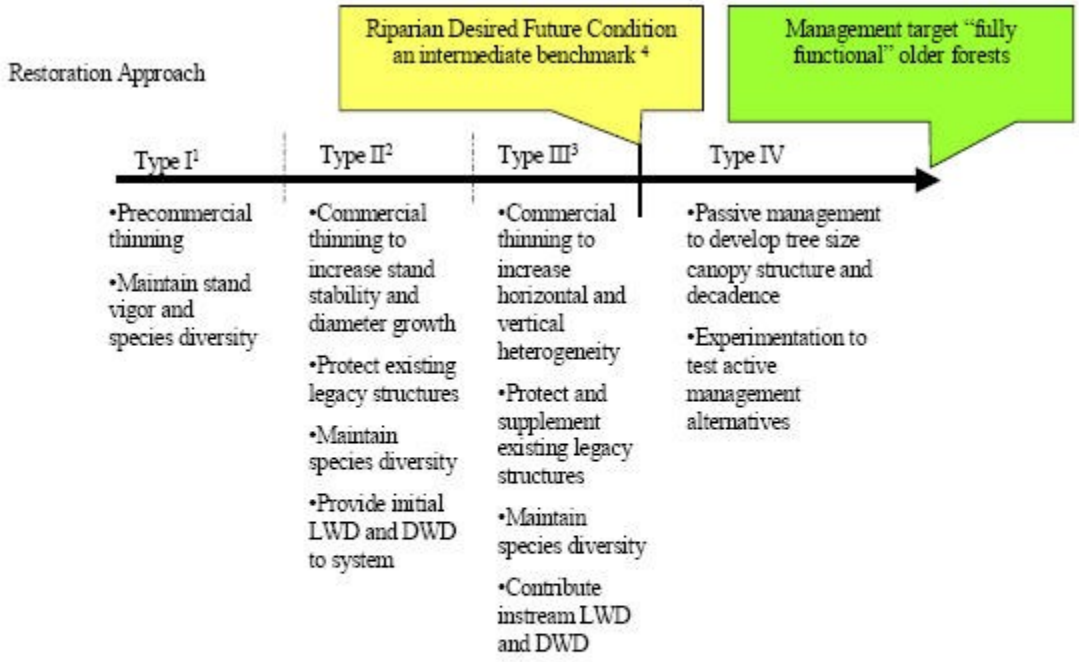
4. Silvicultural Treatments

The main objective of silvicultural activities will be to put the riparian management zone on an accelerated trajectory toward the riparian desired future condition. Treatments are segregated by initial stand condition and labeled as treatment objective Type I-IV. The following table summarizes how different silvicultural treatments will move stands from the Sapling Exclusion stage to the riparian desired future condition and how passive management (Type IV stage) will then eventually lead to the long-term goal of Fully Functional forests.



[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.

Management activities are classified by the stand development stages in which they occur: 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 will be site-specifically designed to accelerate attainment of the desired stand condition and composition. Type III treatments will also incorporate an assessment of the risk that the management activities would impose on the ecosystem.

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 when compared to the no treatment option.

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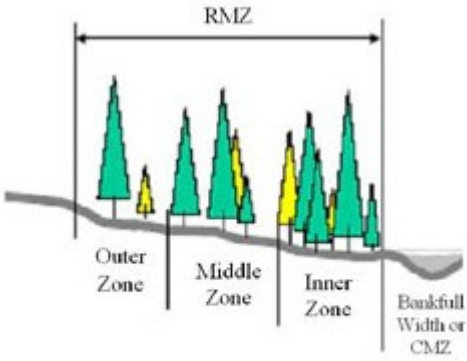
5. Riparian Buffer Spatial Structure

Riparian buffers, or riparian management zones (RMZs), are streamside zones where harvesting is limited or excluded to protect the habitat of salmonids and riparian obligate species. The structure of the riparian buffers depends on the stream type, the site potential tree height, and site-specific management.

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.

On larger, fish-bearing streams (Type 1, 2, and 3) the riparian buffer width is equivalent to the average height an adjoining upland conifer stand would be expected to reach at 100 years of age (Site index 100, SI100) or 100 feet (30.5 m), whichever is greater. The buffer is measured horizontally from the outer edge of the 100-year floodplain and is maintained along each side of the stream.
On Type 4 streams, DNR maintains an RMZ width of at least 100 feet (30.5 m), measured horizontally from the outer edge of the 100-year floodplain along each side of the stream.
A long-term conservation strategy for the management of riparian forests along Type 5 streams is under development. These smaller, non-fish bearing headwater streams are currently managed under the Interim Conservation Strategy. Those associated with highly unstable slopes are protected in accordance with the Washington State Forest Practices rules. Those not associated with highly unstable slopes are protected only when necessary for water quality, fisheries habitat, stream banks, wildlife, and other important elements of the aquatic system.



Schematic showing location of inner, middle, and outer zones within the RMZ.

Specific Riparian Management
Each riparian management zone consists of an inner, middle, and outer zone. The inner zone is a 25 feet (7.6 m) wide strip along the stream's bankfull width. No harvesting occurs within the inner zone. The middle and outer zones and the wind buffer (if needed) may be thinned from below to a Curtis RD (relative density) > 35 or at least 100 dominant and co-dominant trees per acre. Five designated conifer trees per thinned riparian management zone acre from the largest diameter class of the thinned trees are to be fallen and left as down wood or snags.

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.

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6. Implementation Schedule

We performed field trials (pilot projects) for the Riparian Forest Restoration Strategy within each western Washington region. The purpose of establishing pilot projects was two-fold: 1) to follow up on the week-long training that was conducted in May 2006, and 2) to create a set of demonstrations to help confirm all parties were clear on the objectives and practice of the strategy.

As of November 2006, the Northwest, South Puget Sound, and Pacific Cascade regions have received approval for full implementation of the RFRS. Over the next 3 years, we will monitor implementation of the strategy and consider any adaptive management changes. In 2009, the Riparian Forest Restoration Strategy Technical Review Committee will reconvene and address adaptive management opportunities.

RFRS Implementation timeline.

Training

For guidance on implementation of the Riparian Forest Restoration Strategy, please see the Training Materials used during a week-long, internal training conducted by DNR in May 2005.

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7. Monitoring and Adaptive Management

Providing the information needed to implement our Habitat Conservation Plan is an enormous challenge. Many of the silvicultural systems and forest practices needed to meet this challenge are untested or have yet to be developed. Developing innovative forest management methods capable of achieving the economic and ecological objectives of the Habitat Conservation Plan will require the sound application of silvicultural and ecological knowledge, creativity, and reliable information. Reliable information can only be obtained through well-planned and well-executed monitoring and research combined with effective dissemination of information.

Monitoring the effectiveness of these restorative actions requires not only measuring vegetation response to treatments in the riparian area, but also measuring the physical and biological responses of the stream channel, fish habitat, and associated biota. Effectiveness monitoring will help DNR determine whether implementation of the riparian conservation strategies results in the anticipated habitat conditions.

As part of the adaptive management process, effectiveness monitoring for this strategy includes plans for systematic monitoring. Carefully implemented treatments, paired with unharvested reference areas will be used to interpret treatment effects.

The RFRS effectiveness monitoring plan explicitly addresses the following questions to assess how well the management of riparian zones maintains or restores riparian forests:

- 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?

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Literature Cited

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