3

Goals, Objectives, and Management Strategies

For generating revenue and implementing the conservation strategies and research, monitoring, and adaptive management.

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Goals, Objectives, and Management Strategies

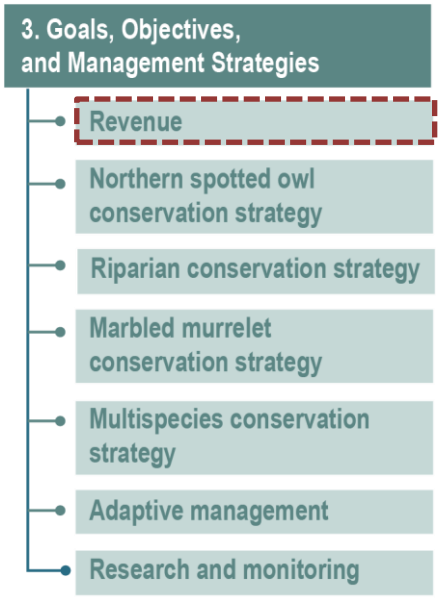
This chapter provides foresters and managers the practical direction and guidance they need to implement the integrated management approach on a day-to-day basis.

Direction and guidance in this chapter includes goals, measurable objectives, and management strategies for the production of revenue for trust beneficiaries, implementation of the four major HCP conservation strategies (northern spotted owl, riparian, marbled murrelet, and multispecies), and implementation of the research and monitoring and adaptive management programs. For the riparian, northern spotted owl, and multispecies conservation strategies, DNR also provides the working hypotheses on which the management strategies are based. A graphic is provided at the beginning of each section to help readers navigate this chapter.

Implementation procedures pertinent to this forest land plan can be found in the Forestry Handbook on DNR's intranet.

Revenue Production

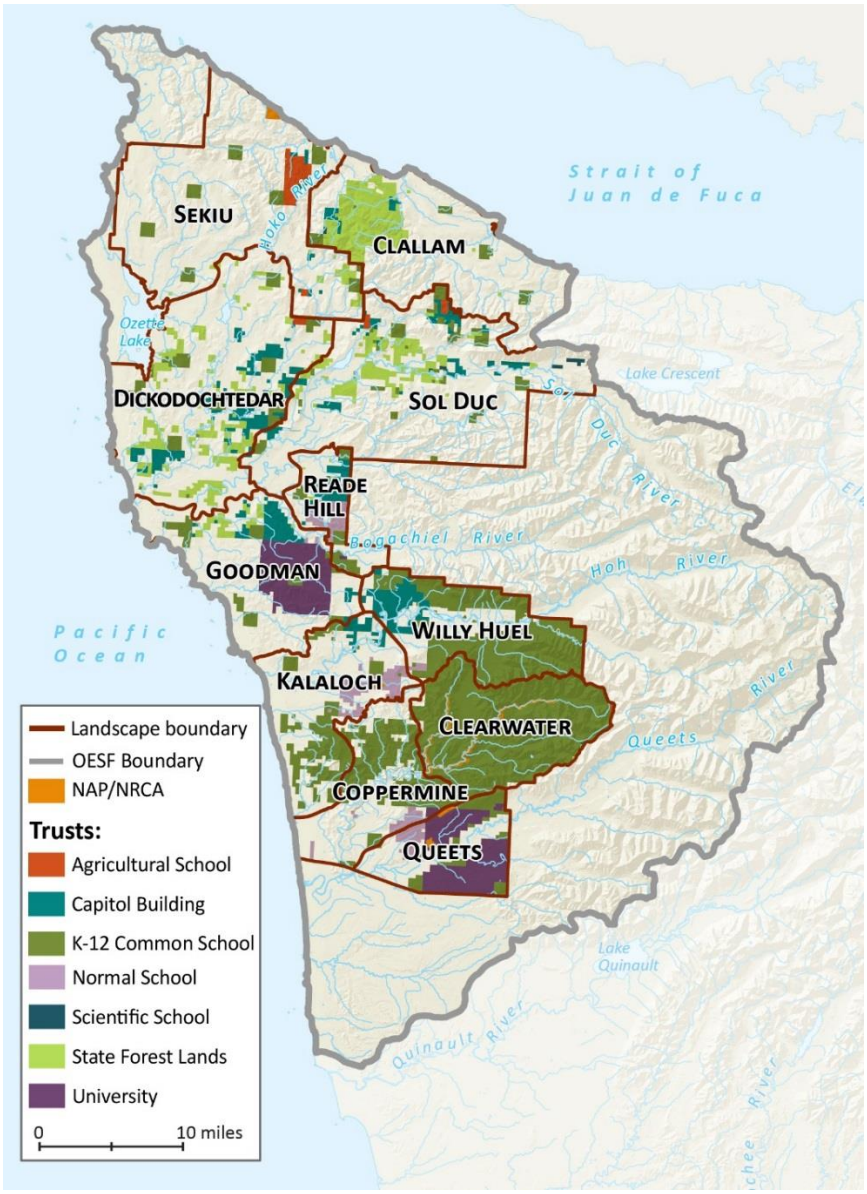
As a trust lands manager, DNR has a fiduciary responsibility to provide a sustainable flow of revenue to its trust beneficiaries. This revenue funds schools, hospitals, fire districts, universities, and other critical needs for local communities and statewide agencies. Following is a list of the trusts that benefit from harvest in the OESF.



- **K-12 Common School trust**: These trust lands support the construction of public kindergarten through twelfth-grade public schools throughout the state.
- **State Forest Land trust**: These trust lands (transfer and purchase) supports schools as well as county services including roads, libraries, fire districts, ports, hospitals, and emergency management.
- **Scientific and Agricultural School trusts**: These trust lands support construction at Washington State University.
- **Normal School trust**: These trust lands support construction at Eastern Washington, Western Washington and Central Washington universities and the Evergreen State College.
- **Capitol Building trust**: These trust lands support construction of state office buildings at the Capitol Campus in Olympia.
- **University trust**: These trust lands support construction at the University of Washington.

Map 3-1 on the following page shows the location of state trust lands managed under each trust, and Table 3-1 lists the acres of state trust lands in each trust.

Map 3-1. State Trust Lands in Each Landscape Managed Under Each Trust[a]



[a]Some trusts are not shown on this map because their acreage is too small to be visible at this spatial scale.

Table 3-1. Acres of State Trust Lands in Each Trust (Current as of 2016)*

Trust	Acres
Agricultural School	4,235
Capitol Building	30,474
K-12 Common School	149,458
Normal School	12,564
Scientific School	605
State Forest Lands	42,617
University	29,010

*This chart shows state trust lands only; totals do not include administrative sites, natural area preserves, or natural resources conservation areas.

The following goal, measurable objective, and strategies are based on p. 28 through 30 of the *Policy for Sustainable Forests*.

Goal:

Provide revenue for trust beneficiaries primarily through the harvest of timber.

Measurable Objective:

Harvest a volume of timber that is consistent with the current sustainable harvest level for the OESF.

Management Strategies:

- Calculate a decadal sustainable harvest level (RCW 79.10.300) and periodically adjust it.
- Manage the OESF as a single sustainable harvest unit regardless of trust.
- Keep annual harvest volumes within 25 percent (higher or lower) of the annual sustainable harvest level (the annual sustainable harvest level is the decadal sustainable harvest level divided by 10).
- Pursue opportunities for financial diversification.

How is the Objective Measured?

To measure its progress in meeting harvest volume targets, DNR compares total sold timber volume to the sustainable harvest level on a

continual basis. Volume is tracked using in-house accounting systems and updated each time a timber sale is sold. This accounting is done for all sustainable harvest units, including the OESF, and is reported in DNR's annual reports.

DNR takes advantage of financial diversification opportunities as they arise. Revenue from non-timber sources is listed each year in DNR's annual report.

How are the Management Strategies Implemented?

►Management Strategy: Calculate a Sustainable Harvest Level and Periodically Adjust it

The decadal sustainable harvest level is the volume of timber to be scheduled for sale from state trust lands during a planning decade as calculated by DNR and approved by the Board of Natural Resources (RCW 79.10.300). It represents the amount of timber that can be harvested from state trust lands sustainably in the framework of current laws and DNR policies.

The decadal sustainable harvest level is recalculated at the end of each planning decade, although DNR may recalculate more often when needed to accommodate new legal, economic, environmental, or other considerations. Because the sustainable harvest level is a policy decision, the level is adopted by the Board of Natural Resources.

To ensure intergenerational equity, DNR requires each decadal sustainable harvest level to fall within 25 percent (plus or minus) of the preceding decade's level (DNR 2006, p. 29). Intergenerational equity means a fair and equitable distribution of the harvest across decades to avoid favoring one generation of trust beneficiaries over another. In calculating the level, DNR looks ahead as many as 10 decades to ensure enough timber is available in subsequent decades to meet this requirement.

►Management Strategy: Manage the OESF as a Single Sustainable Harvest Unit Regardless of Trust

Each decade, DNR adopts a separate decadal sustainable harvest level for each of 20 sustainable harvest units. One of these units is the OESF. The decadal sustainable harvest level for the OESF applies to all state

trust lands in the unit *as a whole*. The decadal sustainable harvest level for the OESF is not broken into separate levels or targets for individual trusts or geographic areas such as landscapes.

►Management Strategy: Keep the Annual Mean Volume Within 25 Percent (Higher or Lower) of the Decadal Mean Volume

DNR's policies on sustainable harvest are designed to produce reliable revenue to trust beneficiaries while still providing enough flexibility to respond to changes in timber markets, natural disturbance, economic conditions, and other factors.

Per the *Policy for Sustainable Forests*, during each year of the planning decade a sustainable harvest unit's total sold timber volume may be as much as 25 percent higher or lower than the annual sustainable harvest level, so long as the decadal level is sustained over the decade. DNR tracks total sold timber volume against annual and decadal sustainable harvest levels on a continual basis and adjusts timber sales as necessary to stay on track.

►Management Strategy: Pursue Opportunities for Financial Diversification

Financial diversification is an important fiduciary consideration for meeting DNR's trust obligations (DNR 2006). DNR prudently pursues economic opportunities related to ecological and social benefits that flow from forested state trust lands to improve the net revenue from forestlands (DNR 2006). For example, DNR offers and manages leases for special forest products such as salal, evergreen huckleberry, sword fern, and moss.

Timber Harvest in the OESF

Northern Spotted Owl Conservation Strategy

The northern spotted owl was listed as threatened under the Endangered Species Act in 1990. The listing was due to widespread loss and adverse modification of suitable habitat across its geographic range, and the inadequacy of existing regulatory mechanisms to conserve the owl.

A federal recovery plan for the northern spotted owl was completed by USFWS in 2011 (USFWS 2011b). DNR supports federal recovery objectives for the owl by providing habitat that makes a significant contribution to demographic support, maintenance of species distribution, and facilitation of dispersal on DNR-managed lands in the OESF (refer to Chapter 5 for definitions of these terms). For a description of northern spotted owl biology, refer to Chapter 3 of the HCP.

The following goals, measurable objective, and strategies are based on p. IV.86 through IV.88 of the HCP.

Goals:

- Develop and implement a forest land plan that does not appreciably reduce the chances for survival and recovery of the northern spotted owl sub-population on the Olympic Peninsula.

- Develop, implement, test, and refine management techniques for stand-level forest management that integrate older forest ecological values, including the stand's function as dispersal, foraging, roosting, and nesting habitat for northern spotted owls, with revenue objectives for those stands.

- Develop, implement, test, and refine landscape-level forest management techniques that support a wide range of forest ecological values in a working forest, including their occupancy by successfully reproducing northern spotted owls that are a functional segment of the Olympic Peninsula sub-population.

Measurable Objective:

Restore and maintain the following threshold proportions of Young and Old Forest Habitat in each of the 11 landscapes in the OESF:

- At least 40 percent (by area) of DNR-managed lands in each landscape as Young Forest Habitat and better (Young Forest or Old Forest Habitat).
- At least 20 percent of DNR-managed lands in each landscape as Old Forest Habitat.

These thresholds are not additive. DNR restores and maintains at least 40 percent of each landscape as northern spotted owl habitat; of that amount, at least 20 percent should be Old Forest Habitat.

Management Strategies and the Working Hypotheses on Which They are Based:

The primary working hypothesis for the northern spotted owl conservation strategy is that DNR can meet its goals for revenue production and northern spotted owl habitat conservation in the OESF by maintaining threshold proportions of northern spotted owl habitat in each landscape. This primary working hypothesis is also broken down into specific working hypotheses. Table 3-2 lists the management strategies and the specific working hypotheses on which they are based.

Table 3-2. Northern Spotted Owl Habitat Management Strategies and Specific Working Hypotheses

Management Strategy	Specific Working Hypothesis
Manage for Young and Old Forest Habitat.	HCP definitions for Young and Old Forest Habitat describe habitat that supports the life history requirements of northern spotted owls.
Maintain and restore threshold proportions of Young Forest and Old Forest Habitat in each of the 11 landscapes of the OESF.	Threshold proportions of habitat are adequate to maintain successfully reproducing northern spotted owls, *and* the spatial distribution of northern spotted owl habitat across the 11 landscapes of the OESF will support successfully reproducing northern spotted owls.
Create and maintain habitat through active management.	Silvicultural treatments in forest stands will create habitat with the quality and at the rate expected in the HCP, *and* northern spotted owls will respond as expected in the HCP to habitat created or maintained through active management.

How is the Objective Measured?

DNR tracks the amount of existing northern spotted owl habitat in each of the 11 landscapes to determine progress toward meeting thresholds. Once per year, DNR reports to the Federal Services (NOAA Fisheries and USFWS) the number of acres of habitat in each landscape and the percentage of each landscape that is currently Young or Old Forest Habitat. For information on how DNR models and tracks habitat, refer to the OESF Living Library on DNR's intranet.

How are the Management Strategies Implemented?

►Management Strategy: Manage for Young and Old Forest Habitat

Young Forest Habitat is defined as forests that meet the structural definitions of sub-mature and young forest marginal habitat. Young Forest Habitat supports dispersal and provides some opportunities for roosting and foraging. Old Forest Habitat is defined as forests that meet the structural definitions of high quality nesting habitat, Type A habitat, and Type B habitat. Old Forest Habitat supports all of the owl's needs, including nesting.

The HCP definitions of northern spotted owl habitat (p. IV.11 through IV.12) list the structural attributes a forest stand must have to be considered habitat. DNR has translated those attributes into specific, numeric queries, for example a minimum number of trees per acre. DNR applies these queries to its forest inventory data to determine if a stand meets habitat definitions. Both the habitat definitions and their numeric queries are shown in Tables 3-3 and 3-4. Through research, monitoring, and adaptive management, the habitat definitions and the queries used to identify them may change over time.

Table 3-3. Young Forest Habitat Definition and Numeric Queries Applied to Forest Inventory Data

Sub-mature Habitat	
Definition	**Numeric queries**
• Forest community dominated by conifers, or in mixed conifer/hardwood forest; the community is composed of at least 30 percent conifers • At least 70 percent canopy closure	• 30 percent or more conifer trees per acre • Curtis's relative density ≥ 48 • 115 to 280 trees per acre >4 inches diameter at breast height (DBH) class

• Tree density between 115 and 280 trees greater than 4 inches DBH per acre • Trees over 85 feet tall • At least three snags per acre that are at least 20 inches in diameter • At least 5 percent groundcover of down wood	• Minimum top height of 40 largest trees >85 feet tall • At least 3 snags per acre >20 inches DBH and 16 feet tall • At least 2,400 cubic feet per acre down wood
Young Forest Marginal	
Definition	**Numeric queries**
• Forest community dominated by conifers, or in mixed conifer/hardwood forest, the community is composed of at least 30 percent conifers • At least 70 percent canopy closure • Tree density between 115 and 280 trees greater than 4 inches DBH per acre • Trees over 85 feet tall • At least two snags per acre that are at least 20 inches in diameter or equal to 10 percent of the ground covered with 4 inch diameter or larger down wood with 25 to 60 percent shrub cover	• 30 percent or more conifer trees per acre • Curtis's relative density ≥48 • 115 to 280 tree per acre >4" DBH • Minimum top height of 40 largest trees >85 feet tall • At least 2 snags per acre >20 inches DBH and 16 feet tall or at least 4,800 cubic feet per acre down wood

Table 3-4. Old Forest Habitat Definition and Numeric Queries Applied to Forest Inventory Data

High Quality Nesting	
Definition	**Numeric queries**
• At least 31 trees per acre greater than or equal to 21 inches DBH with at least 15 trees, of those 31 trees, per acre greater than or equal to 31 inches DBH • At least three trees, from the above group of 31 trees, have broken tops • Canopy closure at least 70% • At least 12 snags per acre larger than 21 inches DBH • A minimum of 5 percent ground cover of down wood	• At least 3 live trees per acre >21 inches DBH with broken tops • At least 16 trees per acre >21 inches DBH • At least an additional 15 trees per acre >31 inches DBH • Minimum top height of 40 largest trees >85 feet tall • Curtis's relative density ≥48 • At least 12 snags per acre ≥21 inches DBH • At least 2,400 cu feet per acre down wood
Type A Habitat	
Definition	**Numeric queries**
• A multi-layered, multispecies canopy dominated by large (30 inches diameter or greater) overstory trees (typically 15 to 75 trees per acre)	• At least 2 canopy layers with at least 2 tree species • At least 20% of trees per acre in minor species

• At least 70 percent canopy closure • A high incidence of large trees with various deformities such as large cavities, broken tops, and dwarf mistletoe infection. • At least two snags per acre that are at least 30 inches in diameter or larger • Large accumulation of fallen trees and other down wood on the ground	• Canopy typically dominated by 75 to 100 trees per acre >20 inch DBH • Curtis's relative density ≥ 48 • At least 2 live trees per acre >21inches DBH with broken tops • Two or more snags per acre >30 inches DBH and 16 feet tall • At least 2,400 cubic feet per acre down wood
Type B Habitat	
Definition	**Numeric queries**
• Few canopy layers, multispecies canopy dominated by large (greater than 20 inches diameter) overstory trees (typically 75 to 100 trees per acre, but can be fewer if large trees are present) • At least 70 percent canopy closure • Some large trees with various deformities • Large (greater than 20 inches diameter) snags present • Large accumulation of fallen trees and other down wood on the ground	• At least 2 canopy layers with at least 2 species • At least 20% of trees per acre in minor species • Canopy typically dominated by 15 to 75 trees per acre >30 inches DBH • Curtis's relative density ≥48 • Large trees with various deformities • At least 1 live tree per acre > 21 inches with broken top • One or more snags per acre >20 inches DBH and 16 feet tall • At least 2,400 cubic feet per acre down wood

►Management Strategies: Maintain and Restore Threshold Proportions of Young Forest and Old Forest Habitat in Each of the 11 Landscapes of the OESF *and* Create and Maintain Habitat Through Active Management

The northern spotted owl conservation strategy is based on the concept of a "shifting mosaic" of habitat. Instead of designating permanent areas in the OESF as northern spotted owl habitat, DNR maintains threshold proportions of habitat in each landscape (40 percent Young Forest Habitat and better, and 20 percent Old Forest Habitat). As one area in a landscape matures into habitat, another can be harvested so long as threshold proportions are maintained.

Northern spotted owl habitat can be located anywhere on forested state trust lands within the 11 landscapes, including areas being managed under the other conservation strategies. For example, marbled murrelet habitat also may be northern spotted owl habitat and vice versa. The riparian conservation strategy also was expected to contribute to northern spotted owl habitat thresholds. At the time the HCP was written, preliminary analysis showed that roughly 20 percent of mid-aged forests were located near stream channels or on potentially unstable slopes or landforms, and an additional 10 percent were in potentially wind-prone areas near streams (DNR 1997, p. IV.103). DNR has identified uncertainties regarding the contribution these areas make toward northern spotted owl habitat conservation (refer to "Research and Monitoring" in Chapter 4 for information on uncertainties).

The northern spotted owl conservation strategy is implemented in two phases, the restoration phase and the maintenance and enhancement phase. The restoration phase is the time it takes a landscape to attain the 40 percent Young Forest Habitat and better threshold.[1] The maintenance and enhancement phase is the time between attainment of the 40 percent threshold and the end of the HCP permit period (2067).[2] The 20 percent Old Forest Habitat threshold can be met in either phase. The length of each phase differs from one landscape to the next; one landscape may be in the restoration phase while another enters the maintenance and enhancement phase. Following, DNR describes management in each phase.

The Restoration Phase

To help meet northern spotted owl habitat thresholds, DNR applies management pathways to each landscape. Pathways are primarily applied during the restoration phase, although they may be extended into the maintenance and enhancement phase if needed.

A pathway is a course of action to achieve the following:

- Attain threshold proportions of northern spotted owl habitat in each landscape more quickly than anticipated in the HCP when possible.
- Increase habitat patch size where possible.
- Where feasible, create or accelerate habitat in deferred areas to take full advantage of these areas.

Most pathways involve selecting forest stands as candidates for active or passive management. Active management means selected forest stands will be thinned to create or accelerate the development of northern spotted owl habitat. Passive management means the stand will not be thinned or regenerated for as long as the pathway remains in effect (most likely, until the end of the restoration phase), although habitat

enhancement projects may still occur (such as creation of snags or down wood). Forest stands selected for active or passive management under the pathways are referred to as "candidate stands."

To understand how the pathways work, consider the following:

- In one landscape, DNR may find that some forest stands in deferred areas are close to becoming Young Forest Habitat. Those same forest stands may be located near adjacent habitat on federal lands. By thinning these stands, DNR may speed attainment of habitat thresholds in the landscape, shift the location of habitat away from operable areas, and create larger patches of habitat. The pathway for this landscape would be "select candidate stands of non-habitat in deferred areas for active management." Once the pathway for the landscape was determined, DNR would select specific forest stands within the landscape that are good candidates for thinning.

- In another landscape, some existing stands of Young or Old Forest Habitat may be located in areas that are inaccessible for timber harvest. Those same stands may be located near northern spotted owl habitat on adjacent federal lands, creating opportunities to maintain patch size. The pathway for this landscape would be "select candidate stands of Young or Old Forest Habitat in operable areas for passive management." Once the pathway for the landscape was determined, DNR would select those specific forest stands within the landscape to be managed passively (not harvested).

Pathways are selected based on numerous, inter-related factors such as forest conditions, availability of stands suitable for thinning, location of habitat, and percent of the landscape deferred from harvest. For each landscape, DNR selects and applies one or more pathways for achieving the 40 percent Young Forest Habitat and better threshold and one or more pathways for achieving the 20 percent Old Forest Habitat threshold.

Candidate stands selected under the pathways are integrated into the tactical model, such that the model knows:

- Which forest stands of existing northern spotted owl habitat have been selected for passive management through the pathways, and

- Which forest stands of non-habitat have been selected for active management through the pathways.

Given this information, the tactical model looks across the landscape to determine which *additional* stands it needs to meet thresholds. These additional stands could be stands that are habitat now, or stands that are projected to develop into habitat in the future. The tactical model uses

this information to develop its optimal solution of which forest stands to harvest or not harvest to meet its revenue and ecological objectives.

Thus, in a given landscape habitat thresholds will be met with a combination of the following, depending on the pathway(s) and candidate stands selected for the landscape:

- Existing habitat selected for passive management through the pathways,
- Non-habitat selected for active management through the pathways, *and*
- Additional forest stands of current or future habitat selected by the model to meet habitat thresholds.

Pathways

Currently, there are eight pathways. Following is a description of each pathway, organized by the major type of management involved. Over time, DNR may adjust these pathway definitions. The intent of the pathways—selecting candidate stands for active or passive management—will not change, but some pathways may be combined for ease of modeling and planning.

Model's Optimal Solution Pathways

- **Pathway 1**: Allow tactical model to develop its optimal solution without any specific stand selected for active or passive management to meet the 40 percent Young Forest Habitat and better threshold
- **Pathway 2**: Allow tactical model to develop its optimal solution without any specific stand selected for active or passive management to meet the 20 percent Old Forest Habitat threshold.

Under these pathways, DNR does not designate specific forest stands in the model for passive or active management to meet habitat thresholds. Instead, DNR allows the model to develop its optimal solution without such designations in place. This choice is appropriate for landscapes in which a) the landscape has already achieved one of the thresholds; b) limited opportunities exist for speeding attainment of thresholds, increasing patch size, or creating habitat or accelerating habitat development in deferred areas; or c) a combination of both. For example, the Reade Hill landscape has already met the 20 percent Old Forest Habitat threshold and is close to meeting the 40 percent Young Forest Habitat Threshold.

Passive Management of Young or Old Forest Habitat

- **Pathway 3**: Select candidate stands of Young or Old Forest Habitat in operable areas for passive management to help meet the 40 percent Young Forest Habitat and better threshold.
- **Pathway 4**: Select candidate stands of Young or Old Forest Habitat in operable areas for passive management to help meet the 20 percent Old Forest Habitat threshold.

Technically, all existing habitat needed to meet thresholds in each landscape is passively managed during the restoration phase. Under this pathway, however, DNR selects stands of existing habitat in operable areas that it wants to ensure are passively managed during the restoration phase to provide added certainty on attaining habitat thresholds.

Stands are selected based on numerous considerations. For example, DNR may select habitat that is adjacent to or near existing high-quality habitat on state trust lands or federal lands, to preserve patch size. DNR may select stands of Young Forest Habitat that are close to attaining Old Forest Habitat conditions to potentially speed attainment of the 20 percent Old Forest Habitat threshold. Or, DNR may consider a stand's operability. Hard-to-reach stands in areas unlikely to be harvested may best be left as habitat during the restoration phase.

Active Management of Non-habitat

- **Pathway 5**: Select candidate stands of non-habitat in operable areas for active management (thinning) to help meet the 40 percent Young Forest Habitat and better threshold.
- **Pathway 7**: Select candidate stands of non-habitat in deferred areas for active management (thinning) to help meet the 40 percent Young Forest and Better threshold.

In both operable and deferred areas, DNR targets non-habitat that is most likely to respond well to thinning. For example, DNR may select candidate stands that have many attributes of Young Forest Habitat already but have too many trees per acre to meet habitat definitions. In selecting candidate stands, DNR also considers patch size and proximity to existing northern spotted owl habitat on DNR-managed lands or adjacent federal lands. Where opportunities exist, DNR selects non-habitat in deferred areas to encourage habitat to develop in deferred versus operable areas.

These pathways reflect the intent of the HCP, which states that when and where feasible, harvest and other silvicultural activities in young stands should promote the development of Young or Old Forest Habitat, such that the restoration phase is expedited (DNR 1997, p. IV.99).

Active Management of Young Forest Habitat

- **Pathway 6**: Select candidate stands of Young Forest Habitat in operable areas for active management to help meet the 20 percent Old Forest Habitat threshold.

- **Pathway 8**: Select candidate stands of Young Forest Habitat in deferred areas for active management to help meet the 20 percent Old Forest Habitat threshold.

To date, DNR has not selected or applied either of these pathways to any landscape in the OESF. However, thinning of Young Forest Habitat may occur outside of these pathways in any landscape. Refer to "Other Management Activities During the Restoration Phase" later in this section for more information.

Table 3-5 lists the pathways currently applied to each landscape. Over time, DNR may adjust pathway selections as conditions in the OESF change. Land transfers, natural disturbance, updated mapping, and other factors can affect the choice of pathway. The tactical model is rerun each time the pathways are adjusted.

Table 3-5. Pathways in Each Landscape

Landscape	40 Percent Young Forest and Better Pathway	20 Percent Old Forest Pathway
Clallam	1 (model's optimal solution)	4 (passive management of Young or Old Forest Habitat, operable areas)
Clearwater	7 (active management of non-habitat , deferred areas)	2 (model's optimal solution)
Coppermine	7 (active management of non-habitat , deferred areas)	2 (model's optimal solution)
Dickodochtedar	1 (model's optimal solution)	4 (passive management of Young or Old Forest Habitat, operable areas)
Goodman	5 (active management of non-habitat, operable areas) and 7 (active management of non-habitat , deferred areas)	2 (model's optimal solution)
Kalaloch	5 (active management of non-habitat, operable areas) and 7 (active management of non-habitat , deferred areas)	4 (passive management of Young or Old Forest Habitat, operable areas)
Queets	7 (active management of non-habitat , deferred areas)	2 (model's optimal solution)

Landscape	40 Percent Young Forest and Better Pathway	20 Percent Old Forest Pathway
Reade Hill	1 (model's optimal solution)	2 (model's optimal solution)
Sekiu	1 (model's optimal solution)	2 (model's optimal solution)
Sol Duc	3 (passive management of Young or Old Forest Habitat, operable areas)	4 (passive management of Young or Old Forest Habitat, operable areas)
Willy Huel	5 (active management of non-habitat, operable areas) and 7 (active management of non-habitat , deferred areas)	2 (model's optimal solution)

Implementing Active Management Under the Pathways

Candidate stands of non-habitat selected for active management (Pathways 5 and 7) in the current decade are shown on the harvest schedule. Not all candidate stands are thinned. Foresters evaluate all the candidate stands shown in the harvest schedule and determine which stands to thin based on numerous considerations such as forest conditions, accessibility, cost and budget priorities, and proximity to planned harvests. Multiple small candidate stands may be combined for more efficient operations. Before the activity takes place, foresters conduct field reconnaissance to verify the feasibility of conducting a thinning.

Under certain circumstances, some thinnings may be non-commercial (trees dropped and left in place instead of hauled to markets). For example, a stand may be inaccessible for haul routes, such as an isolated parcel surrounded by other ownerships. Or, it may be financially infeasible to build haul routes, meaning the cost of building or maintaining haul route would exceed potential revenue from the sale. Other reasons may include difficulties with topography, distance of the stand from potential landing sites, or other issues.

Candidate stands selected for non-commercial thinning may be funded through DNR's budget for silvicultural activities or by other means such as grants, partnerships, or capital funding. Candidate stands selected for commercial thinning in the next five years are included in the five-year timber sale schedule, which is discussed later in this section.

For any thinning on a potentially unstable slopes or landforms, whether that thinning is commercial or non-commercial, DNR follows the forest practices rules and guidance in Section 16 of the Forest Practices Board Manual to protect down-slope resources and public safety.

Other Management Activities During the Restoration Phase

Regeneration Harvest of Young Forest Habitat

During the restoration phase, existing Young Forest Habitat is not be available for regeneration harvest unless it can be demonstrated, through modeling or other means, that the harvest would not increase the length of the restoration phase for the landscape. For example, in some landscapes DNR's projections may show that by a certain decade the proportion of habitat in the landscape will exceed thresholds; in those cases, harvesting a portion of that habitat now would have little effect on when the landscape attains the 40 percent threshold. Such harvest also cannot occur until the 2006 Settlement Agreement has expired. Harvest of Young Forest Habitat during the restoration phase requires notification of DNR's HCP and Scientific Consultation Section before the harvest takes place.

Thinning of Young Forest Habitat

Young Forest Habitat is available for thinning if the thinning will maintain or improve the habitat's structural components such as down wood, snags, and large diameter trees. The stand must continue to meet the definition of Young Forest Habitat (Table 3-3), including a minimum Curtis' relative density of 48, after the thinning.

Regeneration or Thinning Harvest of Old Forest Habitat

Neither thinning nor regeneration harvest occurs in Old Forest Habitat during the restoration phase, except as part of peer-reviewed, DNR-approved research and monitoring projects.

Regeneration or Thinning Harvest of Non-Habitat

DNR conducts both commercial thinning and regeneration harvest of non-habitat stands during the restoration phase. These timber sales are included in the five-year timber sale schedule, along with the selected commercial thinnings under the pathways.

To develop the five-year timber sale schedule, foresters use the tactical model's optimal solution (expressed as a harvest schedule) for the current decade as a starting point. It is possible that foresters may deviate from the model's optimal solution. For example, foresters may find that an area the model has selected in the current decade is unsuitable for timber harvest due to unmapped streams, potentially unstable slopes or landforms, or other issues, and may exchange that area for another that was not recommended for harvest until a future decade. These deviations may affect habitat thresholds if the area the forester selects for harvest was being held by the model as future habitat.

To address this issue, DNR periodically runs the five-year timber sale schedule through the tactical model to see if (or how) the timber sale schedule would affect the attainment of habitat thresholds. If the timber sale schedule *does not* change the decade thresholds are attained, DNR implements the action plan. If it *does* affect the decade thresholds are attained, DNR adjusts the timber sale schedule accordingly.

Road and Other Auxiliary Operational Activities

During the restoration phase, in Young Forest Habitat or candidate stands DNR may perform the following, although such work should be limited to the greatest extent practicable: new road construction; tail holds; guy line circles; yarding corridors; road maintenance and abandonment plan-related work and other forest road maintenance such as grading, shaping, ditch cleanout, culvert replacement, road abandonment, and removal of brush and trees within the road prism and right-of-way; or other auxiliary operational activities.

These activities also can occur in Old Forest Habitat but should be limited to the greatest extent practicable. Foresters are required to notify the HCP and Scientific Consultation Section prior to implementing these activities in Old Forest Habitat.

The Maintenance and Enhancement Phase

Old Forest Habitat will continue developing to at least 20 percent of each landscape during the maintenance and enhancement phase. Once entered, the maintenance and enhancement phase remains in effect for the remainder of the HCP permit period (to 2067).

During this phase, DNR may harvest Young Forest Habitat so long as the 40 percent Young Forest and Better threshold is maintained. Once the 20 percent Old Forest Habitat threshold has been met, DNR may harvest Old Forest Habitat so long as that threshold is maintained. In both cases, "harvest" includes both thinning or stand replacement, and "maintained" means the amount of habitat in the landscape does not fall below threshold proportions. Harvest activities may be done for the purpose of enhancing ecological values, producing revenue, or both. However:

- Regeneration harvest of either Young or Old Forest Habitat cannot occur until the 2006 Settlement Agreement expires.
- The stand cannot be harvested if it is deferred (for example, an old-growth stand defined by PR 14-005-045).

DNR may harvest Old or Young Forest Habitat outside of these guidelines as part of DNR-approved, peer-reviewed research and monitoring projects.

Road and Other Auxiliary Operational Activities

During the maintenance and enhancement phase, in Young or Old Forest Habitat DNR may perform the following, although such work should be limited to the greatest extent practicable: new road construction; tail holds; guy line circles; yarding corridors; road maintenance and abandonment plan-related work and other forest road maintenance such as grading, shaping, ditch cleanout, culvert replacement, road abandonment, and removal of brush and trees within the road prism and right-of-way; or other auxiliary operational activities. Foresters are required to notify DNR's HCP and Scientific Consultation Section prior to building new roads through Old Forest Habitat.

What About Known Nest Sites?

Known northern spotted owl nest sites are located within Status 1 or 2 owl circles as documented in the WDFW state database. With adoption of the HCP, DNR transitioned from managing by owl circles to managing by habitat thresholds. However, DNR does not conduct harvest (thinning or regeneration) or road construction or reconstruction within the best-70 acre core (that may or may not be habitat) around known nest sites between March 1 and August 31 of each year. This guideline applies to both the restoration and the maintenance and enhancement phases. DNR retains these guidelines despite a drop in the number of northern spotted owls on DNR-managed lands in the OESF (refer to Text Box 3-1) and the high likelihood that known nest sites are not currently occupied by northern spotted owls.

Text Box 3-1. Current Status of Northern Spotted Owls in the OESF

Northern spotted owl populations have experienced range-wide declines, especially in the northern portion of their range including the Washington Cascades and Olympics. DNR monitoring on the Olympic Peninsula in the 1990s showed the abandonment of many nesting sites, such that only four sites remained occupied by the early 21st century and only one of those was still occupied by a pair of owls. DNR ceased comprehensive monitoring in 2002 because so few owls remained and because of other priorities for limited funds. Annual monitoring on federal lands documented similar, though less severe declines. (Based on WDFW databases and federal monitoring reports.)

Riparian Conservation Strategy

Under the riparian conservation strategy for state trust lands in the OESF, DNR protects, maintains, and restores habitat capable of supporting viable populations of salmonids and other species dependent on in-stream and riparian environments (DNR 1997, p. IV.107). The OESF riparian conservation strategy seeks to achieve this vision by conserving habitat complexity as afforded by natural disturbance regimes on the western Olympic Peninsula. Habitat complexity is defined as 1) variations in stream-flow velocity and stream depth created by structural obstructions to channel flow, 2) physical and biological interactions between a channel and its floodplain, 3) aquatic and riparian structures that provide cover from predators, 4) a variety of stream substrates that includes gravel for fish spawning and macro-invertebrate habitat, and 5) a diversity of riparian vegetation that provides adequate sources of woody debris and nutrients (such as leaf and needle litter) to channels and that moderates water temperature and microclimate within the riparian corridor (Bisson and others 1992 as cited in DNR 1997, p. IV.107).

A key principle of managing for habitat complexity is to focus on natural processes and variability, rather than attempting to maintain or engineer a desired set of conditions through time (Lugo and others 1999, Dale and others 2000 as cited in Bisson and Wondzell 2009). DNR does not intend to restore streams to a "desired future condition," but to **maintain or aid restoration of riparian functions** important to salmonid habitat. DNR believes that if it focuses on a subset of riparian functions and processes, it can indirectly provide for the full suite of riparian functions and processes to meet the habitat needs of salmon and other species dependent on in-stream and riparian environments. For example, if the riparian management zone is wide enough to provide large woody debris input at a natural background composition and rate, then it most likely will provide most of the required salmonid habitat protection (Washington Forest Practices Board [WFPB] Riparian Habitat Technical Committee 1985, United States Department of Agriculture [USDA] and

United States Department of the Interior [USDI] 1993; Cederholm 1994; as cited in DNR 1996).

DNR acknowledges that habitat complexity as afforded by natural disturbance regimes is difficult to quantify or target. Research is needed to interpret this concept in more practical terms and to demonstrate how riparian systems vary in space and time. The Status and Trends Monitoring of Riparian and Aquatic Habitat in the OESF project will help with this understanding (refer to Chapter 4 for information about this project).

DNR's goals, measurable objectives, and strategies are based on p. IV.107 through IV.108 of the HCP. These goals and objectives represent DNR's contribution to watershed health; in many watersheds, DNR manages only a portion of the watershed. DNR will describe, in a later section, how objectives will be measured.

Goals:

- Maintain or aid restoration of the composition, structure, and function of aquatic, riparian, and associated wetland systems which support aquatic species, populations, and communities.
- Maintain or aid restoration of the physical integrity of stream channels and floodplains.
- Maintain or aid restoration of water to the quantity, quality, and timing in which these stream systems evolved (the natural disturbance regime of these systems).
- Maintain or aid restoration of the sediment regimes in which these systems evolved.
- Develop, use, and distribute information about aquatic, riparian, and associated wetland-ecosystem processes and their maintenance and restoration in commercial forests.

Measurable Objectives:

- Maintain or aid restoration of the potential of riparian forests to provide large woody debris to the stream channel. Large woody debris recruitment refers to logs, pieces of logs, root wads, or large chunks of wood falling into stream channels. Large woody debris is an important habitat component for fish and other aquatic organ-isms (Swanson and others 1976, Harmon and others 1986, Bisson and others 1987, Maser and others 1988, Naiman and others 1992, Samuelsson and others 1994).
- Maintain or aid restoration of the potential of riparian forests to provide shade to the stream channel. Stream shade refers to the

extent to which incoming sunlight is blocked on its way to the stream channel. Stream shade is considered one of the primary factors influencing stream temperature (Brown 1969). Stream temperature influences water chemistry, which can affect the amount of oxygen present to support aquatic life. In addition, all aquatic organisms have a temperature range outside of which they cannot survive.

- Prevent detectable increases in water quantity (peak flow) during storm events. Detectible in this context means a 10 percent or greater increase in peak flow over unmanaged conditions. Peak flows can affect stream channels and in-stream habitat because of the large amount and high velocity of water moving through the stream.

- Protect the integrity of riparian forests from severe endemic windthrow. Windthrow is the breaking or blowing over of trees in the wind. Endemic windthrow results from peak winds that occur fairly frequently (every five years or less), and is considered severe when it causes a significant, temporary loss of riparian function.

Management Strategies and the Working Hypotheses on Which They are Based:

The riparian conservation strategy is based on two primary working hypotheses. The first is that establishing buffers on streams is the best means to meet riparian conservation objectives, and will effectively maintain the stream's key physical and biological functions until the stream recovers sufficiently from past disturbance to allow greater integration of revenue production and habitat conservation. The second is that protecting, maintaining, and restoring habitat complexity afforded by natural disturbance regimes in the western Olympic Peninsula is sufficient to support viable populations of salmonid species and other species dependent on in-stream and riparian environments. These primary working hypotheses are broken down into specific working hypotheses. Table 3-6 on the following page lists the management strategies and the specific working hypotheses on which they are based.

Management strategies are meant to be site specific. The size and configuration of buffers varies across the land base according to the condition of the watershed in which they are located, the presence or absence of potentially unstable slopes or landforms, and severe endemic windthrow risk. This site-specific approach is meant to enable greater integration of revenue production and ecological values in each watershed.

The management strategies use two key terms: interior-core buffer and exterior wind buffer. The interior-core buffer is adjacent to the stream, and the exterior wind buffer is adjacent to the interior-core buffer. Together, the interior-core and exterior buffer comprise the riparian

management zone. Riparian management zones are not harvest deferrals; they are areas managed to meet DNR's measurable objectives and to minimize the effects of upland management activities on riparian areas.

Table 3-6. Riparian Management Strategies and Specific Working Hypotheses

Management Strategy	Specific Working Hypothesis
Apply interior-core buffers that incorporate potentially unstable slopes or landforms that could deliver sediment or debris to the stream network.	***Working Hypothesis 1*:** Within each Type 3 watershed, interior-core buffers should maintain and restore habitat capable of supporting viable listed, non-listed, and candidate populations of salmonid species and other species dependent on in-stream and riparian environments **when buffers are designed to**: 1. maintain or aid restoration of the potential of riparian forests to supply large woody debris to the stream channel, 2. maintain or aid restoration of the level of shade provided to the stream channel, and 3. minimize disturbance of potentially unstable slopes or landforms that could deliver sediment or debris to the stream; **and when interior-core buffers are**: 4) protected from severe endemic windthrow **and that protection is combined with:** 5. prevention of detectable increases in peak flow through the maintenance of hydrologic maturity within the watershed, 6. protection of wetlands, and 7. development and application of comprehensive road maintenance and abandonment plans. ***Working Hypothesis 2:*** The protection of potentially unstable slopes and landforms that may deliver sediment or debris to streams is sufficient to prevent increases in the frequency or severity of slope failure above natural levels along those streams, which also should prevent the severe alteration of the natural input of large woody debris, sediment, and nutrients to the stream network that would have resulted from those failures.

Management Strategy	Specific Working Hypothesis
Establish exterior wind buffers or reconfigure harvested edge or leave tree configuration to prevent severe endemic windthrow in the interior-core buffer.	As implemented, windthrow probability modeling and remote and field assessments adequately identify risks of severe endemic windthrow, and exterior wind buffers or changes to the configuration of the harvested edge, leave tree distribution, or both are sufficient to protect the integrity of the interior-core buffer and the functions and processes it provides.
Implement comprehensive road maintenance and abandonment plans	Implementation of comprehensive road maintenance and abandonment plans is sufficient to restore and maintain fish passages for all fish and their life history stages to available riparian habitat, and to direct road-related sediment away from streams.
Protect wetlands	Protection of wetlands with buffers and special management considerations (DNR 1997, Table IV.9, p. IV.120) is sufficient to prevent net loss of wetland acreage or function.

How are the Objectives Measured?

DNR measures the potential of riparian forests to provide large woody debris and shade to stream channels through a watershed assessment that is automated within the tactical model. In its assessment, the tactical model assesses potential using factors such as forest conditions and distance of trees from the stream channel.

In scheduling harvests, the model's goal is to maintain a "non-declining yield" of large woody debris recruitment and shade potential at a Type 3 watershed scale. A non-declining yield means the potential for large woody debris recruitment and shade remains the same or increases over time. The tactical model also maintains enough hydrologically mature forest in the watershed to avoid a detectible increase (10 percent or greater over unmanaged conditions) in peak flow. A hydrologically mature forest has a canopy that is dense enough to intercept snowfall and often has enough vegetation to absorb water or slow its flow into the stream. More information on the watershed assessment is provided later in this chapter.

DNR analyzes the harvest schedule produced by the tactical model and tallies the total number of acres of regeneration harvest the model

recommended within the default width of the interior-core buffers over a 10-year period. The number of acres is typically small. DNR refers to this total as "allotted acres." Allotted acres and default widths are discussed later in this chapter.

Large woody debris recruitment and shade potential should be restored or maintained if interior-core buffers are applied and allotted acres are not exceeded. DNR tracks allotted acre use on a continual basis and makes that information available in the OESF Living Library to inform timber sales planning.

Peak flow should be prevented if sufficient hydrologically mature forest is maintained in a watershed. As stated previously, the tactical model takes hydrologic maturity into consideration when recommending timber sales. Foresters begin their timber sale planning by considering the tactical model's recommendations as described under "Planning from a Landscape Perspective" in Chapter 2. As needed, foresters also calculate hydrologic maturity when planning timber sales.

DNR uses windthrow probability modeling and remote and field assessments as needed to determine the need for an exterior wind buffer or reconfiguration of the harvested edge, distribution of leave trees, or both to protect the interior-core buffer from severe endemic windthrow. More information on the process DNR follows to designate exterior buffers is provided later in this chapter. If this process is followed, the integrity of the interior-core buffer should be maintained.

DNR has identified uncertainties related to these assumptions. These uncertainties are evaluated and prioritized for research and monitoring projects through the adaptive management process.

How are the Management Strategies Implemented?

Following, DNR discusses specific strategies for interior-core and exterior wind buffers.

►Management Strategy: Apply Interior-Core Buffers

Interior-core buffers are intended to protect and aid restoration of riparian processes and functions and minimize the effects of upland management activities on riparian areas. Interior-core buffers accomplish this by 1) minimizing the disturbance of potentially unstable slopes or landforms to protect and aid natural restoration of riparian processes and functions (DNR 1997, p. IV.109), and 2) maintaining forest cover in

proximity to streams. Erosion and sedimentation from landslides can affect salmonids and other riparian-dependent species by changing channel morphology and reducing habitat complexity (DNR 1997).

When and Where to Apply the Interior-core Buffer

DNR applies interior-core buffers when implementing a variable retention harvest in the adjacent uplands. DNR applies interior-core buffers to the following streams:

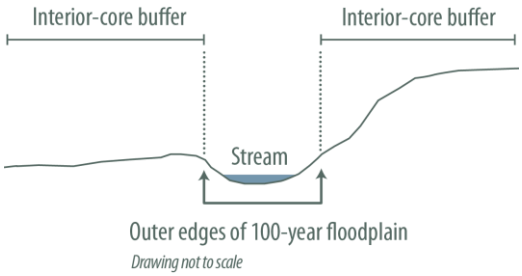
- All Type 1 through 4 streams
- Type 5 streams on potentially unstable slopes or landforms

DNR does not apply an interior-core buffer to Type 5 streams on stable ground.

Width and Configuration of the Interior-core Buffer on Type 1 Through 4 Streams

For all Type 1 through 4 streams, DNR begins with the following default widths of the interior-core buffer. Buffers are measured outward horizontally from the outer edge of the 100-year floodplain (refer to Figure 3-1).

Figure 3-1. Measuring Horizontally



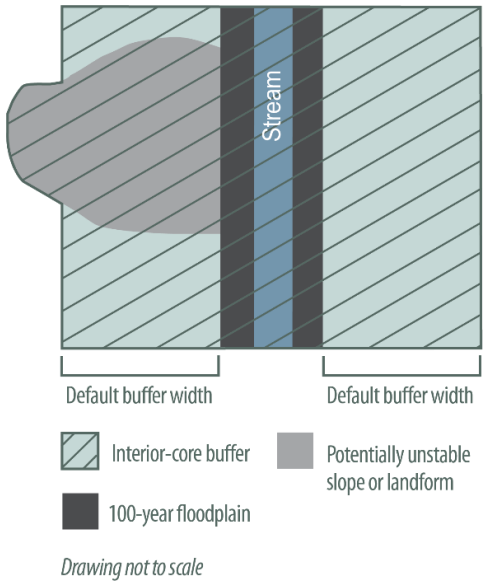
- Type 1 and 2 streams: 150 feet
- Type 3 and 4 streams: 100 feet

Default widths are based on average buffer widths listed in the HCP (Table IV.10. p. IV.123), which are the same for every Type 3 watershed and based on the buffer widths proposed in the literature for several key watershed parameters.

Potentially Unstable Slopes or Landforms

One of DNR's goals for the riparian conservation strategy is to maintain or aid restoration of the sediment regimes in which the riparian system evolved. To accomplish this, DNR prevents an increase in the frequency and severity of landslides by incorporating into the interior-core buffer any potentially unstable slope or landform that could deliver sediment or debris to the stream. These areas are incorporated into the interior-core even when they extend beyond the default width of the buffer (refer to Figure 3-2).

Figure 3-2. Interior-Core Buffer with a Potentially Unstable Slope or Landform

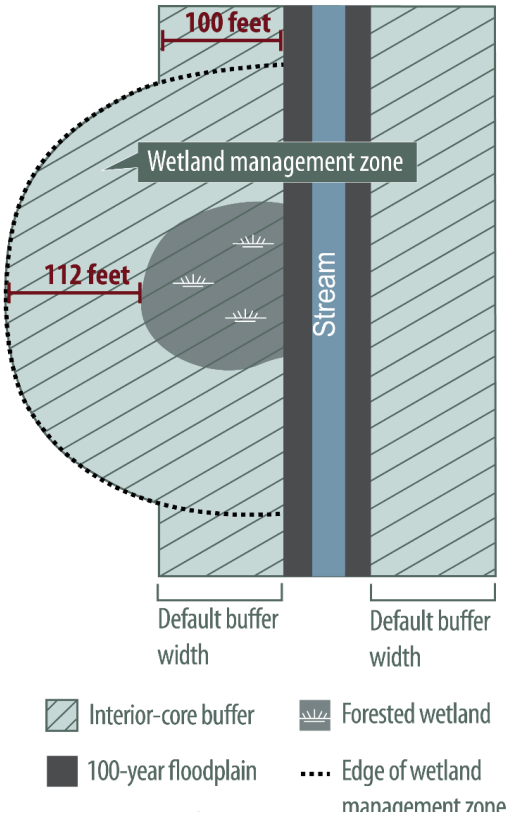


Wetlands

DNR incorporates into the interior-core buffer any wetland and its wetland management zone associated with typed streams. For these areas, DNR compares the OESF wetland and riparian procedures (PR 14-004-500 and PR 14-004-160, respectively) and follows those guidelines that are the most conservative. For example, if the wetland management zone is wider than the width of the interior-core buffer, DNR applies the wetland management zone width around the wetland (refer to Figure 3-3). Similarly, if the wetland is forested and thinning is allowed, DNR follows the riparian thinning guidelines as they are slightly more conservative. DNR does not conduct regeneration harvest in forested wetlands or their riparian management zones.

Figure 3-3. Forested Wetland Incorporated Into Interior-Core Buffer of a Type 3 Stream

In this example, the wetland management zone was slightly wider than the interior-core buffer.



Equipment Limitation Zone

In accordance with WAC 222-30-021, DNR applies a 30-foot-wide equipment limitation zone to all streams (including Type 5 streams) regardless of whether the stream is on stable ground or potentially unstable slopes or landforms. This zone is measured outward horizontally from the outer edge of the 100-year floodplain. Equipment use and disturbances are limited in this area.

Placement of Regeneration Harvest Within Interior-core Buffers

A limited amount of regeneration harvest is allowed inside the interior-core buffer. This amount is determined through a watershed assessment that is automated within the tactical model.

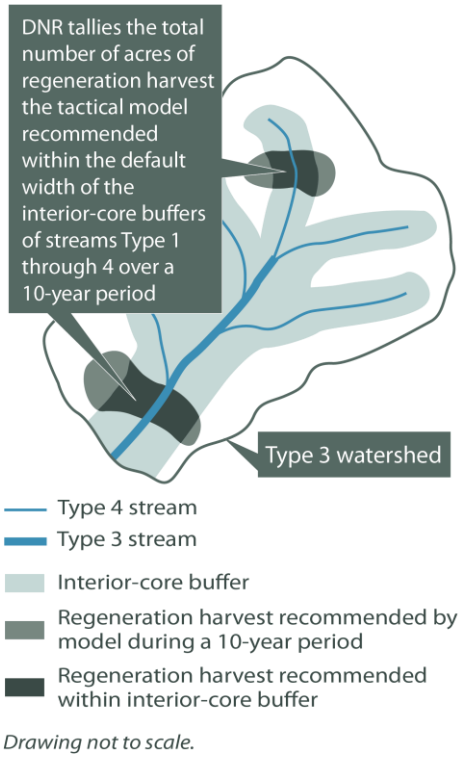
The tactical model assesses the potential of the riparian forest to provide large woody debris and shade to the stream based on factors such as forest conditions and distance of trees from stream. Using this information, the model determines if a regeneration harvest can occur in a riparian area without impeding achievement of the following goals at the Type 3 watershed level:

- Maintain a "non-declining yield" of shade and large woody debris recruitment potential in each Type 3 watershed. A non-declining yield means that proposed timber harvests should either prevent a decrease in shade and large woody debris recruitment potential, or lead to an increase in potential over time.
- Prevent detectable increases in peak flow. Peak flow is prevented by maintaining a sufficient amount of hydrologically mature forest in each watershed.

If a regeneration harvest can occur in a riparian area without impeding achievement of these goals, the model is free to recommend that harvest as part of its optimal solution in the context of all other objectives.

DNR analyzes the model's optimal solution (expressed as a harvest schedule) and tallies the number of acres of regeneration harvest that the model recommended within the default width of the interior-core buffers of Type 1 through 4 streams over a 10-year period in each Type 3 watershed (refer to Figure 3-4). This amount is referred to as the "allotted acres" for a given watershed. DNR updates these amounts when the tactical model is updated and rerun. Depending on model results, some watersheds may not have any allotted acres available.

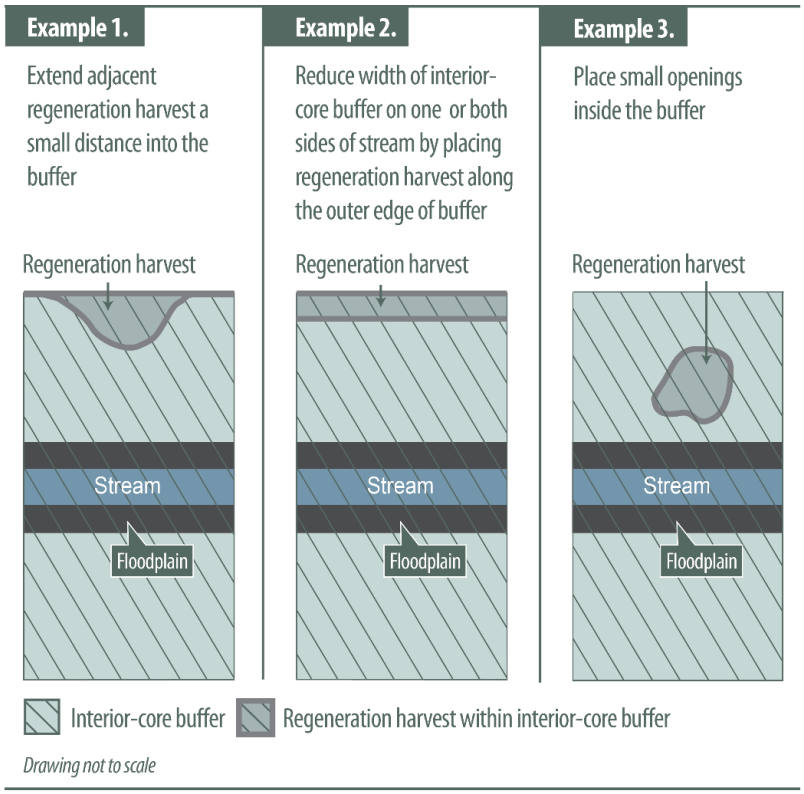
Figure 3-4. Calculating Allotted Acres of Variable Retention Harvest Within the Interior-core Buffer



Drawing not to scale.

Foresters may use allotted acres in a number of ways. For example, they may extend an adjacent regeneration harvest into the interior-core buffer. They may reduce the overall width of the interior-core buffer on one or both sides of the stream by the number of allotted acres. They may use allotted acres for hardwood conversion, in which they replace hardwood trees such as big leaf maple with conifers. Or they may use allotted acres to address unusual circumstances, for example when one side of the interior-core buffer crosses a ridge, and the trees on the far side of the ridge cannot contribute to riparian function. Foresters also may elect not to use the allotted acres, and instead apply the full, default-width of the interior-core buffer. Examples of how allotted acres may be applied are shown in Figure 3-5.

Figure 3-5. Examples of Regeneration Harvest Within Interior-core Buffers



When planning timber sales, foresters should check the OESF Living Library for the most current allotted acres for the Type 3 watershed(s) in which the sale is located, as these numbers are updated on a continual basis. The following guidelines apply to allotted acres:

- Allotted acres are set for the overall Type 3 watershed, not for individual streams. Acres of regeneration harvest may be placed on one stream or split across two or more streams in the watershed, so long as allotted acres are not exceeded for the watershed.
- Allotted acres must be placed at least 25 feet from the outer edge of the 100-year floodplain (measured horizontally).
- Foresters should consider windthrow risk when placing allotted acres within the interior-core buffer. The OESF windthrow probability model, described later in this section, may be used to test harvest configurations.
- In making decisions on allotted acres, foresters should consider not only the current sale but subsequent sales that may occur within the same watershed(s). Once allotted acres are used, additional acres may not become available in that watershed until sufficient

additional riparian forest develops) in the watershed to maintain non-declining yields of large woody debris recruitment and shade.

- Foresters should not place regeneration harvest on any wetland or wetland management zone that has been incorporated into the interior-core buffer, whether that wetland or wetland management zone falls inside or outside the default width of the buffer.

Aside from regeneration harvest as described in this section, other management activities allowed in the interior-core buffer may or may not count against allotted acres. Management activities that DO count against allotted acres include:

- Gaps larger than ¼ acre on a variable density thinning (refer to "Other Activities in the Interior-core Buffer" for more information on thinning).
- Hardwood conversions.
- After a natural disturbance, salvage that involves regeneration harvest. If the number of acres salvaged exceeds allotted acres (or the watershed has no allotted acres available), foresters notify the HCP and Scientific Consultation section before proceeding with the salvage.

Management activities that DO NOT count against allotted acres include:

- Regeneration harvest or gaps on a variable density thinning located on the portion of the potentially unstable slope or landform that extends beyond the default width of the interior-core buffer.
- New roads, existing road right-of-way, yarding corridors, DNR-authorized recreational trail crossings, or new transmission line or gasline projects. Per Section 3 of the Forest Practices Board Manual, roads within 200 feet of typed waters should be avoided where possible. Refer to Section 3 of the manual for more information. To minimize cumulative impacts associated with roads, DNR designs roads to take the most direct route over streams that is operationally feasible.

Other Management Activities in the Interior-core Buffer

- **Pre-commercial and commercial thinning**. Thinning may occur up to the last row of trees adjacent to typed waters except on any 100-year floodplain that has been designated by the Federal Emergency Management Agency (FEMA) on flood insurance rate maps (refer to DNR's corporate GIS layers). These floodplains are typically associated with Type 1 and 2 streams (DNR 1997 p. IV.110). To maintain shade, DNR does not thin any area of the interior-core

buffer below an average of RD 35. DNR follows the forest practices rules and Chapter 16 of the Forest Practices Board Manual when delineating and conducting activities on potentially unstable slopes.

- **Restoration efforts**, including habitat-enhancement projects such as the creation of snags, down wood and in-stream large woody debris.
- **Application of herbicides** in accordance with WAC 222-38-020, *Handling, Storage, and Application of Pesticides* and PR 14-006-040, Site Preparation and Vegetation Management.
- **Brush and bough harvest**.
- **Pruning**.
- **Peer-reviewed and DNR approved research and monitoring projects** designed to improve the integration of revenue and ecological values.
- **Operational trials**. Refer to "Research and Monitoring" later in this chapter for more information.

Applying Interior-core Buffers to Type 5 Streams

DNR applies an interior-core buffer on all Type 5 streams located on field-verified, potentially unstable slopes or landforms. The interior-core buffer includes the stream and the identified potentially unstable slope or landform. Thinning and regeneration harvest is allowed in the interior-core buffer of Type 5 streams; for harvest in these areas, DNR will follow the forest practices rules and Chapter 16 of the Forest Practices Board Manual. There is no acreage limit for regeneration harvest on the interior-core buffer on Type 5 streams.

►Management Strategy: Establish Exterior Wind Buffers

Exterior wind buffers are designed to protect the integrity of the interior-core buffer from the loss of riparian function that results from severe endemic windthrow. It is neither expected nor intended that the exterior wind buffer will prevent all windthrow from occurring in the interior-core buffer. Windthrow in streamside forests is a normal occurrence that serves as an important mechanism for the recruitment of large woody debris to the stream channel and also contributes to the natural sediment budget of the stream. However, DNR relies on interior-core buffers to maintain a range of ecosystem functions (including habitat for northern spotted owls and other species) that may be compromised if severe endemic windthrow occurs.

The exterior wind buffer is not designed to protect the interior-core from *catastrophic* windthrow, which results from strong peak winds that occur infrequently (more than 20 years between occurrences). Such winds can damage timber across a large area, including both interior forest stands and forest stands with exposed edges.

When to Apply the Exterior Wind Buffer

A number of factors promote susceptibility to windthrow on the western Olympic Peninsula. Mitchell and Lanquaye-Opoku (2007) found that the proportion of harvested edge segments affected by windthrow increased with exposure of the edge to peak winds: windthrow was most prevalent where the harvest edge directly faced the prevailing winds *and* the edge was exposed in multiple directions to winds with a fetch of at least 100 meters (fetch is the length of the forest opening over which a given wind has blown). Other factors include the local wind climate (distance from coast, mean annual wind speed, elevation, and aspect) and stand height. Edge orientation, wind exposure, and topographic attributes were found to be more important than stand or soil variables in predicting windthrow.

The need for an exterior wind buffer is based on an assessment of the likelihood of severe endemic windthrow in the interior-core buffer. To determine the need for an exterior wind buffer, for each timber sale foresters run the OESF windthrow probability model, or a future model as developed, using the "severe endemic windthrow" setting. In DNR's current model, this setting identifies segments of the interior-core buffer with a 5 percent or greater chance of severe endemic windthrow, which is defined in the model as 90 percent of the area experiencing 50 percent or greater canopy loss. Foresters run the model at both the watershed and stream-reach scale.

DNR may combine the use of the model with qualitative methods to identify windthrow risk. Those methods include but are not limited to review of aerial photos and other information (to understand windthrow trends in the area) or completion of the "Buffer Strip Survival Rate Worksheet" in "Designing Stable Buffer Strips for Stream Protection" in the Forestry Handbook. If the windthrow probability model is not available, DNR uses these qualitative techniques to identify windthrow risk.

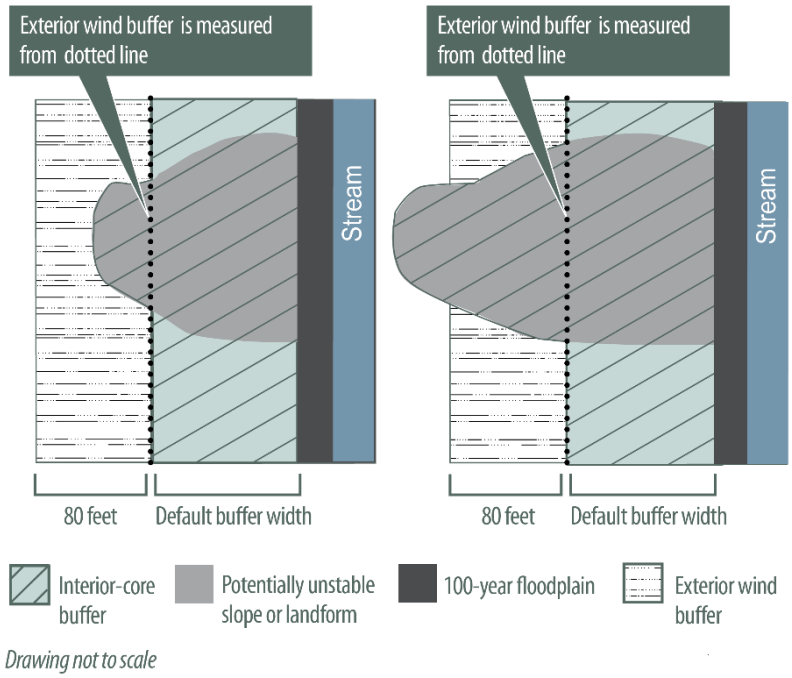
If there is a risk of severe endemic windthrow, DNR may either place an exterior wind buffer on segments of the interior-core buffer identified as having a risk of severe endemic windthrow , or modify the shape and orientation of the harvested edge, distribution of leave trees, or both to reduce the risk of severe endemic windthrow. If the latter, foresters rerun the OESF windthrow probability model on the reconfigured timber sale.

If there is still a risk of severe endemic windthrow, foresters apply an exterior wind buffer where needed.

Configuration of the Exterior Wind Buffer

Where applied, the exterior wind buffer measures 80 feet (horizontal distance) outward from the outer edge of the default width of the interior-core buffer (refer to Figure 3-6). The dimensions of the exterior wind buffer represent DNR's best understanding of what might be required to protect the integrity of the interior-core and the riparian functions the interior-core buffer provides. The width of the exterior wind buffer is based on empirical studies of windthrow patterns on Vancouver Island, British Columbia (Lanquaye 2003) that concluded that less than 25 percent of the windthrow extended further than 25 meters (82 feet) into the edge, and less than 10 percent of the windthrow extended beyond 50 meters (164 feet) into the edge.

Figure 3-6. Measuring the Exterior Wind Buffer



Management Activities in the Exterior Wind Buffer

- **Pre-commercial and commercial thinning**. Thinning is allowed in all areas of the exterior wind buffer. Thinning should produce and maintain forest stands that are wind-firm, robust, and compositionally diverse. The spacing of tree removal at the time of thinning is determined in the field based on an assessment of the physical and biological condition of the site. The OESF windthrow

probability model can be used to test different thinning configurations to ensure wind firmness after thinning.

- **Application of herbicides** in accordance with WAC 222-38-020, *Handling, Storage, and Application of Pesticides* and PR 14-006-040, *Site Preparation and Vegetation Management*.
- **Brush and bough harvest**.
- **Pruning**.
- **New roads, existing road right-of-way, yarding corridors, or DNR-authorized recreational trail crossings**.
- **Peer-reviewed and DNR approved research and monitoring projects** designed to improve the integration of revenue and ecological values.
- **Operational trials**. Refer to "Research and Monitoring" later in this chapter for more information.

►Management Strategy: Implement Comprehensive Road Maintenance and Abandonment Plans

A well designed, located, constructed, and maintained system of forest roads is essential to forest management and protection of public resources. DNR's overall objectives for road construction and maintenance in the OESF include the following (DNR 1997, p. IV.118):

- Annually, assess conditions of active roads.
- Maintain existing roads to minimize drainage problems and sediment delivery to streams.
- Minimize active road density. Stabilize and close access to roads that no longer serve a management function or that cause burdensome management or environmental problems. Build new roads only when a weighing of ecological, operational, and economic factors shows a new road to be the most reasonable option.
- Build new roads based on sound engineering and consistent with the forest practices rules.
- Prioritize roads for decommissioning, upgrading, and maintenance during annual road maintenance and abandonment planning.
- Identify fish passage blockages that may develop over time at stream crossings and schedule blockage removal.

WAC 222-24-051 requires large forest landowners,[3] including DNR, to prepare and submit road maintenance and abandonment plans (RMAPs). These plans include forest road inventories and schedules for any repair work that is needed to bring roads up to current state standards. DNR has prepared RMAPs for each of the 11 landscapes in the OESF.

Comprehensive RMAPs specify the road work that is needed and when the work will be completed. Some of the work (for example, culvert and cross-drain projects) is done independently from timber sales and other work is done in conjunction with specific sales (for example, road maintenance prior, during and after timber sales and other forest management activities). DNR conducts road maintenance and abandonment planning and projects in accordance with WAC 222-24 *Road Construction and Maintenance* and the Forest Practices Board Manual.

Suspend Timber Hauling During Storm Events

DNR also considers how operations can be adjusted to further minimize delivery of fine sediment to streams. For example, DNR may suspend timber hauling on state trust lands in the OESF during storm events, when heavy rainfall can potentially increase surface water runoff and sediment delivery, unless the road is designed to handle wet-weather haul. The decision to suspend timber hauling on state trust lands is based on professional judgment. A weather event is considered a storm event when high levels of precipitation are forecast and there is a potential for drainage structures, such as culverts and ditches, to be overwhelmed, increasing the potential for sediment delivery to streams. Whether timber hauling is suspended or not, DNR compliance foresters monitor haul roads to determine if potential problems are developing that may lead to sediment delivery to streams and take action as necessary.

►Management Strategy: Protect Wetlands

DNR's wetland strategy on state trust lands in the OESF is intended to protect wetland plant and wildlife species, water quality, soils, and plant communities. Statewide, DNR allows no net loss of wetland acreage or function (DNR 2006). Wetland protection aims to 1) retain the plant canopies and root systems that maintain water transpiration and uptake processes, 2) minimize disturbance to natural surface and subsurface flow regimes, and 3) ensure stand regeneration (DNR 1997, p. IV.119).

Wetlands serve many vital landscape functions, including protection and improvement of water quality, storm-water retention, peak flow attenuation, seasonal stream flow augmentation, nutrient supply to downstream ecosystems, and habitat for many native wildlife species, either seasonally or for part of their lifecycles.

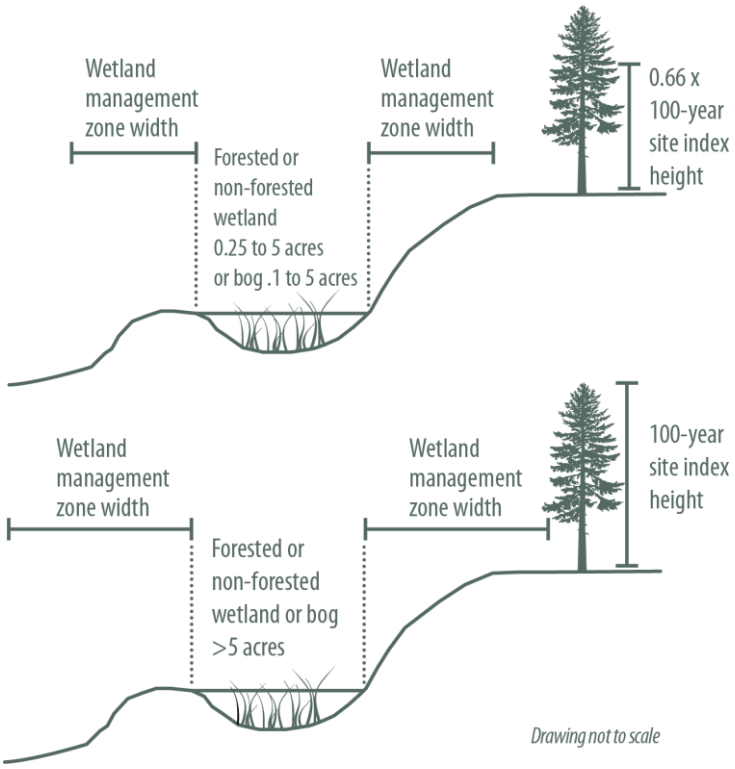
Wetlands that Require Protection

In the OESF, forested and non-forested wetlands (including bogs), as defined by WAC 222-16, are protected with wetland management zones and other management considerations if they are .25 acre or larger (wetlands) or .1 acre or larger (bogs) (DNR 1997, p. IV.120). A series of wetlands smaller than .25 acre will be protected if they function collectively as a larger wetland (DNR 1997, P. IV. 120). A wetland or bog is considered forested if current canopy closure (if the trees are mature) or probable future canopy closure (if the trees are not mature) is 30 percent or higher.

Width of the Wetland Management Zone

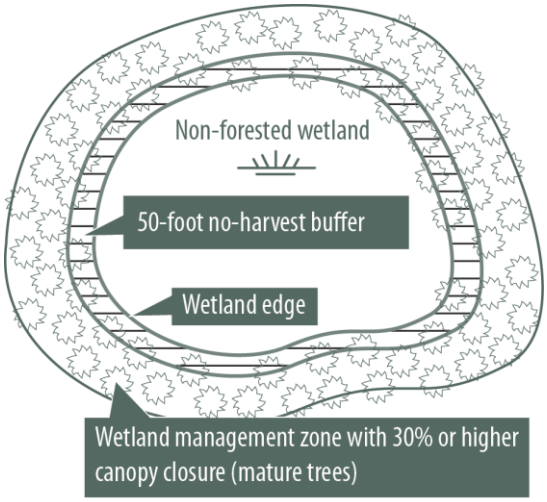
The width of the wetland management zone depends on the size and type of the wetland in question. The width of the wetland management zone is based on the 100-year site potential conifer tree height of the adjacent riparian forest. Foresters use the site index for site adapted (vigorously growing) species and measure the wetland management zone outward horizontally from the outer edge of the wetland (Figure 3-7). Widths of wetland management zones are listed in Tables 3-7 and 3-8 on p. 40 and 3-41, respectively.

Figure 3-7. Measuring the Wetland Management Zone



No-Harvest Buffer

Figure 3-8. No-harvest Buffer



Within the wetland management zone, DNR designates a 50-foot no harvest buffer around non-forested wetlands that have forested wetland management zones (refer to Figure 3-8). A wetland management zone is considered forested if current canopy closure (if the trees are mature) or probable future canopy closure (if the trees are not mature) is 30 percent or higher. The no-harvest buffer is measured outward horizontally from the outer edge of the non-forested wetland. No regeneration or thinning will occur within the no-harvest area.

Table 3-7. Wetland Management in the OESF (DNR 1997, p. IV.120)

Wetland type	Wetland size	Width of wetland management zone	No-harvest buffer	Thinning in wetland?	Thinning in wetland management zone?
Forested wetland	0.25 - 5 acre	2/3 100-year site potential tree height	None	Allowed. Perpetuate wind firmness and ≥ 120 ft^2 basal area per acre	Allowed. Perpetuate wind firmness and ≥ 120 ft^2 basal area per acre
Forested wetland	> 5 acre	100-year site potential tree height	None	Allowed. Perpetuate wind firmness and ≥ 120 ft^2 basal area per acre	Allowed. Perpetuate wind firmness and ≥ 120 ft^2 basal area per acre
Non-forested wetland	0.25 - 5 acre	2/3 100-year site potential tree height	50 feet	Not applicable	Allowed outside no-harvest buffer. Perpetuate wind firmness and ≥ 120 ft^2 basal area per acre
Non-forested wetland	> 5 acre	100-year site potential tree height	50 feet	Not applicable	Allowed outside no-harvest buffer. Perpetuate wind firmness and ≥ 120 ft^2 basal area per acre

Table 3-8. Bog Management in the OESF (DNR 1997, p. IV.120)

Wetland type	Wetland size	Width of wetland management zone	No-harvest buffer	Thinning in bog?	Thinning in wetland management zone?
Forested bog	0.1 - 5 acre	2/3 100-year site potential tree height	None	Allowed. Perpetuate wind firmness and ≥ 120 ft^2 basal area per acre	Allowed. Perpetuate wind firmness and ≥ 120 ft^2 basal area per acre
Forested bog	> 5 acre	100-year site potential tree height	None	Allowed. Perpetuate wind firmness and ≥ 120 ft^2 basal area per acre	Allowed. Perpetuate wind firmness and ≥ 120 ft^2 basal area per acre
Non-forested bog	0.1 - 5 acre	2/3 100-year site potential tree height	50 feet	Not applicable	Allowed. Perpetuate wind firmness and ≥ 120 ft^2 basal area per acre
Non-forested bog	> 5 acre	100-year site potential tree height	50 feet	Not applicable	Allowed. Perpetuate wind firmness and ≥ 120 ft^2 basal area per acre

Management Activities Within Wetlands and Wetland Management Zones

At a minimum, harvest in wetlands and their wetland management zones will be consistent with the level of protection outlined in this section and summarized in Tables 3-7 and 3-8. Forestry operations in forested wetlands and wetland management zones (outside of no-harvest buffers) will minimize entries into these areas and utilize practices that minimize disturbance, such as directional felling of timber away from wetlands and use of equipment that causes minimal soil disturbance. If ground

disturbance caused by forest management activities alters the natural surface or subsurface drainage of a wetland, then restoration of the natural drainage will occur.

Thinning

Forested wetlands and their wetland management zones may be thinned. For all wetlands and wetland management zones, particularly those in areas susceptible to windthrow, a primary conservation objective is the maintenance of wind-firm stands. In forested wetlands and their wetland management zones (outside of the 50-foot no-harvest buffer on non-forested wetlands), DNR perpetuates a basal area of at least 120 square feet per acre. Similar to exterior wind buffers, the spacing of tree removal at the time of thinning is determined in the field by the forester based on an assessment of the physical and biological condition of the site. The OESF windthrow probability model can be used to test different thinning configurations to ensure wind firmness after thinning. Foresters also may reference recent windthrow in other, similar wetlands or wetland management zones. DNR retains green trees that are representative of the dominant and co-dominant tree species prior to thinning.

Forested wetland management zones around non-forested wetlands can be thinned (outside of the no-harvest buffer), but DNR will maintain wind firm stands as described in the preceding paragraph.

Roads and Landings

In order to assure that there is no net loss of wetland function, all road and landing construction near or within wetlands are conducted in accordance with WAC 222-24 *Road Construction and Maintenance* and the guidance for wetlands provided in the HCP (p. IV.69 and IV.119). Roads are not constructed in bogs or low nutrient fens (a type of wetland that usually has sedge peat soils and is in contact with nutrient-rich ground and surface water). Field staff, in consultation with DNR's HCP and Scientific Consultation Section, provide on-site and in-kind mitigation of acreage and function for wetland losses from road or landing construction, or other management activities within wetlands or wetland management zones that result in a loss of wetland function. The effects of roads on natural surface and subsurface drainage will be minimized. Roads are designed to take the most direct route operationally feasible across wetlands and wetland management zones to minimize the cumulative impacts associated with roads.

Other Management Activities

- **Herbicides.** The use and application of herbicides within wetlands and wetland management zones is done in accordance with WAC

222-38-020, *Handling, Storage, and Application of Pesticides* and PR 14-006-040, *Site Preparation and Vegetation Management*.

- **Restoration efforts and pruning.**
- **DNR-authorized Recreational trail crossings.** DNR-authorized recreational trail crossings are allowed through wetland management zones but are avoided in both forested and non-forested wetlands. Trail crossings are designed to take the most direct route operationally feasible across wetland management zones.

Research and Monitoring

Harvest experiments to achieve wind-firm stands may be considered in wetlands susceptible to windthrow (DNR 1997, p. IV.120). Projects of this nature would be conducted through the research and monitoring program.

Marbled Murrelet Conservation Strategy

At the time the HCP was adopted, DNR did not have enough information to develop a long-term conservation strategy for marbled murrelets. In absence of a long-term strategy, DNR follows the interim HCP marbled murrelet conservation strategy (DNR 1997, p. IV.39 through IV.42) using the guidance provided in the "Memorandum for Marbled Murrelet Management within the Olympic Experimental State Forest" dated March 7, 2013 (OESF Marbled Murrelet Memo). The purpose of the OESF Marbled Murrelet Memo is to protect marbled murrelet habitat and allow timber harvest and other activities to proceed while the long-term strategy is being developed. Once the long-term strategy is completed and approved, this forest land plan will be updated if and as necessary.

Goal:

Provide forest conditions in strategic locations on forested trust lands that minimize and mitigate incidental take of marbled murrelets resulting from DNR's forest management activities.

Measurable Objective:

Protect areas currently identified in the OESF Marbled Murrelet Memo until a long-term conservation strategy for marbled murrelet habitat has been developed.

Management Strategies:

Following are DNR's strategies for implementing the interim marbled murrelet conservation strategy. Working hypotheses will be developed as the long-term conservation strategy is completed and approved.

- Implement existing HCP obligations through guidance provided in the OESF Marbled Murrelet Memo.
- Implement the marbled murrelet long-term conservation strategy when it is completed and approved.

How is the Objective Measured?

The objective is met so long as the areas listed in the OESF Marbled Murrelet Memo (or the areas listed in the marbled murrelet long-term conservation strategy when completed and approved) are protected.

How are the Management Strategies Implemented?

Refer to the OESF Marbled Murrelet Memo, or the marbled murrelet long-term conservation strategy when completed and approved, for implementation information such as guidelines for deferrals, buffers, timing restrictions, and roads.

Marbled Murrelet
Photo courtesy Rich MacIntosh

Multispecies Conservation Strategy

The multispecies conservation strategy covers habitat for unlisted wildlife species in the OESF, but also includes provisions for other species that face some risk of at least local extinction. The latter category includes federally listed species such as northern spotted owls and marbled murrelets; federal species of concern such as northern goshawks and harlequin ducks; state sensitive species such as the Olympic mudminnow; and state candidate species such as pileated woodpeckers.

Under the multispecies conservation strategy for the OESF, habitat for unlisted species and species at risk of local extinction is largely an outcome of landscape-level management in the OESF (DNR 1997, p. IV.137). For example, conservation measures for riparian areas and northern spotted owl and marbled murrelet habitat are expected to create interconnected patches of late-successional, mid-aged, and young forests (DNR 1997, p. IV.137) that would support a range of species. This strategy also includes site-or species-specific conservation measures such as protection of balds, caves, and other unique habitats and nesting sites for specific species.

The following goals, measurable objective, and strategies are based on p. IV.134 through 143 of the HCP.

Goals:

- Develop and implement a forest land plan that does not appreciably reduce the likelihood of survival and recovery of unlisted species on the Olympic Peninsula.
- Learn to integrate the values of older forest ecosystems and their functions with revenue production.
- Fill critical information gaps related to the composition, structure, and function of aquatic, riparian, and upland ecosystems, and the links between these and forest management activities and conservation of habitat for unlisted species.

Measurable Objective:

Provide a variety of habitat conditions to support multispecies goals by meeting measurable objectives for the northern spotted owl, marbled murrelet, and riparian conservation strategies and revenue production, and by implementing site- or species-specific conservation measures.

Management Strategies and the Working Hypotheses on Which They are Based:

Refer to Table 3-9.

Table 3-9. Multispecies Strategies and the Working Hypothesis on Which They are Based

Management Strategy	Working Hypothesis
Implement the northern spotted owl, riparian, and marbled murrelet conservation strategies.	DNR can meet its objectives for conservation of habitat for unlisted species and species at risk of local extinction in the OESF by managing stands and landscapes to meet its conservation objectives for the riparian, northern spotted owl, and marbled murrelet conservation strategies, and by implementing additional site- or species-specific conservation measures.
Follow existing procedures and guidelines for unique habitats.	
Manage habitat for unlisted species of concern.	

How is the Objective Measured?

Refer to respective sections of this plan for how objectives are measured for revenue production and for northern spotted owl, riparian, and marbled murrelet conservation strategies.

How are the Management Strategies Implemented?

►Management Strategy: Implement the Northern Spotted Owl, Riparian, and Marbled Murrelet Conservation Strategies

For detailed information on these strategies, refer to their respective sections in this chapter.

►Management Strategy: Follow Existing Procedures and Guidelines for Unique Habitats

Some wildlife species require special landscape features or habitat elements that may not be adequately conserved by species-specific strategies. Special conservation measures for talus field, caves, cliffs, large snags, and large, structurally unique trees may be important to these species (DNR 1997, p. IV.137). The protection of uncommon habitats and habitat elements is described in the HCP, and on-the-ground guidance is given in DNR's Forestry Handbook. For all harvest activities, DNR follows these procedures and guidelines:

- PR 14-004-046, *Identifying and Managing Structurally Complex Forests to Meet Older Forest Targets (Westside)*
- PR 14-004-170, *Protecting Talus Fields*
- PR 14-004-500, *Wetland Management in the OESF HCP Planning Unit*
- PR 14-006-090, *Management of Forest Stand Cohorts*
- GL 14-004-010, *Old-growth Timber Harvest Deferral and Protection (Westside)*
- PR 14-004-230, *Protecting Mineral Springs*
- PR 14-004-190, *Protecting Cliffs*
- PR 14-004-180, *Protecting Caves*
- PR 14-004-2200, *Protecting Balds*

►Management Strategy: Manage Habitat for Unlisted Species of Concern

For certain species, conservation measures are in place for known nesting, denning, and/or roosting sites as well as for habitat that is not widely distributed. DNR is not required to survey for nests, dens, roosts, or individual occurrences of unlisted species (DNR 1997, p. IV. 136). However, for all harvest activities, DNR follows these procedures:

- PR 14-004-290, *Protecting Pileated Woodpecker Nests*
- PR 14-004-300, *Protecting Vaux's Swifts Nests and Night Roosts*
- PR 14-004-340, *Protecting Peregrine Falcon Habitat*
- PR 140-004-280, *Protecting Pacific Fisher Dens*
- PR 14-004-260, *Protecting Northern Goshawk Nest West of the Cascades*
- PR 14-004-310, *Protecting Myotis Bat Communal Roosts and Maternal Colonies*
- PR 14-004-250, *Protecting Harlequin Duck Nests*
- PR 14-004-240, *Protecting Common Loon Nests*

- PR 14-004-330, *Protecting Bald Eagle Nesting , Roosting, and Foraging Sites*
- PR 14-004-390, *Protecting Aleutian Canada Goose Habitat*
- Policy 14-009, *Wildlife Habitat*

Pileated Woodpecker
Photo courtesy USFWS

Harlequin Duck
Photo courtesy USFWS

Adaptive Management

The idea of management actions that continue to change in response to new information is fundamental to the concept of ecologically-based sustainable forest management (Lindenmayer and Franklin 2002).

The HCP requires DNR to "demonstrate a process by which land management activities in the Experimental Forest can respond to new information" (DNR 1997, p. I.15). The adaptive management process is described in detail in Chapter 4 and also in PR-14-004-530, *Adaptive Management in the OESF HCP Planning Unit*. Following are DNR's goal, measurable objectives, and strategies, which are based on p. IV.82 through IV.85 and p. V1 through V10 of the HCP and Implementation Agreement, respectively.

Goal:

Continually improve the integration of revenue production and ecological values by learning from the outcomes of operational and experimental approaches.

Measurable Objective:

Implement a formal adaptive management process in which incomplete knowledge (uncertainties) related to forest management is identified, hypotheses around desired outcomes are formulated, actions to test these hypotheses are implemented, and reliable information is provided for decision makers to use to consider management adjustments.

Management Strategies:

- Implement the adaptive management process as described in PR-14-004-530 and Chapter 4.
- Conduct effective information management, which includes documenting recommended and approved research and monitoring activities and management changes.

- Share the outcomes of the adaptive management process with the Federal Services, stakeholders, other land managers, and the general public.

How is the Objective Measured?

DNR reports the outcomes of the adaptive management process described in the adaptive management procedure (PR 14-004-530) in the HCP Annual Report to the Federal Services.

How are the Management Strategies Implemented?

Refer to Chapter 4 and PR 14-004-530 for a full discussion of the adaptive management process.

Research and Monitoring

Research and monitoring are commitments in the HCP and the OESF is identified as the priority location for implementing them. Also, research and monitoring are the primary sources of information for a science-informed adaptive management process. Following are DNR's goal, measurable objectives, and strategies for research and monitoring, which are based on p. IV.82 through IV.85 and p. V.1 through V.10 of the HCP and Implementation Agreement, respectively.

Goal:

Explore the links between management activities and ecological processes and functions at both the stand and landscape level (DNR 1997, p. I.14).

Measurable Objectives:

- Conduct implementation monitoring to determine whether the HCP conservation strategies are implemented as written (DNR 1997, p.V.1).
- Conduct effectiveness monitoring to determine whether implementation of the conservation strategies results in anticipated habitat conditions (DNR 1997, p.V.1).
- Conduct validation monitoring to evaluate cause-and-effect relationships between habitat conditions resulting from implementation of conservation strategies, and the salmonid and northern spotted owl populations these strategies are intended to benefit (DNR 1997, p.V.1).
- Conduct research to obtain information to move from short- to long-term conservation strategies; assess and improve effectiveness of the four major habitat conservation strategies (northern spotted owl,

riparian, marbled murrelet, multispecies); and increase management options and commodity production opportunities (DNR 1997, p. V.6)

- Conduct operational trials to explore new ideas for forest management techniques, equipment, or contract stewardship.

Management Strategies:

- Document the types, amounts, and locations of forest management activities and assess their compliance with requirements of the HCP habitat conservation strategies (implementation monitoring) (DNR 1997, p. V.2).
- Document changes in riparian, northern spotted owl, and marbled murrelet habitat conditions and determine whether implementation of the HCP habitat conservation strategies results in anticipated habitat conditions (effectiveness monitoring) (DNR 1997, p. V.2).
- Document habitat use by salmonids, northern spotted owls, and marbled murrelets and evaluate species responses to management activities (validation monitoring) (DNR 1997, p. V.2).
- Develop study plans and implement research projects that are scientifically credible and cost-effective (DNR 1997, p. V.8).
- Implement small scale, short time-frame operational trials to test or prototype innovative ideas and techniques for forest operations.
- Conduct effective information management, which includes documenting research and monitoring activities; making records easily accessible; and exchanging information such as project reports, research and monitoring data, and peer-reviewed publications within DNR and with external partners.
- Collaborate with research organizations, local land managers, and other interested parties to gain expertise, improve efficiency, communicate knowledge, and share the cost of research and monitoring projects.

How are the Objectives Measured?

The benchmark for achieving research and monitoring objectives is the development and adoption of peer-reviewed study plans, and tracking their accomplishment through progress reports. Study plans are linked to specific uncertainties identified through the adaptive management process, and include testable hypotheses, detailed study design, field protocols, and analytical methods. Similar to the adaptive management

procedure, study plans help institutionalize monitoring and sustain DNR's attention on monitoring over time.

The benchmark for achieving operational trials is the documentation and sharing of results across DNR.

How are the Management Strategies Implemented?

Refer to Chapter 4 for a full discussion of the research and monitoring and operational trials programs.

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[1] DNR's interpretation of "restoration" is based on p. IV.91 of the HCP.

[2] The HCP anticipated that it would take between 40 to 60 years to reach the 40 percent Young Forest Habitat and better threshold in OESF landscapes. However, those estimates were based on stand age alone; in other words, when a stand reached a certain age it was assumed to be habitat. Using stand age alone can result in an over-estimate of habitat. DNR's current projections are based on an analysis of forest stand structure, not age. This change in methodology accounts for differences between HCP and current estimates of the length of time needed to attain the 40 percent threshold.

[3] Large forest landowners harvest an annual average of more than two million board feet of timber from their own forest land in Washington State.