



State Trust Lands Habitat Conservation Plan 2016 Annual Report

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For Fiscal Year 2016
.....

Published May 2017

▲ Large down wood in a tributary to the Little Hoko River, a watershed monitored in DNR's Olympic Experimental State Forest. DNR's Effectiveness Monitoring Programs measure a variety of habitat metrics including down wood in streams, riparian forests, and upland forests to determine whether the conservation strategies in the Habitat Conservation Plan result in improved habitat conditions for the Northern Spotted Owl and salmonid species.



WASHINGTON STATE DEPT OF
**NATURAL
RESOURCES**

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Prepared by
Washington State Department
of Natural Resources
Forest Resources Division



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Acronyms

dbh	Diameter at breast height
DEIS	Draft environmental impact statement
DFC	Desired future condition
DNR	Washington State Department of Natural Resources
ESA	Endangered Species Act
FEIS	Final environmental impact statement
FRIS	Forest resource inventory system
FIU	Forest inventory unit
FY	Fiscal year
HCP	State Trust Lands Habitat Conservation Plan
LPU	Landscape planning unit
LIDAR	Light detection and ranging
MoRF	Movement, roosting, and foraging
MOU	Memorandum of understanding
NAP	Natural area preserve
NRCA	Natural resource conservation area
NRF	Nesting, roosting, and foraging
NOAA	National Oceanic and Atmospheric Administration
OESF	Olympic Experimental State Forest
QMD	Quadratic mean diameter
P&T	DNR's forest management planning and tracking database
PNWRS	Pacific Northwest Research Station
RCO	Recreation and Conservation Office
RCW	Revised Code of Washington
RDEIS	Revised draft environmental impact statement
RDFC	Riparian desired future condition
RD	Relative density
REGIS	Road easement geographic information system
RFRS	Riparian Forest Restoration Strategy
RMAP	Road maintenance and abandonment plan
RS-FRIS	Remote-sensing forest resource inventory system
SEPA	(Washington) State Environmental Policy Act
SOMU	(Northern) Spotted owl management unit
USFWS	United States Fish and Wildlife Service
USFS	United States Forest Service
WAU	Watershed administrative unit
WDFW	Washington Department of Fish and Wildlife

Introduction

Appendix: Background on the State Trust Lands Habitat Conservation Plan

In fiscal year (FY) 2016, the Washington State Department of Natural Resources (DNR) continued to manage state trust lands to further the conservation, research, and monitoring objectives described in the Habitat Conservation Plan (HCP). In this reporting period, DNR also continued to make progress on its three high-priority planning projects – the Marbled Murrelet Long-Term Conservation Strategy, the Olympic Experimental State Forest (OESF) Forest Land Plan, and the westside sustainable harvest calculation.

Unless otherwise noted, information about DNR programs included in this report covers FY 2016 (July 1, 2015, through June 30, 2016). However, in some cases, significant program activities or milestones that occurred in early FY 2017 are reported, particularly for DNR’s high-priority planning projects that involve collaboration with the U.S. Fish and Wildlife Service (USFWS) and National Oceanic and Atmospheric Administration Fisheries (NOAA) (collectively, “the Services”).

Report Organization

In 2016, staffing levels allowed DNR’s Forest Resources Division to resume producing comprehensive reviews of DNR’s program activities for the HCP Annual Report. This year’s report highlights DNR’s Implementation and Effectiveness Monitoring programs. In previous HCP annual reports, comprehensive reviews were included at the beginning of the report. This year, the comprehensive reviews have been included in the body of the report prior to the annual update for each program to simplify the report structure and improve readability.

In the FY 2015 HCP Annual Report, the Adaptive Management section was reorganized to better reflect the stages of the adaptive management process. This revised structure is replicated in the FY 2016 report, with the addition of a new Publications section that summarizes external publications written by DNR state lands researchers that are relevant to forest management in the Pacific Northwest. The Research section also has been reformatted to more accurately describe projects that address multiple research and monitoring priorities.

Finally, the presentation of NSO habitat data has been changed from a tabular format to a chart format to provide a visual representation of DNR’s progress in meeting habitat goals.

Highlights

In FY 2016 and early FY 2017, DNR accomplished several objectives affecting lands managed under the HCP. Highlights include:

- **Released a Draft Environmental Impact Statement (DEIS) for the marbled murrelet long-term conservation strategy.** The DEIS describes and analyzes six alternative strategies including a no-action alternative that represents the interim strategy. The five action alternatives add marbled murrelet conservation areas to the existing framework of forestland conservation established by the HCP, Policy for Sustainable Forests, and other policies and strategies.

- **Adopted the Olympic Experimental State Forest (OESF) Forest Land Plan.** This plan will guide the management of over 270,000 acres of forested state trust lands on the western Olympic Peninsula.
- **Launched several planning processes to guide recreation on DNR-managed forestland.** Recreation planning efforts include state lands from Mount Baker to Bellingham in Whatcom County, Teanaway Community Forest in Kittitas County, Morning Star Natural Resources Conservation Area (NRCA) in Snohomish County, and Manastash Ridge in Kittitas County.

Progress toward Conservation Objectives

[Appendix: Background on Conservation Objectives](#)

FY 2016 Northern Spotted Owl Habitat Data

[Appendix: Habitat Type Definitions](#)

[Appendix: Background on Northern Spotted Owl Habitat Data](#)

DNR’s northern spotted owl (NSO) conservation strategy on the west side consists of two complementary habitat threshold targets:

1. In all westside HCP planning units except the OESF, restore and maintain at least 50 percent of designated nesting, roosting, and foraging (NRF) and dispersal management areas at the spotted owl management unit (SOMU) scale as habitat.
2. In the OESF, restore and maintain at least 40 percent of each landscape planning unit (LPU, also generically referred to as SOMU) as NSO habitat with at least 20 percent of each LPU as old forest habitat.

Below are updates to westside habitat percentages by HCP planning unit. The “Percent Habitat” data in the figures below show information as it existed on November 8, 2016, when it was extracted from DNR’s SOMU spatial layer overlaid with the NSO habitat spatial layer.

Columbia and North Puget HCP Planning Units

Figure 1 shows percent habitat for each SOMU in the Columbia HCP Planning Unit. Within this unit, the Upper Washougal dispersal SOMU is above habitat threshold at 56 percent. In the Upper Washougal dispersal SOMU, approximately 164 acres of forest classified as non-habitat or unknown were inventoried and reclassified as dispersal, sub-mature, or young forest marginal habitat. A variable retention harvest (VRH) was also conducted in the Upper Washougal SOMU in which approximately 306 acres were harvested in dispersal, sub-mature, and young forest marginal habitat through the Prospector timber sale. These activities resulted in a net decrease in percent habitat of 0.71 compared to last year. Percent habitat increased by 0.8 in the Silverstar dispersal SOMU due to 30 acres of next best (non-habitat) that were reclassified as dispersal habitat following a forest inventory.

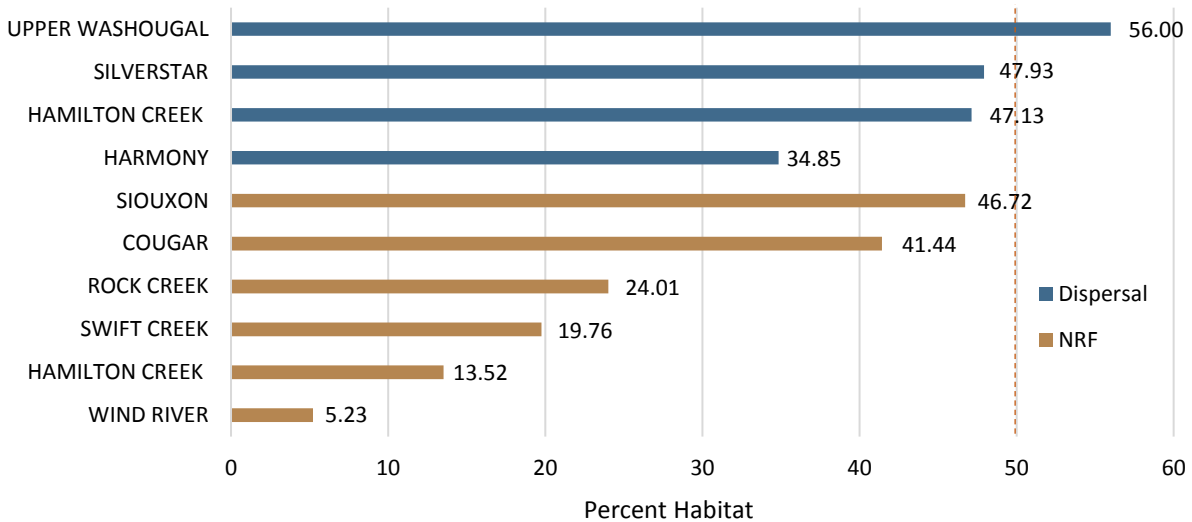


Figure 1: Habitat Percentages by SOMU in the Columbia HCP Planning Unit as of 11/8/2016. The dashed line represents the habitat target.

Figure 2 shows percent habitat for each SOMU in the North Puget HCP Planning Unit. Within this unit, the Alder and Upper Skagit South dispersal SOMUs are above habitat threshold at 52.93 and 52.46, respectively. In the Alder dispersal SOMU, percent habitat decreased by 0.76 compared to last year due to approximately 51 acres harvested in dispersal habitat through the Rendezvous timber sale. No other SOMUs in either planning unit recorded changes in NSO habitat levels due to harvest activities in 2016.

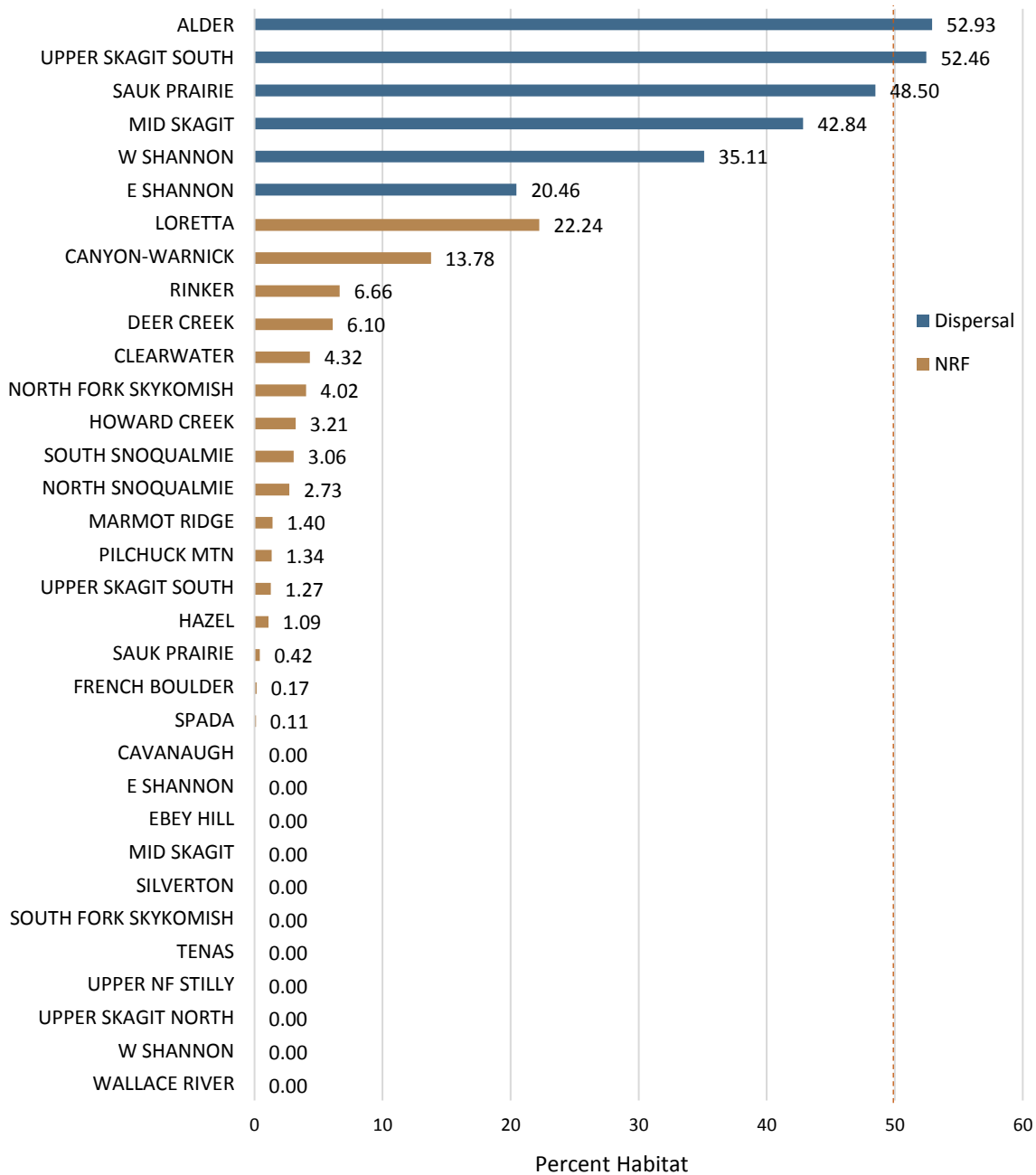


Figure 2: Habitat Percentages by SOMU in the North Puget HCP Planning Unit as of 11/8/2016. The dashed line represents the habitat target.

South Puget HCP Planning Unit

The 2010 *South Puget HCP Planning Unit Forest Land Plan Final EIS* identifies “a forest stand-level [NSO] habitat condition that contains forest stand structural components needed for movement (tree density, cover, and canopy layering), foraging (snags and coarse woody debris), and roosting (canopy layering)” (p. 32). This movement, roosting, and foraging (MoRF) habitat is a subset habitat class within dispersal management areas in South Puget Planning Unit SOMUs. The South Puget Planning Unit has an overall habitat threshold target of 50 percent for each SOMU. Dispersal

management areas have a MoRF threshold target of at least 35 percent with the remaining 15 percent classified as movement habitat. The two NRF management areas within the South Puget HCP Planning Unit share the same habitat targets as other westside NRF management areas.

Figure 3 shows the total NSO habitat percentages in the South Puget Planning Unit SOMUs. In the Elbe Hills SOMU, percent habitat increased by 0.55 compared to last year due to approximately 106 acres of forest with unknown habitat status that were reclassified after inventory to the young forest marginal or movement habitat types. In the Tahoma SOMU, percent habitat increased 0.06 due to 18 acres of unknown habitat that were reclassified as young forest marginal habitat after inventory.

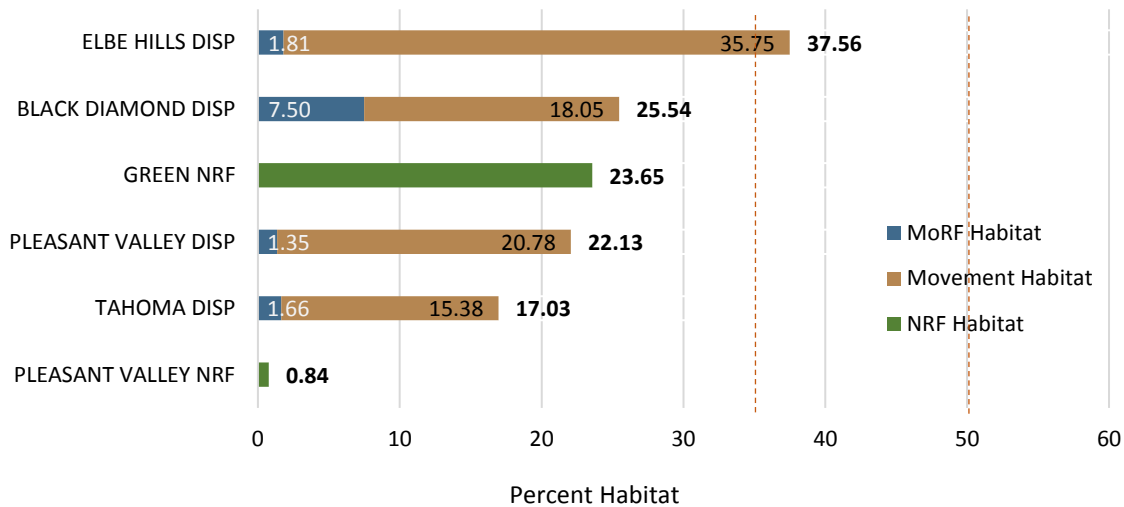


Figure 3: Habitat Percentages by SOMU in the South Puget Planning Unit as of 11/8/2016. Dashed lines represent habitat targets.

Olympic Experimental State Forest HCP Planning Unit

In the OESF HCP Planning Unit, habitat is tracked based on 11 LPUs. DNR does not designate NRF or dispersal areas in the OESF. In each of the 11 LPUs, DNR’s habitat goals are to restore and maintain a minimum of 40 percent NSO habitat, of which at least 20 percent is old forest habitat, and the remaining 20 percent is structural habitat or better. Figure 4 shows current total NSO habitat percentages in OESF Planning Unit LPUs. While no LPUs in OESF currently meet the 40 percent total NSO habitat goal, two units (Queets and Upper Clearwater) meet the old forest habitat goal. In the Kalaloch LPU, percent habitat increased by 0.31 compared to last year due to 62 acres of forest with unknown habitat status that were reclassified after inventory to young forest marginal habitat.

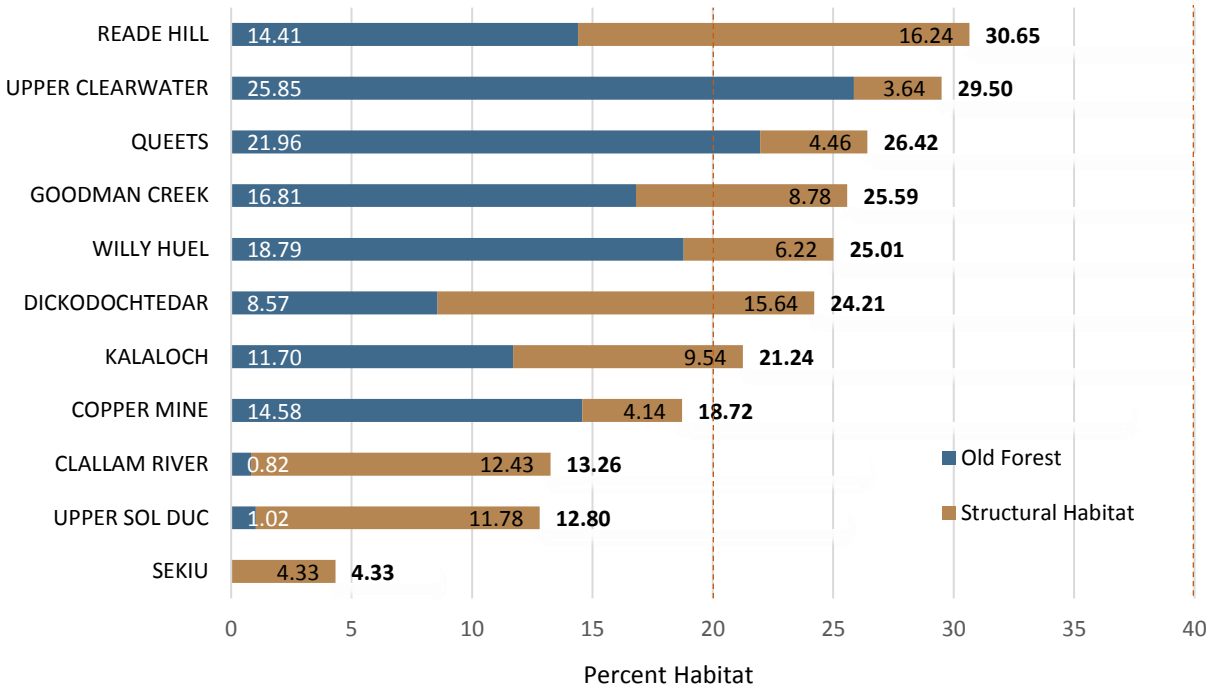


Figure 4: Habitat Percentages by LPU in the OESF HCP Planning Unit as of 11/8/2016. Dashed lines represent habitat targets.

FY 2016 Riparian Habitat Forest Restoration Data

Appendix: Background on the Riparian Conservation Strategy

Restoration thinning in riparian areas is conducted under guidance of the 2006 [Riparian Forest Restoration Strategy \(RFRS\)](#) and is implemented in concert with the timber sales program. Riparian restoration thinnings are designed to provide growing space to encourage older forest stand structures, maintain overstory tree growth, provide large wood to streams, and enhance understory development. DNR tracks timber sales that implement the RFRS to ensure that stand conditions are appropriate for thinning, and to better understand the role of active management in meeting the long-term goals of riparian forest complexity. Table 1 provides the percent of completed timber sales, by region, that have implemented the RFRS since FY 2012.

Table 1: Percent of Westside Timber Sales Implementing the RFRS.

Region	Percent of West-side Timber Sales Implementing the RFRS ¹				
	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016
Northwest	22	33	22	5	25
Olympic	0	0	0	25	0
Pacific Cascade	11	16	26	27	13
South Puget Sound	14	20	24	17	17
All westside timber sales	13	21	23	19	16

¹ These data exclude the OESF HCP Planning Unit, where the RFRS does not apply.

On average, approximately 18 percent of timber sales conducted on the west side since 2012 have implemented some RFRS thinning prescriptions. DNR does not track the number of timber sales that were evaluated for RFRS treatments and rejected due to stand conditions, operational infeasibility, or prohibitive costs associated with additional road building or yarding systems.

Figure 5 shows the estimated acreage thinned, by DNR region, under the RFRS since FY 2012. Approximately 494 acres of riparian restoration thinning were conducted during FY 2016, compared to 346 acres in FY 2015. Since 2012, over 1,400 acres of riparian area have been thinned to accelerate development of complex forest structure.

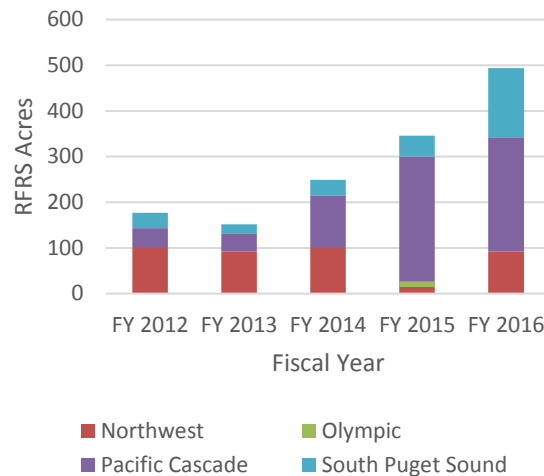


Figure 5: Estimated Acreage Thinned under the RFRS by Region. Data for Olympic Region excludes the OESF where the RFRS does not apply.

Wetland Management and the RFRS

Management of forested wetlands and wetland management zones (WMZs) under the HCP include short-term measures to maintain minimal acceptable wetland and buffer function (retention of at least 120 ft² basal area per acre of the most wind-firm trees). In practice, forested wetlands are rarely thinned because there is generally insufficient basal area to meet the 120 ft² requirement and because thinning on wetland soils tends to increase the risk of windthrow for the remaining trees.

In FY 2016, DNR continued to apply an increasingly common approach consistent with the RFRS in which RMZs and WMZs are thinned using the same prescription. For example, Unit 3 in the Ridge Walker Sorts timber sale in Pacific Cascade Region was thinned from below with a diameter limit and species selection in both RMZs and WMZs. More information about this sale including maps delineating RMZs and WMZs can be found in the [November 2015 Timber Auction Book](#).

Headwaters Conservation Strategy

In 2007, DNR developed a draft Headwaters Conservation Strategy in collaboration with the Services and the scientific community to guide forest management along Type 5 streams and complete the HCP riparian conservation strategy. It was determined however, that the draft strategy would have required a high level of spatial tracking to comply and document, and a considerable number of management decisions to complete each timber sale. As a result, a simpler alternative draft headwaters strategy is being developed that will meet the original conservation objective of the previous draft. This alternative strategy incorporates emerging ideas about the importance of non-fish-bearing stream habitat for ecosystem conservation and the linkage to downstream fish habitat quality.

Marbled Murrelet Conservation Strategy Development

[Appendix: Background on the Marbled Murrelet Conservation Strategy](#)

Long-Term Conservation Strategy

In December 2016, DNR and the USFWS released a [draft environmental impact statement \(DEIS\)](#) on a long-term strategy for marbled murrelet conservation for the six western Washington HCP planning

units. The long-term strategy is intended to provide strategic conservation of murrelet habitat on state trust lands while allowing for timber harvest and other activities that earn revenue for public schools, counties, and other trust land beneficiaries.

The DEIS describes and analyzes six alternative strategies, including a no-action alternative that represents the interim strategy. The DEIS satisfies both the State Environmental Policy Act (SEPA) and National Environmental Policy Act (NEPA) environmental review requirements. Four public meetings and a webinar were held in January 2017, and a 90-day public comment period concluded on March 9, 2017.

The five action alternatives would add marbled murrelet conservation areas to the existing framework of forestland conservation established by the HCP, Policy for Sustainable Forests, and other policies and strategies. The amount of new, murrelet-specific conservation proposed under the alternatives ranges from 10,000 to 151,000 acres, all located within 55 miles of marine waters (the assumed inland range of the marbled murrelet). New conservation measures are also proposed to manage the impacts of forest management activities including harvest, thinning, recreation, road building and maintenance, and other land uses that could cause audio-visual disturbance to nesting murrelets (Figure 6).



Figure 6: Marbled Murrelet Nest with an Egg. Photo courtesy of Nicholas Hatch.

Potential environmental impacts of the alternatives are analyzed in the DEIS. Most land uses and natural resources are not expected to be adversely impacted. However, there are potential, adverse economic impacts to timber-dependent counties and the trusts. Potential impacts of each alternative to the marbled murrelet population were assessed using a population viability analysis conducted by subject-matter experts.

The DEIS also examined the ratios of impacts to mitigation under each alternative through the life of the HCP (to the year 2067). The analysis applies the analytical framework previously established by DNR and USFWS to provide objective, repeatable, science-based estimates of the potential impacts and mitigation to marbled murrelet habitat from DNR's land management activities under the HCP. This framework determines the location, quality, and quantity of marbled murrelet habitat on DNR-managed lands and calculates the potential impacts to habitat and mitigation through time. Impacts from forest management and land uses include habitat removal through harvest and related infrastructure, edge effects from roads and high-contrast forest edges, and audio and visual disturbance from forest management activities such as rock blasting and recreation.

After the public comment period, DNR and USFWS will summarize and respond to comments received on the DEIS and incorporate necessary changes into a final EIS. The Board of Natural Resources will then select a proposed long-term strategy and submit an application to USFWS to amend the HCP and associated incidental take permit. USFWS will subsequently complete a biological opinion, determine sufficiency under the Endangered Species Act, and issue a record of

decision under NEPA. The Board of Natural Resources will ultimately decide whether to adopt the long-term strategy.

Interim Conservation Strategy

Negotiations between DNR and the USFWS surrounding the long-term strategy for marbled murrelet conservation began on July 8, 2013. DNR will continue to implement the marbled murrelet interim conservation strategy throughout western Washington until a long-term conservation strategy is completed. DNR continues to discuss implementation of the interim strategy with USFWS.

In keeping with the marbled murrelet interim conservation strategy, stands on DNR-managed lands were classified by a habitat relationship model. These “reclassified habitat” stands were predicted to contain occupied sites, and the reclassified habitat that was predicted to contain 95 percent of the occupied sites had protocol surveys conducted to determine occupancy. Inventory surveys using the [2003 Pacific Seabird Group murrelet survey protocol](#) were completed for DNR state lands in Straits, South Coast, and Columbia HCP planning units and documented to USFWS on December 2, 2003.

Within the areas where surveys were completed, DNR identified 42,353 acres of unoccupied reclassified habitat in which some of the habitat could be harvested. Some surveyed, unoccupied habitat has been released from deferral status as directed in Step 4 of the marbled murrelet interim conservation strategy in the HCP (p. IV.40). Reclassified habitat within the Columbia Planning Unit is located solely within Southwest Washington and was recently made available for some harvests through negotiations with USFWS on the marbled murrelet long-term conservation strategy. Southwest Washington is defined as those portions of the Columbia and South Coast planning units west of Interstate 5 and that portion of the South Coast Planning Unit that is located south of Highway 8 and south of Highway 12 between Elma and Aberdeen.

Of the 14,174 acres currently available for harvest under the interim conservation strategy, 2,262 acres, or 16 percent of available acres, have been harvested. Table 2 shows the amount of released, reclassified marbled murrelet habitat in the Straits, South Coast, and Columbia planning units and acres harvested within each watershed administrative unit (WAU).

Table 2: Released Reclassified Marbled Murrelet Habitat.

WAU	Total Acres of Reclassified Habitat ¹	Acres of Released, Reclassified Habitat Available for Harvest	Acres Harvested as of 6/30/2016 ^{2,3}
Straits HCP Planning Unit			
Bell Creek	222	0	0
Big Quil	122	61	1
Chimakum	13	6	0
Cushman	15	8	0
Dabob	22	11	0
Discovery Bay	1,161	581	319
Dungeness Valley	1,410	265	39
Hamma Hamma	184	92	37
Lake Crescent	156	0	0
Lilliwaup	573	287	39

Little Quil	97	49	7
Ludlow	94	47	45
Lyre	636	19	0
Morse Creek	308	8	3
Port Angeles	1,441	154	118
Salt	2,418	745	238
Sequim Bay	1,959	450	253
Siebert McDonald	1,857	607	177
Skokomish, Lower NF	71	36	10
Sutherland-Aldwell	1,925	561	172
Twins	731	347	58
South Coast HCP Planning Unit, East of I-5			
Newaukum, Lower NF	5	3	0
Scatter Creek	167	84	22
Skookumchuck, Lower ⁴	91	45	5
South Coast HCP Planning Unit, North of Highways 8 and 12			
Cook-Elk	230	0	0
Copalis River	249	21	0
Hoquiam, EF	8	4	1
Hoquiam, WF-MF	57	0	0
Humtulpis, Middle	110	55	66
Humtulpis, WF	253	30	1
Joe-Moclips	635	158	27
Stevens Creek	107	54	49
Columbia and South Coast HCP Planning Units within Southwest Washington, West of I-5 and South of Highways 8 and 12			
Abernathy	997	499	36
Bear River	184	0	0
Black River	553	276	1
Cedar Creek	2,565	1,282	1
Chinook	36	0	0
Cloquallum	2	1	0
Curtis	53	27	0
Delezene	4	2	0
Elk Creek	162	81	2
Elk River	40	20	0
Elochoman, Main	955	478	0
Garrard Creek	1,619	809	0

Grays Bay	845	220	3
Headwaters	688	344	0
Johns River	24	12	0
Kennedy Creek	0	0	0
Lincoln Creek	337	168	0
Main Fork	300	34	0
Mill Creek	1,503	751	55
Mox Chehalis	578	289	8
Naselle Headwaters	1,243	194	0
Naselle, Lower	725	67	0
Nemah	1,449	0	0
Palix	670	161	0
Porter Creek	2,442	1,221	222
Rock-Jones	39	19	0
Skamokawa	2,974	820	0
Smith Creek	34	0	0
South Fork	566	28	0
Waddel Creek	883	441	3
Willapa Headwaters	1,731	865	165
Willapa, Lower	94	44	1
Willapa, SF	728	232	78
Wilson Creek	1	0	1
TOTAL	42,353	14,174	2,262

¹ The Skokomish (Straits); Wishkah, Lower (South Coast, North of Highways 8 and 12); and Hanaford (South Coast, East of I-5) WAUs have no reclassified habitat, so they are not displayed in this table.

² Data originated in DNR's Planning and Tracking (P&T) system. Subsequent new data or corrections are not reflected here. The P&T data has been overlaid with the Marbled Murrelet Habitat GIS layer queried 4/12/2017 to identify timber sale activities (sold and completed, FYs 2004–2016) in released habitat. Values have been rounded to the nearest acre.

³ Harvested acreage includes blowdown salvage sales as well as traditional harvest treatments.

⁴ This WAU was incorrectly listed as North of Highways 8 and 12 in last year's HCP annual report.

Adaptive Management

Appendix: Background on Adaptive Management

The HCP describes adaptive management as a process that provides for ongoing modifications of management practices to respond to new information and scientific developments. Over the past three years, DNR State Lands' adaptive management group has focused on better documenting and coordinating active research on state lands to support the missions of DNR's Adaptive Management Program:

- Setting research priorities
- Managing research projects

- Reviewing results
- Making changes to DNR’s forest management practices
- Monitoring management activities to help inform needs

In the OESF, the adaptive management process was formalized with the adoption of the 2016 [OESF Forest Land Plan](#) that will guide the management of over 270,000 acres of forested state trust lands on the western Olympic Peninsula. The plan describes a step-by-step adaptive management process, and an administrative procedure for adaptive management in the OESF was adopted as part of the plan. The first OESF adaptive management meeting took place in February 2016 and focused on review and prioritization of ongoing research and monitoring projects.

Comprehensive Review: Implementation Monitoring

[*Appendix: Background on Comprehensive Reviews*](#)

[*Appendix: Background on Implementation Monitoring*](#)

Overview

The Implementation Monitoring Program was formed in 1999 to meet DNR’s commitment to monitor and report on implementation of the conservation strategies described in the HCP. In addition to meeting HCP commitments, the program evaluates DNR’s conformance to other agency guidance documents and regulatory requirements and supports the implementation of multiple policies in DNR’s 2006 Policy for Sustainable Forests. Implementation monitoring is an important component of adaptive management and also supports effectiveness and validation monitoring by determining whether conservation strategies are being implemented on the ground as written.

State lands managed by DNR are subject to complex forest management strategies necessary to achieve a variety of habitat conservation commitments. The objective of the Implementation Monitoring Program is to confirm that these strategies are appropriately implemented, identify areas for continuous improvement, and respond to changing conditions and new information. In order to meet these objectives, the program has four primary goals:

1. Determine whether conservation strategies described in the HCP are being implemented as written by quantifying the operational compliance of strategy application to the landscape.
2. Identify successes in implementing HCP conservation strategies and department guidance, identify potential causes of non-compliance, and find areas for improvement.
3. Provide managers with information and feedback regarding the implementation of forest management activities.
4. Support DNR’s evolving adaptive management process by using monitoring results to facilitate the improvement of department guidance, reduce risk and inconsistencies of implementation, and increase effectiveness of implementation of department guidance on state trust lands.

The first implementation monitoring report was published in 2003, with subsequent reports published as projects were completed. To date, 13 reports have been published and are available on [DNR’s Monitoring and Reporting webpage](#). Initial monitoring projects were “pilot” in nature, meaning that different monitoring methodologies were tested and the resources required to conduct monitoring were quantified. Over time, the monitoring focus has shifted from monitoring all or multiple strategies applied under a management activity, to conducting strategy-specific sampling that focuses

on how a single strategy is implemented across multiple sample units. Table 3 lists the conservation strategies that have been monitored since the start of the HCP and the level of compliance found.

Table 3: Conservation Strategies Monitored under the HCP.

Strategy/Strategy Component	Geographic Scope (HCP Planning Unit or Region)	Percent Compliant ¹
Report Publication Year²: 2003		
Riparian buffers	North and South Puget Planning Units	75
Stream typing	North and South Puget Planning Units	92
Hydrologic maturity	North and South Puget Planning Units	100
Potentially unstable slopes	North and South Puget Planning Units	100
Northern Spotted Owl Strategy	North and South Puget Planning Units	100
Marbled Murrelet Strategy	North and South Puget Planning Units	100
2004		
Riparian buffers	Westside Planning Units and OESF	69
Stream typing	Westside Planning Units and OESF	93
Northern Spotted Owl Strategy	All Planning Units	100
Balds	All Planning Units	100
Mineral springs	All Planning Units	100
2005		
Wetlands - buffers and basal area	Westside Planning Units and OESF	65, 96
Wind buffers	Westside Planning Units and OESF	50
Cliffs, talus, caves, bald eagle, pileated woodpecker	Westside Planning Units and OESF	100
Large, structurally unique trees/snags	Westside Planning Units and OESF	83
2007		
Hydrologic maturity	Westside Planning Units	88
Northern Spotted Owl Strategy	Columbia, North Puget, South Puget, and Straits Planning Units	78
Northern Spotted Owl Strategy	Klickitat Planning Unit	96
Riparian buffers	All Westside Regions	82
2008		
Uncommon habitats	South Puget Sound, Northwest, and Olympic Regions	100
Stream typing	OESF	96
Riparian buffers	OESF	71
2009		
Large, structurally unique trees/snags	All Westside Regions	90
Wetlands – net loss of acreage and function	All Westside Regions	95

2012		
Northern Spotted Owl Strategy	All Planning Units except OESF	83
Hydrologic maturity	Westside Planning Units except OESF	100
Road element of the RFRS	Westside Planning Units including OESF	88
Silviculture activity completion (database validation)	All Planning Units except Chelan	100
Timber sale completion (database validation)	All Planning Units except Chelan	98
2013		
Riparian buffers	Westside Planning Units except OESF	100
Riparian thinnings – post-treatment conditions	Westside Planning Units except OESF	97
Riparian thinnings - inner zone harvested	Westside Planning Units except OESF	86
Riparian thinnings - equipment exclusion zone	Westside Planning Units except OESF	86
Riparian thinnings - large woody debris creation	Westside Planning Units except OESF	inconclusive
Stream typing	Westside Planning Units except OESF	84
Riparian hardwood conversion (RHC) and Individual conifer release (ICR)	Westside Planning Units except OESF	100
Unstable hillslope component of the RFRS	Westside Planning Units including OESF	100
2014		
Wetlands - buffers, basal area, and rutting	Westside Planning Units except OESF	87
Wetlands - roads	Westside Planning Units except OESF	100
RHC and ICR - inner zone integrity	Westside Planning Units except OESF	93
RHC and ICR - integrity of equipment exclusion zone	Westside Planning Units except OESF	93
2015		
Northern Spotted Owl Strategy	Westside Planning Units except OESF	100
2016		
Roads component of the RFRS	Westside Planning Units except OESF	90

¹ Reference the appropriate report for the nature of non-compliance or indeterminacy and monitoring methodologies.

² The report scheduled to be published in 2006 was not published until 2007. Reports were not published in 2010-2011 due to budget and staffing limitations.

In addition to conducting field monitoring, the program began conducting monthly office reviews in July 2013 on every timber sale across all HCP planning units. The intent of these reviews is to ensure consistent documentation and track how frequently different strategies and strategy components are implemented.

Strategy Implementation Frequency

In 2002, the Implementation Monitoring Program developed the HCP checklist, a document used by foresters to identify which HCP strategies are applied with a management activity. In 2013, the creation of an HCP checklist database along with the development of a more detailed HCP checklist has allowed for more efficient tracking of applied strategies.

The frequency of implementation of HCP strategies and strategy components varies widely. For example, in Western Washington, at least one component of the riparian conservation strategy is implemented on nearly every timber sale, and the large, structurally unique trees component of the multispecies conservation strategy is implemented on every variable retention harvest (Figure 7). In contrast, the following strategies have not resulted in changes to harvest operations in any timber sale reviewed since July 2013: mineral springs, oak woodlands, bats, California wolverine, Columbian whitetail deer, common loon, harlequin duck, northern goshawk, Oregon silverspot butterfly, Pacific fisher, and Vaux's swift.

Monitoring Results

The results of the implementation monitoring conducted to date indicate that DNR's operational compliance with the conservation strategies in the HCP has generally improved (or remained compliant) since the start of the HCP. For example, the operational compliance for stream buffer widths has increased from 75 percent to 100 percent based on monitoring results published in 2003 and 2013, respectively. Monitoring of uncommon habitats (Figure 8), which is an infrequently implemented component of the multispecies conservation strategy and therefore may have a higher risk of non-compliance, has consistently been implemented with 100 percent compliance (2004, 2005, and 2008 reports). Recent reports (e.g., 2013 and 2015) have observed that DNR has taken a consistently conservative approach when implementing strategies on the ground.

In some cases, compliance has been less than 100 percent because the monitoring staff could not conclusively prove compliance, not because a specific non-compliance was identified. For example, out of 23 timber sales that were selected for an office review in 2005 to evaluate conformance with the Northern Spotted Owl Strategy, DNR was unable to determine compliance of five sales due to either incomplete or contradictory documentation (e.g. the timber sale jacket indicated that activity was in one spotted owl circle, while GIS showed it in a different owl circle). The strategy received an average compliance rating of 78 percent across all planning units monitored. To avoid similar outcomes, the Implementation Monitoring Program now works with region staff to ensure documentation is complete as part of the monthly office reviews for every timber sale within HCP planning units.



Figure 7: Variable Retention Harvest in Olympic Region. The large, structurally unique trees component of the multispecies conservation strategy was applied in this forest management unit. Photo courtesy of Zak Thomas.



Figure 8: A Cliff Feature Monitored under the Uncommon Habitats Component of the Multispecies Conservation Strategy. Photo courtesy of Zak Thomas.

When interpreting monitoring results, it is important to consider the nature of the non-compliance in addition to the level of compliance reported. For example, implementation of wetland protection measures was found to be 95 percent compliant in the 2009 report and 87 percent compliant in 2014 report, but the nonconforming FMUs identified in 2009 contained two wetlands that were not protected at all during harvest, whereas in 2014, the nonconforming buffers were 95–99 percent of the required width. Over time, DNR has included more detail regarding both compliance and non-compliance in the monitoring reports to allow the Services and DNR to gain a better understanding of what occurred on the ground and assess the potential ecological implications.

Monitoring Impacts

Monitoring results are shared with DNR operational and technical specialists to facilitate learning and continuous improvement, inform the development of training and guidance materials, and support other DNR program areas. For example, improved documentation of RFRS implementation frequency has provided data that is being considered in DNR’s sustainable harvest calculation.

Some other examples of changes initiated by implementation monitoring findings include:

- Daily archiving of WAU reports initiated based on the suggestions of the February 2007 report, so compliance with the Hydrologic Maturity in the Rain-on-Snow Zone component of the riparian conservation strategy could be better tracked. Previously, WAU reports were not archived, making it difficult to evaluate whether completed harvests were in conformance with this strategy component.
- Results from the 2009–2011 report increased the use of GIS in presales methods in one region to better track spatial changes in spotted owl circles that were previously thought to be static.
- Delineation of leave trees in FMUs has become more consistent across all regions.
- The results of the monthly office reviews indicate that documentation of management decisions has improved across DNR regions.

Future Monitoring Methodologies

In 2017–2018 the monitoring program plans to test the effectiveness of remote monitoring methodologies including the use of high-resolution imagery. It is anticipated that remote monitoring could be used as a first step in evaluating forest management units for compliance with certain strategies and identifying those requiring a field visit to determine “on-the-ground” compliance. Remote monitoring may facilitate the review of multiple strategies simultaneously, allowing for better tracking of compliance over time and enabling prioritization of strategies for detailed monitoring projects. For many HCP strategies however, field verification will be the only way to adequately evaluate operational compliance. Future monitoring efforts will strive to focus on instituting consistent sampling methodologies for specific strategies from year to year to allow for better comparisons of compliance over time. Changes in department guidance and development of new policies may influence future monitoring priorities and methodologies.

FY 2016 Implementation Monitoring Results

In FY 2016, the Implementation Monitoring Program reported on the implementation of the roads component of the RFRS. Monitoring staff visited 31 stream crossings in order to determine whether guidance was implemented correctly and if any modifications to guidance could make activities more consistent with the wood placement expectations described. There were no instances of wood not

being placed at a crossing where placement of wood was prescribed, or evidence of inner zone wood removed from the RMZ that was significantly larger than what was placed in the stream. However, monitoring staff noted three instances where placed wood was either less than two times the width of the ordinary high water mark and/or placed upstream of the crossing. On average, DNR placed 3.1 pieces of wood per crossing into and adjacent to streams (Figure 9). Examples of areas of the guidance that may benefit from further clarification include wood placement standards in the middle and outer zone and whether placement of hardwood species is permissible. Current and past reports produced by the Implementation Monitoring Program can be found on [DNR's Monitoring and Reporting webpage](#).



Figure 9: Large Down Woody Debris Left as Mitigation for a Road Crossing a Type 3 Stream. Photo courtesy of Zak Thomas.

Comprehensive Review: Effectiveness Monitoring

Appendix: Background on Effectiveness Monitoring

As described in the HCP, DNR is required to conduct effectiveness monitoring to determine whether implementation of the conservation strategies results in anticipated habitat conditions. Effectiveness monitoring is intended to document changes in habitat conditions, including general forest structure, specialized habitat features, and spotted owl prey populations that result from timber harvest and other forest management activities. Over time, the results from DNR's effectiveness monitoring may be used to modify management practices to enable DNR to better manage land in accordance with the conservation objectives reflected in the HCP.

After the HCP was signed in 1997, DNR began collaborating with the Services to develop effectiveness monitoring plans for spotted owl and riparian habitat to meet the commitments outlined in the HCP. Several plans were finalized in 2001. These plans provide the foundation for DNR's effectiveness monitoring programs for spotted owl and riparian habitat, and continue to inform program development and implementation. DNR's Riparian Silviculture Effectiveness Monitoring Program is currently modernizing the format of these monitoring plans and intends to publish them on the DNR website.

This section includes reviews of DNR's effectiveness monitoring programs for spotted owl habitat, riparian silviculture, and aquatic and riparian habitat in the OESF.

Northern Spotted Owl Effectiveness Monitoring Program

The NSO Effectiveness Monitoring Program is intended to document changes in habitat, including general forest structure and specific habitat features that result from timber harvest and other

management activities carried out under the HCP. The HCP specifies that the monitoring program is to cover a range of habitat management areas including nesting-roosting-foraging (NRF) and dispersal areas, using a representative sampling approach and built on field-based before-and-after comparisons.

Program Implementation

The first NSO effectiveness monitoring installations were established during 2004–2007. These “passive monitoring” sites were designed to monitor the variable-density-thinnings (VDTs) regularly implemented by DNR, rather than monitoring new or future desired treatments under an experimental approach. Five sites were established across four HCP Planning Units (Figure 10). Pre-treatment data were collected within a year of the commencement of harvest, and post-treatment data were collected within a year of harvest completion.

In 2009, the NSO Effectiveness Monitoring Program was put on hold due to budget and staffing reductions. In 2013, increases in staffing allowed renewal of the sampling program, with all sites being re-measured by 2015 at 6–9 years post-treatment rather than the originally intended five years. For brevity, this latest re-measurement is referred to as the seven-year measurement. A summary of the sampling history of each site is included in Table 4.



Figure 10: Map of NSO Effectiveness Monitoring Sites.

Table 4: Summary and Sampling History of NSO Effectiveness Monitoring Sites.

Site/Timber Sale Name	Planning Unit	Management Area Type	Year Measured		
			Pre-treatment	Post-treatment	7-year Re-measurement
Lyons Share	Columbia	NRF	2004	2006	2015
Cougarilla	South Puget	Dispersal	2005	2006	2013
Loop	Klickitat	NRF	2006	2007	2014
Big Beaver	South Puget	Dispersal	2007	2008	2014
Whitehorse Flat	North Puget	NRF	2007	2008	2015

Although pre-treatment stand and site characteristics varied among sites, all sites share some basic commonalities. They all include 50–80 year-old second-growth stands in the stem-exclusion stage with a single canopy layer and little understory development. They also share a treatment objective to accelerate development toward desired habitat conditions including reduced stem densities, multiple canopy layers, horizontal heterogeneity, gaps, larger dominant trees, and decadence. In general, the treatments were conservative in maintaining relative density (RD) above or near 48, with an objective to maintain canopy closure above 70 percent in accordance with the habitat definitions in the HCP.

Each site consists of 2–3 treated stands that were thinned, and one comparable unthinned control stand. Within each stand, 13 0.12-acre circular plots were randomly distributed across a four-acre core area, surrounded by a 200-foot buffer of similarly treated area. The total area of each stand is approximately 15 acres. Each 0.12-acre plot consists of nested subplots for measuring trees, saplings, seedlings, understory vegetation, canopy cover, snags, and down wood. The plots were permanently established with rebar and tags. All trees greater than four-inch dbh were tagged and tracked for growth and mortality. Canopy depth and branching (i.e., epicormic development) measurements were recorded for each tree. During the seven-year re-measurement, photos were taken at some stands to further document differences between thinned and unthinned stands (Figure 11).

Preliminary Findings

DNR is currently analyzing data for all measurements (pre-treatment, post-treatment, seven-year re-measurement). A significant component of this process includes merging disparate data formats into one clean database and performing quality checks on all measurements.

Figure 12 shows preliminary results for one structural response, understory tree recruitment, in the four westside monitoring sites. Panel A compares the percent of each stand occupied by saplings in unthinned control stands and thinned stands, Panel B compares the sapling density, and Panel C compares the mean sapling diameter. These preliminary results suggest the thinning treatments have elicited measurable development of a second canopy layer, which is a common objective of DNR’s thinnings in NSO habitat. Overall, preliminary findings are that NSO habitat conditions have been maintained or enhanced as intended in treated areas; however, finalized results will be published as part of the forthcoming establishment report (see [Future Priorities](#) below).



Figure 11: Whitehorse Flat NSO Effectiveness Monitoring Site, North Puget HCP Planning Unit. The top photo shows an unthinned control stand and the bottom photo shows a stand thinned seven years earlier. Photos courtesy of Dan Donato.

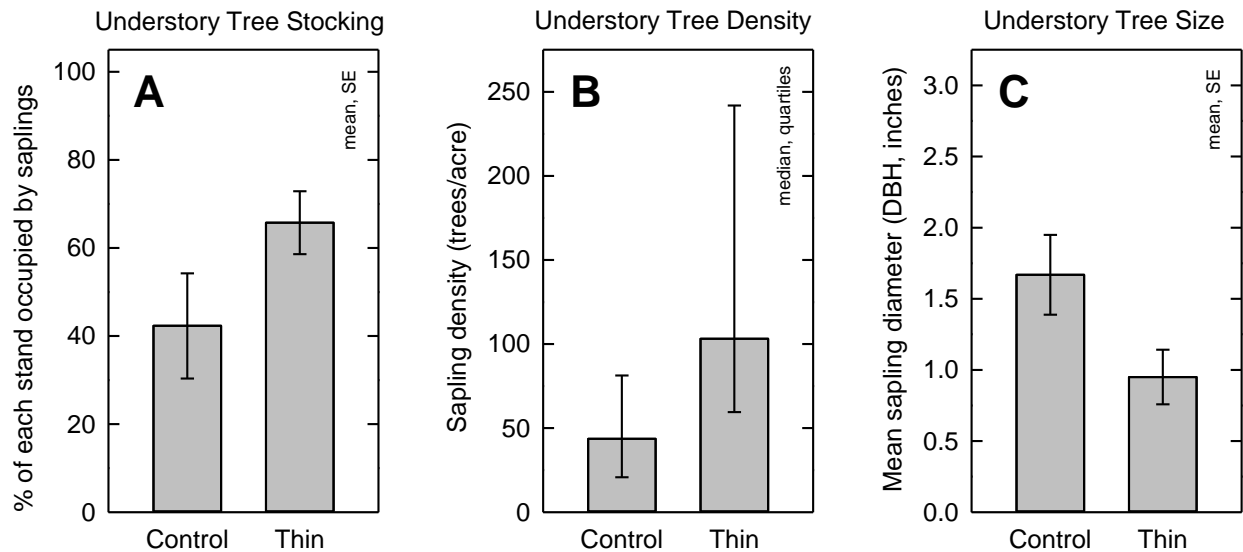


Figure 12: Preliminary Results from the NSO Effectiveness Monitoring Installations for Understory Tree Recruitment. Results are for saplings that have reached breast height (4.5 ft) but are less than 4" dbh. Data shown are from the four west-side installations at the 7-year post-treatment measurement.

Related Research

In addition to monitoring the permanent installations, DNR is also conducting several research projects related to NSO effectiveness monitoring:

- **Mind the Gap:** This project measures the response of habitat features to small-gap creation within thinned stands in the OESF. This project is described in further detail in the [Research](#) section.
- **Landscape-scale Effectiveness Monitoring:** The objective of this project is to evaluate how habitat conditions have changed since the implementation of the HCP. This project is described in further detail in the [Research](#) section.
- **Evaluating Persistence of NSO Habitat in the Eastern Washington Cascades:** This project will assess historic, current, and future NSO habitat on DNR land in eastern Washington. The results of this study may inform the location of future NSO effectiveness monitoring plots. This project is described in further detail in the [Research](#) section.
- **Westside Individuals, Clumps, and Openings (WICO):** This project aims to develop innovative approaches for using spatial structure analysis to create higher-quality habitat in managed second-growth forests. Adapting recently developed methods for restoration thinnings on the eastern slopes of the Cascades, this study aims to characterize patterns of stems in old forest reference stands (focusing on known NSO nest sites and territories) and evaluate the degree to which these patterns can be emulated in VDT treatments. This project is being conducted in partial collaboration with the University of Washington.

Future Priorities

A short-term priority for the NSO Effectiveness Monitoring Program is to develop an establishment report that includes initial findings for the current network of established sites. Longer-term priorities include evaluating options for sampling frequency. Although sampling frequency was originally intended to be conducted at five-year intervals, there may be advantages to continuing the sampling

at approximately seven-year intervals or increasing to 10-year intervals. The responses of forest growth and development are slow enough that not much resolution would be lost by increasing the sampling interval, and it would allow additional sites to be established and measured with a similar amount of resources.

DNR is also considering adding new sites to the NSO Effectiveness Monitoring Program. Currently there are no sites in the OESF, and DNR is evaluating options for establishing monitoring sites there. Separately, DNR is considering establishing a second set of effectiveness monitoring sites to complement the existing network of passive monitoring sites. The second set of sites would be monitored under an active approach, in which novel or future desired treatments are evaluated within an experimental design in support of adaptive management. To the extent practicable, the establishment of new sites would be prioritized in planning units in which sites have not yet been established.

FY 2016 Update

In FY 2016, the final series of measurements for the seven-year post-treatment sampling were completed for the NSO effectiveness monitoring sites. Integration of the re-measurement data with the prior measurements and initial data analysis is currently ongoing.

DNR also continued to work with the University of Washington on the WICO project to compare spatial patterns in late-successional stands. In FY 2016, DNR finished collecting stem-mapping data at three late-successional reference stands and across three recently thinned second-growth stands (plus unthinned controls) located in the Lyons Share, Cougarilla, and Big Beaver NSO effectiveness monitoring sites. Stem-mapping was conducted on 10 acres at each site. DNR is currently analyzing this data.

Status and Trends Monitoring of Aquatic and Riparian Habitat in the OESF

In 2012, the Status and Trends Monitoring of Aquatic and Riparian Habitat Program was launched to document changes to riparian and in-stream conditions in watersheds managed by DNR for timber, fish and wildlife habitat, and other ecosystem values. The study's main hypothesis is that implementation of the HCP riparian conservation strategy for the OESF allows natural processes of ecological succession and disturbance to improve habitat conditions across managed watersheds over time.

The HCP documents the riparian conservation objectives for the OESF (p. IV.107):

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

The key objectives of the Status and Trends Monitoring Program are to provide empirical data to evaluate progress in meeting the HCP riparian conservation objectives and to reduce uncertainties around the integration of habitat conservation and timber production. When integrated with information on management activities in the OESF, the monitoring data from this project will allow DNR to make inferences about the effects of specific forest management operations on habitat, thus

helping DNR fulfill the commitments for effectiveness monitoring and adaptive management under the HCP. Additionally, this project contributes to DNR’s Validation Monitoring Program as data will be used to characterize habitat conditions to study fish response to managed landscapes.

The results from this study also will be used to assess the habitat projections in the 2016 [Environmental Impact Statement for the OESF Forest Land Plan](#) and to test assumptions about ecological relationships between in-stream, riparian, and upland conditions, thus improving DNR’s forest management planning. Results of the study are expected to provide valuable information for managing state land outside the OESF and to tribal, private, and federal land managers in the Pacific Northwest who face the challenges of managing forests for multiple uses.

Study Design

Since the launch of the program in 2012, monitoring of small fish-bearing streams has been conducted in 50 watersheds across the OESF and in four reference (unmanaged) watersheds in the Olympic National Park. Nine aquatic and riparian indicators are sampled at the reach level at the outlet of each watershed: channel morphology, channel substrate, habitat units, stream shade, water temperature, stream discharge (monitored in 14 reaches), riparian microclimate (monitored in 10 reaches), riparian forest vegetation, and in-stream large wood (Figure 13). In addition to field sampling, the watersheds are monitored remotely or through operational records for management activities (timber harvest and road construction) and natural disturbances such as wind throw and landslides.



Figure 13: Measurement of In-Stream Wood. A DNR field technician uses a calipers to measure large woody debris in a stream in the OESF. Photo courtesy of Teodora Minkova.

Program Implementation

DNR published the Status and Trends Monitoring Program [study plan](#) in 2012 and has been funding program implementation since that time. The U. S. Forest Service (USFS) Pacific Northwest Research Station joined as a research collaborator in the summer of 2012, contributing scientific expertise, funding, and field staff time. Throughout the course of the project DNR has worked with students, interns, and volunteers to collect and analyze field data. Participating organizations include The Evergreen State College, EarthCorps, and Student Conservation Association. The major implementation activities completed and planned are summarized in Table 5.

Table 5: Timeline of Completed and Planned Activities.

Year	Activities	Link to Report
2012	<ul style="list-style-type: none"> ▪ Identification of monitoring watersheds ▪ Delineation and permanent marking of 50 sample reaches in the OESF ▪ Initial field characterization of the sample sites ▪ Installation of stream temperature data loggers 	2012 Progress Report
2013	<ul style="list-style-type: none"> ▪ Reallocation of some monitoring watersheds to improve sample representativeness ▪ Development of monitoring protocols 	2013 Progress Report

	<ul style="list-style-type: none"> Refinement of field procedures Installation of monitoring equipment Field protocol implementation in 10 watersheds 	
2014	<ul style="list-style-type: none"> Implementation of field protocols in 32 watersheds Downloading data from continuously recording field sensors Managing field data 	2014 Progress Report
2015	<ul style="list-style-type: none"> Implementation of field protocols in remaining 12 watersheds Downloading data from continuously recording field sensors Analyzing hydrologic data Measuring riparian vegetation Comprehensive quality control analysis in five watersheds Hydrology analysis First assessment of habitat status 	Habitat Status Report and 2015 Progress Report
2016–2025	<ul style="list-style-type: none"> Annual field sampling, quality control, data management, data analyses, publications, and periodic refinement of field protocols 	N/A
2020	<ul style="list-style-type: none"> Completion of the five-year habitat trend report including analysis of watershed-wide conditions and history of management and natural disturbances 	N/A
2025	<ul style="list-style-type: none"> Completion of the ten-year trend report including more conclusive results on the rate of habitat recovery and the effects of management, as well as potential recommendations for management adjustments 	N/A

Initial Conclusions and Future Priorities

In the fall of 2016, DNR published a [habitat status report](#) in conjunction with the 2015 progress report that summarized the aquatic and riparian habitat conditions of the sample reaches based on the field data collected in 2013–2015. Multiple habitat metrics were calculated and analyzed as distributions across the 50 OESF sample reaches and four reference reaches. OESF habitat data were compared to reference reaches, regulatory thresholds, and to values reported for unmanaged watersheds in other regional studies.

The comparative analyses suggest two conclusions about the current status of in-stream habitat quality in the OESF sample reaches: 1) the 50 sample reaches represent a broad range of habitat conditions, and 2) overall, the sample reaches appear to have relatively good habitat quality. DNR expects that it will take at least 5–10 years before reliable trends in the quality of aquatic and riparian habitat will be detected, but this will depend on the variance of the habitat metrics (i.e. trends for less variable metrics can be detected sooner than for more variable ones).

Next steps and priorities for FY 2017 include collecting and managing field data according to monitoring protocols, developing hydrographs and analyzing hydrology monitoring data, exploring available remote sensing data and operational records to characterize disturbances in the monitored watersheds, analyzing ecological relationships among various stream and watershed-level data, and seeking collaborations with research partners.

FY 2016 Update

In FY 2016, the Status and Trends Monitoring Program continued to conduct field work and data management for all nine habitat indicators. In addition to DNR staff, the project involved two interns and multiple volunteers.

The program also published three project reports:

1. [2015 Quality Control Report](#)

A quality control analysis was conducted for 33 of the metrics monitored under this project in order to quantify sources of variability and provide recommendations for improvement of monitoring protocols, field training, temporal sampling design, and future status and trends analyses. The levels of measurement error in this project were found to be similar to, or lower than, those of other regional status-and-trends stream habitat monitoring projects. This indicates that the QA/QC procedures in this project are sufficiently rigorous given the project objectives, geographic scale, and budget.

2. [2015 Hydrology Status Report](#)

This report included several analyses of stream discharge data collected through June 2015: quality assessment of the data, adjustments to compensate for channel and equipment movements, and development of provisional rating curves. A graduate student from The Evergreen State College conducted the analysis as part of an internship with DNR.

3. [Habitat Status Report and 2015 Project Progress Report](#)

Multiple habitat metrics were calculated from the first round of field sampling conducted in 2013–2015 and were analyzed as distributions across the 50 OESF sample reaches and four reference reaches. More information about the habitat status report can be found in the [Comprehensive Review](#) section above.

Riparian Silviculture Effectiveness Monitoring Program

DNR's effectiveness monitoring program for riparian silviculture was launched in 2001 following publication of the Riparian Silviculture Effectiveness Monitoring Plan that was developed by DNR in collaboration with the Services. The objective of the program is to determine whether various restoration thinning treatments are resulting in riparian habitat conditions that support salmon recovery efforts and contribute to the conservation of other riparian and aquatic species.

The program uses an active monitoring approach in which habitat metrics are measured before and after treatment. The initial set of treatments consists of thinning to Curtis relative density 40 (RD40) or 50 (RD50), thinning to RD50 with intentional canopy gaps (RD50 gap), or no thinning (REF). These treatments are characteristic of treatments implemented under the 2006 Riparian Forest Restoration Strategy and are applied in RMZs in cooperation with DNR's timber sales program.

DNR established six monitoring sites between 2003 and 2008 in the OESF, South Puget, and North Puget HCP planning units. To assess changes in riparian habitat conditions, habitat metrics are measured at each monitoring site prior to harvest, after harvest, and periodically thereafter. A sampling history of the monitoring sites is included in Table 6.

Table 6: Summary and Sampling History of Riparian Silviculture Effectiveness Monitoring Sites.

Site/Timber Sale Name	Planning Unit	Treatments	Year Measured		
			Pre-treatment	Post-treatment	Re-measurement
H1320	OESF	RD40, RD50, REF	2003	2006	2015
Salmon PC	OESF	RD40, RD50, REF	2004	2008	2013
Cougarilla	South Puget	RD40, RD50, RD50 gap, REF	2006	2008	2016
Big Beaver	South Puget	RD40, RD50, RD50 gap, REF	2006	2008	2016
North Mountain	North Puget	RD40, RD50, REF	2008	2013	
Pink Flamingo	North Puget	RD40, RD50, REF	2008	2010	2014

Sampling Design

Each monitoring site includes a stream reach containing two or three treated stands and an unmanaged reference stand that are embedded within a timber sale (Figure 14). The configuration of treatments is randomly assigned within each site. For each treatment, 12 monitoring plots are established within a two-acre stand that is bisected by the stream.

Prior to treatments, permanent monitoring plots are installed and four variables of interest are measured: 1) overstory structure and composition, 2) understory structure and composition, 3) canopy closure, and 4) down wood. After the specific treatment is assigned, trees are harvested and are either removed or left on-site as down wood. Habitat measurements are then repeated at each monitoring plot.

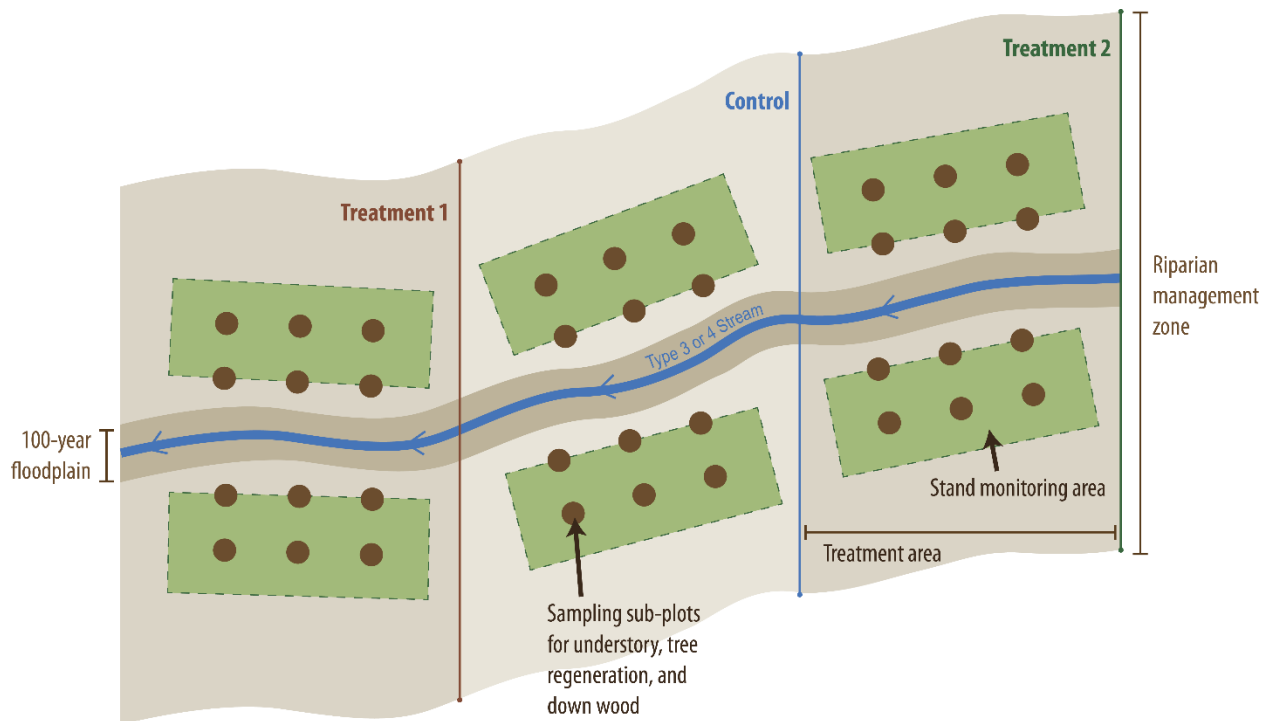


Figure 14: Configuration of Permanent Monitoring Plots used for Riparian Silviculture Effectiveness Monitoring.

Preliminary Findings

DNR is currently analyzing data collected during the most recent re-measurement and plans to publish results documenting changes measured in the first six to ten years since thinning treatments. The results discussed below are examples of trends emerging from the preliminary analysis for measurements of understory structure and composition, canopy closure, and down wood. Results for overstory structure and composition are currently being analyzed.

Understory Structure and Composition

Figure 15 shows the response of understory conifer density to thinning treatments. Compared to the reference stand, the treated stands had a significantly higher density of seedlings after harvest at the Salmon PC site in the OESF. Sites in the North and South Puget HCP planning units had a similar response. This suggests that the initial increase in sunlight following harvest and the growth disturbance results in higher seedling density. Establishment and continued growth of secondary conifer size classes are critical to converting stand structure to the complex forest habitat desired in riparian management zones.

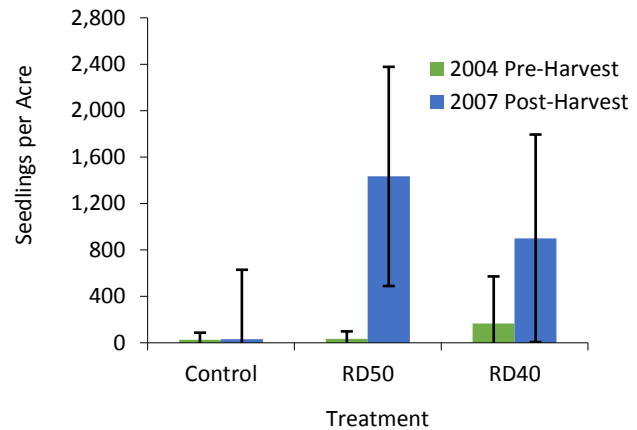


Figure 15: Change in Understory Conifer (1–4.5 ft. Tall) Density after Restoration Thinning at the Salmon PC Monitoring Site. Error bars are plus and minus standard error on the average of subsamples.

Canopy Closure

Although the amount of sunlight reaching the forest floor increases immediately after thinning, preliminary results suggest that this decrease in canopy closure is temporary. For example, Figure 16 shows the percent canopy closure before and after treatment at the H1320 monitoring site. Three seasons after harvest, the stands thinned to RD40 and RD50 did not have a significant difference in canopy closure compared to pre-harvest levels. In addition, results indicate that there is greater variation in canopy closure levels within treated stands. This is important for the establishment of patches of understory vegetation, one of the management objectives of restoration thinning.

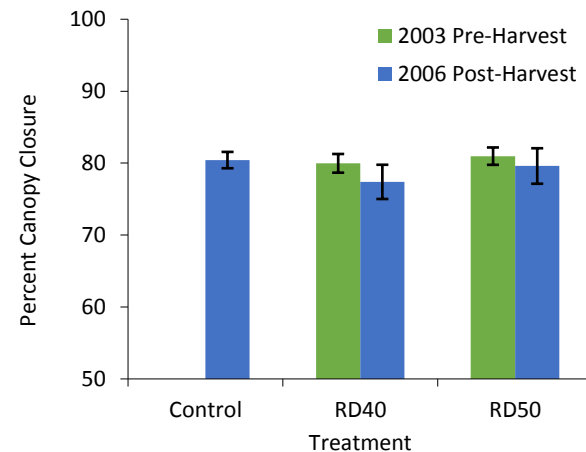


Figure 16: Change in Canopy Closure after Restoration Thinning at the H1320 Monitoring Site. Error bars are plus and minus standard error on the average of subsamples.

Down Wood

The addition of down wood to streams as part of restoration thinning is a key part of naturalizing forest structures and disturbance regimes of riparian forests. RMZs established as plantations often have little down wood from tree mortality; most instream and terrestrial wood habitat structure tends to be from legacy wood remaining after previous harvests.

Preliminary results indicate that down dead wood greater than ten centimeters in diameter generally decreased in treated stands post-harvest. This may be due to the displacement and incorporation of

down wood into the forest floor when harvesting equipment moves onsite or differences in surveyor determinations when measuring down wood. DNR is currently updating a guidance document for field staff to increase awareness and protection of existing down wood through pre-harvest layout and road-design techniques.

However, some sites, such as Cougarilla in South Puget, had a similar volume of down wood post-harvest compared to control stands. The influx of down wood from the restoration thinning at Cougarilla resulted in a larger proportion of less-decayed down wood in the treated stands compared to the control stand which had a higher proportion of more-decayed, older down wood. This new down wood will provide structural aquatic and terrestrial habitat to replace decayed wood displaced by harvesting.

Initial Conclusions and Future Priorities

Overall, preliminary findings indicate that thinning treatments are facilitating the development of structurally complex riparian forests, consistent with the RFRS and the riparian conservation objectives in the HCP. Based on the initial results, there does not appear to be a significant difference between the three thinning treatments.

A short-term priority for the Riparian Silviculture Effectiveness Monitoring Program is to publish initial findings for the current network of established sites. Longer-term priorities include evaluating options for future sampling frequency, such as extending the interval between re-measurements, and establishing additional monitoring sites in the South Coast, Columbia, and Straits planning units.

FY 2016 Update

In FY 2016, the Riparian Silviculture Effectiveness Monitoring Program collected re-measurement data to document understory and vegetation response at the Cougarilla and Big Beaver sites in the South Puget Sound region. The Riparian Silviculture Effectiveness Monitoring Program is currently analyzing this data and plans to publish measured changes.

Validation Monitoring

[Appendix: Background on Validation Monitoring](#)

Launched in FY 2015, the Riparian Validation Monitoring Program is designed to test the hypothesis that forest management practices implemented under the HCP restore and maintain habitat that is capable of supporting viable salmonid populations within the OESF. If trends in salmonid conditions (e.g., abundance, biomass, species composition, age structure, percent anadromy, and number of spawning redds) are detected, monitoring will seek to evaluate cause-and-effect relationships between DNR management activities, riparian habitat, and salmonids. Once underlying mechanisms are established, DNR may choose to adapt management practices.

Since 2012, DNR's Status and Trends Monitoring of Riparian and Aquatic Habitat Program has monitored habitat data in 54 watersheds: 50 Type 3 watersheds across the OESF and four reference watersheds in the nearby Olympic National Park. In FY 2016, these watersheds were evaluated to determine if they were suitable for use in the Riparian Validation Monitoring Program. In August through September 2015, DNR conducted surveys in 44 out of the 54 watersheds using backpack electrofishing (Figure 17) to determine fish presence, absence, and species composition. Ten watersheds were not surveyed due to access limitations or because the site had previously been sampled and no fish were present. Data on species composition, age structure (based on fish lengths), and potential life histories of the salmonids within the watersheds were analyzed.



Figure 17: Backpack Electrofishing Survey in the OESF.
Photo courtesy of Teodora Minkova.

Following the electrofishing surveys, the data were used to evaluate two projections of fish distribution for the OESF: the Intrinsic Potential (IP) models used in the Revised Draft EIS for the OESF HCP Planning Unit Forest Land Plan, and Washington Department of Fish and Wildlife (WDFW)'s Salmonid Stock Inventory. Both the IP models and Salmonid Stock Inventory were found to be inaccurate predictors of the individual species presence and would not produce reliable estimates of species assemblage for all of the watersheds in the OESF. As a result, DNR will attempt to use the initial sampling data to develop better location-specific models for determining species assemblage.

After initial sampling was completed, a scientific advisory group comprised of experts from the U.S. Geological Survey, U.S. Forest Service, NOAA Fisheries, and DNR was formed to ensure the use of sound scientific principles within the Riparian Validation Monitoring Program and that the program meets the commitments in the HCP. In collaboration with the scientific advisory group, DNR developed a study plan that describes how validation monitoring will be implemented in the OESF. The [study plan](#) was published in November 2016. In FY 2017, DNR plans to initiate the monitoring outlined in the plan including a study to determine juvenile salmonid monitoring methods within 20 of the habitat watersheds, coho redd surveys within 20 habitat watersheds to determine adult abundance, and snorkel surveys in larger portions of the Clearwater River watershed (DNR Type 1 and Type 2 streams) to assess species assemblage, life history use, and connection with the habitat watersheds.

Research

DNR continually conducts research on its forested trust lands to better understand how different forest management practices affect forest productivity and habitat conditions. This section describes DNR's research projects on HCP-covered lands that address the three research priorities defined in the HCP (p. V.6):

- **Priority 1 Research** is “research that is a necessary part of a conservation strategy.”
- **Priority 2 Research** is “research needed to assess or improve conservation strategies or to increase management options and commodity production opportunities.”

- **Priority 3 Research** is “research needed to improve general understanding of the animals, habitats, and ecosystems addressed by the HCP.”

Table 7 summarizes DNR’s research projects on HCP-covered lands and the priorities they address. Some projects address multiple research priorities and monitoring commitments. More information on each project is included below.

Table 7: DNR’s Research Projects on HCP-Covered Lands.

Project	Priority 1	Priority 2	Priority 3	Monitoring
eDNA research in OESF			X	X
Evaluating Persistence of Northern Spotted Owl Habitat in the Eastern Washington Cascades	X	X		
Experiment in Long-Term Ecosystem Productivity			X	
Historic range of variation in forest structure in the North and West Cascades	X			
Influence of Repeated Alternative Biodiversity Thinning Treatments on Coastal Forests			X	
Landscape-Scale Effectiveness Monitoring		X		X
Large-Scale Integrated Management Experiment	X	X	X	X
Mind the Gap		X		
Northern Flying Squirrel Habitat Enhancement			X	
Post-Fire Regeneration in Eastern Washington			X	
Response to RFRS Treatments		X		X
Riparian Validation Monitoring	X	X	X	X
Status and Trends Monitoring of Riparian and Aquatic Habitat		X	X	X
Thinning in NSO Habitat	X	X		
Western Washington Climate Change Modeling		X		

eDNA Research in OESF: Many aquatic species that occupy streams of the OESF are found in low densities and are often difficult to detect. In 2016, DNR’s Riparian Validation Monitoring program partnered with the USFS Pacific Northwest Research Station to collect water samples for environmental DNA (eDNA) analysis. By filtering water in streams of the OESF, researchers can identify the DNA left behind by the aquatic species that have recently or currently occupy each stream. Data from eDNA analyses, along with DNR fish abundance data, may help to develop tools for understanding the presence, abundance, and genetic variability of multiple aquatic species including fish, amphibians, and macroinvertebrates. In addition, results from this work will help DNR better understand the aquatic communities that occupy streams of the OESF. Data from this project is currently being analyzed.

Evaluating Persistence of Northern Spotted Owl Habitat in the Eastern Washington Cascades:

This project will assess historic, current, and future NSO habitat on state lands in the eastern Washington Cascades. DNR hopes to answer two fundamental questions:

1. How much late-successional, complex-structure habitat can likely be sustained in these fire-prone landscapes?
2. Where on the landscape is such habitat most likely to develop and persist the longest?

Results from this project will help the agency determine the degree to which the current approach for managing eastside NSO habitat under the HCP is likely to be sustainable for the life of the HCP. This research will also help inform other DNR priorities such as sustainable harvest calculations and forest land planning efforts.

Experiment in Long-Term Ecosystem Productivity: Models suggest that intensively harvested conifer plantations experience long-term degradation of productivity due to a slow drain of nutrients, especially nitrogen. This project, a collaborative effort between the Pacific Northwest Research Station, Oregon State University, the University of Washington, Western Washington University, and DNR, will test the influence of stand composition and the level of wood removed on tree and soil productivity, soil structure, and plant species diversity. The cooperative, multiple-decade study has been replicated in four experiment sites in the OESF and three national forests in Oregon (the Willamette, Siskiyou, and Siuslaw). The OESF-based installation in Sappho, Washington was initiated in 1995 with funding provided by the USFS Pacific Northwest Research Station and DNR. Ten-year post-harvest measurements were conducted in the summer of 2014. A summary of this project is available on the [OESF webpage](#).

Historic Range of Variation in Forest Structure in the North and West Cascades: Estimates of historic range of variation (HRV) for late-successional conditions can be used as a coarse-filter proxy to identify the historic range in abundance of NSO and murrelet habitat under natural disturbance regimes. These historic conditions can then be compared with current conditions to identify differences in late-successional conditions for different forest zones. Beginning in 2017, a pilot project will use historic photos from 1930–1960 to develop a canopy surface model (PhoDAR). DNR will determine if PhoDAR can be used to estimate the historic patch size and configuration of unmanaged late-successional conditions.

Influence of Repeated Alternative Biodiversity Thinning Treatments on Coastal Forests: In the late 1990s, DNR used pre-commercial thinning (PCT) across the landscape including in riparian and wetland areas and in sites adjacent to high-quality older forest habitat. Managers recognized the ability of PCT to influence stand development trajectory and were interested in exploring a wide variety of alternative approaches to increase future wildlife habitat by increasing forest structural diversity. Setting stands on different development pathways was recognized as important to meeting the management goal of balancing timber and non-timber management on the OESF.

This project was initiated in 1999 in cooperation with Olympic Region staff and it allows DNR to measure the influence of repeated thinnings on both vegetation structure and timber production. Treatment responses are quantified by measuring a permanent plot network and analyzing light detection and ranging (LiDAR) derived canopy metrics. Information gained from this project will inform agency decisions about the value of different treatment options in meeting multiple management objectives under the biodiversity pathways approach. A summary of this project is available on the [OESF webpage](#).

Landscape-Scale Effectiveness Monitoring: The goal of this project is to determine how landscape-scale habitat conditions have changed since the implementation of the HCP. DNR is conducting a quantitative analysis with empirical data across broad areas of state trust lands to determine whether the riparian and NSO habitat strategies implemented under the HCP are increasing coverage of mature or older forest with higher levels of structural complexity.

Large-Scale Integrated Management Experiment: DNR and the University of Washington's Olympic Natural Resources Center have developed a proposal to implement a long-term, landscape-level management experiment in the OESF to evaluate the ecological and economic feasibility of the integrated management approach. The project will compare a no-action control and integrated management applied at three different intensities across a selection of Type 3 watersheds. A series of replicated experimental treatments in upland and riparian areas will be applied as part of DNR's timber sales program. Response variables are derived from consideration of past and potential future management decisions and include ecological effects, economic returns, and assessment of operational feasibility. In 2016, a study proposal was developed and meetings with stakeholders took place. Development of a study plan and the start of study implementation are planned for 2017.

Mind the Gap: The goal of this DNR-funded project is to better match silvicultural gap treatments with the late-successional forests they aim to emulate. It is being conducted in three phases:

- Phase I: A retrospective study of ten-year-old silvicultural gaps.
- Phase II: An observational study of natural gap structures in primary (never managed) old-growth forests, which will establish critical reference information.
- Phase III: A replicated silvicultural experiment to test novel gap treatments (informed by the structures found in primary forests) within a variable density thinning treatment.

DNR is tracking tree recruitment, understory vegetation response, branching/crown responses, decadence (dead wood) creation around gap edges, and post-treatment dynamics of gap contraction and expansion (i.e., blowdown). Results from this study are relevant to providing structural diversity and habitat in managed forests. The project was initiated and peer-reviewed in 2014, with data collection for Phase I completed that summer. Data analysis for Phase II is ongoing, including high-resolution LiDAR processing, gap delineation, field validation, and spatial analyses. Unit layout and pre-treatment data have been completed for Phase III and post-treatment data will be collected when the harvest is complete. A summary of this project is available on the [OESF webpage](#).

Northern Flying Squirrel Habitat Enhancement:

The objective of this region-led pilot study is to evaluate the effect of various thinning treatments on nesting habitat for northern flying squirrels, the principal prey species for the spotted owl. In 2014, DNR installed 16 artificial nest cavities across the Forgotten Top timber sale in the South Puget HCP planning unit. The nest cavities were monitored before and after harvest to determine the presence of flying squirrels and game cameras were installed to record animal activity (Figure 18). Initial results indicate that flying squirrels were present pre- and post-harvest, but not during harvest activities. Monitoring of nest sites is expected to continue into 2018.



Figure 18: A Game Camera Captures a Northern Flying Squirrel Landing on a Nest Box. Photo courtesy of Alan Mainwaring.

Post-Fire Regeneration in Eastern Washington: During the exceptional wildfire years between 2012 and 2015, over 2.1 million acres burned in Washington, primarily east of the Cascade crest (Figure 19). Most projections suggest fire activity will increase and catalyze ecosystem change under a warming climate. Limited reforestation funds and the expanding burn acreage means that natural regeneration will determine the capacity of many eastside forests to provide goods, services, and



Figure 19: Post-fire Landscape in Eastern Washington. Photo courtesy of Dan Donato.

management options over the long term. DNR is conducting one of the first region-wide studies of post-fire regeneration in eastern Washington, focusing on all large fires on public forestlands that burned during 2012–2015. The project objectives are to quantify the rate, density, and composition of tree and non-tree vegetation regeneration as influenced by burn severity and environmental setting, and to evaluate the potential for regeneration failure in warm, dry sites near the lower treeline. The study was initiated in 2016 with the establishment of approximately 60 field plots. Plot establishment will continue over the next few years, with a plan to monitor plots at 5–10 year intervals.

Response to RFRS Treatments: Beginning in 2006, DNR has been documenting site responses to silvicultural treatments designed to meet the management objectives specified in the RFRS. More details about this ongoing research can be found in the [Riparian Silvicultural Effectiveness Monitoring](#) section.

Riparian Validation Monitoring: This work helps determine whether DNR’s current forest management practices in the OESF restore and maintain habitat that is capable of supporting viable salmonid populations within the OESF. A summary of this work can be found in the [Validation Monitoring](#) section.

Status and Trends Monitoring of Riparian and Aquatic Habitat: This project evaluates changes to riparian and aquatic habitat conditions in managed watersheds of small fish-bearing streams across the OESF. More details on this work can be found in the [Effectiveness Monitoring](#) section.

Thinning in NSO Habitat: The NSO Effectiveness Monitoring Program evaluates whether the HCP strategies and associated silvicultural treatments maintain or enhance NRF and dispersal habitat (see the [NSO Effectiveness Monitoring](#) section). In addition to comparing thinned and unthinned stands in habitat-designated areas, DNR is also collaborating with the University of Washington to compare the spatial structure of these stands to late-successional reference stands known to function as NSO habitat. For the latter study, stem-mapping data have been collected at three late-successional reference stands and across three monitoring sites, and data analysis is ongoing.

Western Washington Climate Change Modeling: This project examines potential changes in vegetation zones, wildfire, early-seral, and late successional conditions under different climate and fire suppression assumptions. Results from this work will inform discussions on climate adaptation in westside forests, a topic that has yet to be widely addressed in these forest systems. Results from this work will also be considered in the development of the Environmental Impact Statements for DNR’s

sustainable harvest calculation and Marbled Murrelet Long-term Conservation Strategy. This project was completed in 2016 and two peer-reviewed publications will be submitted in 2017.

OESF Research and Monitoring Program

[Appendix: Background on the Research and Monitoring Program](#)

The OESF Research and Monitoring Program has several objectives:

- Implement, coordinate, and track research and monitoring projects on the OESF.
- Establish and maintain research partnerships with universities, colleges, federal agencies, and other organizations.
- Communicate and collaborate with local land managers, tribes, environmental organizations, and regulators on research and monitoring projects.
- Facilitate the adaptive management process at DNR.
- Provide educational opportunities such as internships, lectures and field trips.

In 2016, the [OESF Forest Land Plan](#) was adopted that will guide the management of over 270,000 acres of forested state trust lands on the western Olympic Peninsula. The plan also describes DNR's approach to research and monitoring in the OESF, the relationship between operations and learning activities, near-term research and monitoring priorities, and a step-by-step adaptive management process.

DNR scientists shared seven research and monitoring projects currently active in the OESF with over 40 staff from Olympic Region and the Forest Resources Division during the 2016 OESF annual meeting in Forks. It was recommended that this forum be expanded to an annual, one-day OESF conference open to external researchers working on the OESF, local land managers, and the public. Summaries of ongoing research and monitoring projects in the OESF are available in the [Research](#) section of this report and on the [OESF webpage](#).

The OESF research tracking database was further populated in 2016. The database includes metadata on ongoing research and monitoring projects related to natural resource management and ecology conducted by DNR or external parties, and stores all scientific and administrative documents on project implementation. The database was made available on DNR's intranet and was linked to DNR's state-wide GIS layer on research areas.

Two paid student interns from The Evergreen State College and University of Washington worked in the OESF in FY 2016, helping DNR researchers with the hydrology and stream nutrients component of the Riparian Status and Trends Monitoring Program (Figure 20) and the assessment of the understory development for the Long-Term Ecosystem Productivity Study.

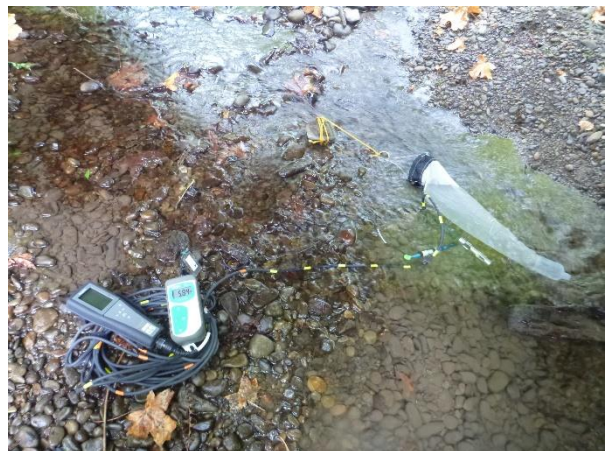


Figure 20: Instruments Used by a DNR Intern to Measure Stream Chemistry in the OESF. Photo courtesy of Teodora Minkova.

The OESF Research and Monitoring Program also facilitated educational opportunities during this reporting period for students at The Evergreen State College. In October 2015, over 60 students and their professors from the Masters of Environmental Studies program visited the OESF as part of a three-day tour of the Olympic Peninsula. The visit included presentations by DNR scientists and Olympic Region staff (Figure 21).

The collaboration between DNR and the University of Washington Olympic Natural Resources Center increased significantly in 2016. This culminated in the development of a joint study proposal to implement a long-term, landscape-level management experiment in the OESF to evaluate the ecological and economic feasibility of the integrated management approach. More information about this project can be found in the [Research](#) section of this report.



Figure 21: DNR Staff Share Information about the OESF. Students and professors from The Evergreen State College attend a presentation during an OESF tour in October 2015. Photo courtesy of Teodora Minkova.

Publications

In addition to conducting research on DNR-managed forestlands, DNR state lands researchers also write and contribute to publications relevant to forest management in the Pacific Northwest. DNR contributed to the articles listed below published in FY 2016. DNR authors are denoted in bold text.

Baker, Susan C., Charles B. Halpern, Timothy J. Wardlaw, Rodney L. Crawford, **Richard E. Bigley**, Graham J. Edgar, Shelley A. Evans, Jerry F. Franklin, Gregory J. Jordan, Yuliya Karpievitch, Thomas A. Spies, and Russell J. Thomson. "Short-and long-term benefits for forest biodiversity of retaining unlogged patches in harvested areas." *Forest Ecology and Management* 353 (2015): 187–195.

- This study utilized the world's three oldest intentional aggregated-retention sites (21–26 years old) and three recently harvested sites (5–8 years old) in western Washington to compare species composition between undisturbed aggregates and regenerating forests to assess the maintenance of biodiversity function of aggregates. Results indicate that aggregated retention has short- and long-term benefits for biodiversity reflecting both the lifeboating and forest-influence functions of aggregates. [Available online.](#)

Baker, Susan C., Charles B. Halpern, Timothy J. Wardlaw, Christel Kern, Graham J. Edgar, Russell J. Thomson, **Richard E. Bigley**, Jerry F. Franklin, Kamal J. K. Gandhi, Lena Gustafsson, Samuel Johnson, Brian J. Palik, Thomas A. Spies, E. Ashley Steel, Jan Weslien, and Joachim Strengbom. "A cross-continental comparison of plant and beetle responses to retention of forest patches during timber harvest." *Ecological Applications* 26, no. 8 (2016): 2493–2504.

- This analysis provides strong support for the widespread application of aggregated retention in boreal and temperate forests to maintain biodiversity. The strategic placement of aggregates help maintain the natural heterogeneity and biodiversity of mature forests managed for multiple objectives. [Available online.](#)

Haase, Diane L., **Nabil Khadduri**, Thomas D, Landis. “Frost protection with irrigation: taking another look.” *Forest Nursery Notes*, Summer (2015): 4–11.

- This paper describes the underlying physical, chemical, and physiological principles of controlling frost damage to nursery seedlings through irrigation. It also details recent advances in frost protection monitoring and equipment. [Available online](#).

Haase, Diane L., **Nabil Khadduri**, Euan Mason, and Kas Dumroese. "Relationships among chilling hours, photoperiod, calendar date, cold hardiness, seed source, and storage of Douglas-fir seedlings." *Tree Planters' Notes* 59, no. 1, (2016): 52–63.

- This paper summarizes results of a three-nursery trial examining physiological and seasonal factors that indicate a seedling is ready to lift and be cooler- or freezer-stored. The paper models the impacts these factors have on subsequent first-year survival and growth after leaving the nursery. [Available online](#).

Halofsky, Joshua S., Jessica E. Halofsky, David R. Conklin, Dominique Bachelet, Miles A. Hemstrom, Becky K. Kerns, and Anita T. Morzillo. “Using MC1 to help inform management decision.” In *Global vegetation dynamics: Concepts and Applications in the MC1 Model*, edited by D. Bachelet and D. Turner, 153–170. New York: Wiley, 2015.

- This book chapter explores trends in different values in the forests of the Olympic Peninsula and the dry forests of eastern Oregon under different climate and management assumptions. Values examined include changes to forest types, structural stages, harvest rates, and potential northern spotted owl habitat. Due to projected increases in wildfire, results across both regions suggest the ability to sustain all values at current levels is unlikely.

Khadduri, Nabil. “Using plant growth regulators on red alder and Douglas-fir plugs.” *Tree Planters' Notes* 58, no. 2 (2015): 72–77.

- This paper details trial results of plant growth regulator applications to control height, physiological condition and performance of red alder and Douglas-fir seedlings in a nursery setting. [Available online](#).

Larson, Andrew J., James A. Lutz, **Daniel C. Donato**, James A. Freund, Mark E. Swanson, Janneke HilleRisLambers, Douglas G. Sprugel, and Jerry F. Franklin. "Spatial aspects of tree mortality strongly differ between young and old-growth forests." *Ecology* 96, no. 11 (2015): 2855–2861.

- This research investigated spatial patterns of tree mortality in young versus old forests, in part to provide information that could help guide future habitat thinnings in westside forests. [Available online](#).

Oster, Rocky and **Jeff DeBell**. “Development of a backpack-mounted pollen vacuum.” *Tree Planter's Notes* 59, no. 1 (2016): 42–47.

- The article shows how to build a backpack-mounted pollen vacuum for use in seed orchards. [Available online](#).

Uscola, Mercedes, **Nabil Khadduri**, Diane L. Haase, **John Trobaugh**, and Douglass F. Jacobs. “Effect of nursery photoperiod manipulation on coastal Douglas-fir seedling development: early results.” *Tree Planters' Notes*, 59, no. 2 (2016): 69–75.

- This paper details trials evaluating optimum protocols of artificially imposing short day lengths to prepare coastal Douglas-fir container seedlings for maximum success once out-planted to the woods. [Available online.](#)

Conservation Strategy Updates

The HCP established numerous conservation strategies designed to minimize and mitigate the negative effects of land management activities on the habitats of federally listed species, riparian habitats, unlisted species of concern, and uncommon habitats that exist within the land base covered by the HCP. DNR’s conservation strategies are occasionally updated due to research, plan development, changes to laws, and/or adjustments to DNR’s administrative procedures. DNR did not make any updates to the conservation strategies in FY 2016.

Forest Inventory

Since 2013, DNR’s Forest Inventory Team has been developing the Remote-Sensing Forest Resource Inventory System (RS-FRIS) to replace the current inventory system. RS-FRIS combines conventional plot measurements taken in the field with data from remote sensors to provide information at a higher spatial resolution and lower cost than conventional inventory. RS-FRIS combines two remote sensing technologies, LiDAR and photogrammetric detection and ranging (PHODAR), to provide a variety of three-dimensional information on stand conditions including the height of dominant trees, board-foot volume of all trees, canopy closure, and relative density.

In FY 2016, DNR field technicians measured 423 inventory plots on DNR trust lands across the state (Figure 22). These field measurements combined with LiDAR data acquisition resulted in an additional 345,000 acres of trust lands covered by RS-FRIS. At the end of FY 2016, RS-FRIS covered 95 percent of westside HCP lands and 81 percent of eastside HCP lands. In FY 2017, DNR will continue acquiring LiDAR data and conduct plot measurements to further expand coverage of RS-FRIS. RS-FRIS data will be used to support a variety of DNR program areas including research and monitoring, habitat delineation, timber sales, and forest modeling.

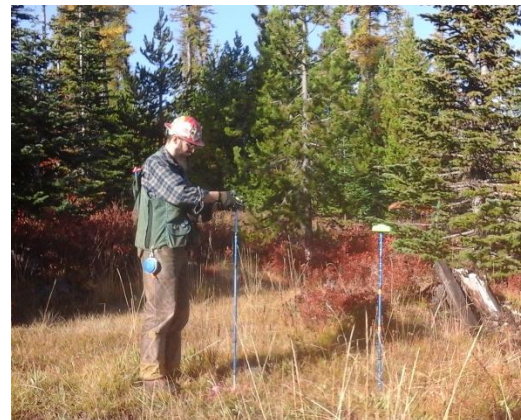


Figure 22: A DNR Field Technician Establishes an Inventory Plot in Eastern Washington. Photo courtesy of Peter Gould.

Silvicultural Activity for FY 2016

Appendix: Background on Silvicultural Activity

Information and analysis provided in this section are based on activities designated as “complete” in DNR’s planning and tracking database (P&T) as of December 12, 2016. P&T is a dynamic system in which data is continually updated.

Five major silvicultural activity types are discussed in this report: timber harvest, site preparation, forest regeneration, vegetation management, and pre-commercial thinning. These activities usually occur in this chronological sequence for a unit where timber has been harvested. Timber harvests are

the primary driving force for other silvicultural activities, as most harvests remove enough trees to require reforestation of the stand. Table 8 shows completed acres of silvicultural activities for FY 2016 as well as the mean annual acres of each activity for the last five fiscal years.

Timber Harvest

The rights to harvest timber from state trust lands are purchased at regional public auctions held each month. A timber sale contract allows the purchaser to remove timber, typically over a one- to two-year period. Thus, the levels of sold timber sales may stay relatively stable from year to year. However, timber removals or levels of completed activities may vary based on the purchaser's choice of when to harvest (and thus complete) the sale.

The number of acres where VRH occurred in FY 2016 was about 12 percent below the five-year mean, commercial thinning acres were 36 percent above the five-year mean, and variable density thinning acres were 34 percent above the five-year mean. The number of acres where uneven-aged management occurred was 76 percent higher than the five-year mean as this treatment has been increasingly implemented on state forestlands in eastern Washington.

Forest Site Preparation

Forest site preparation acreage in FY 2016 was 17 percent below the five-year mean, which can be attributed to the decreasing level of VRH in western Washington and increasing level of uneven-aged management in eastern Washington (uneven-aged management treatments do not involve planting seedlings after harvest). In westside planning units not including the OESF, aerial herbicide treatments were 51 percent below the five-year mean while ground herbicide treatments were 37 percent above the mean. In the OESF, site preparation was 39 percent below the five-year mean as the proportion of thinning treatments implemented in this area has increased.

Forest Regeneration

Forest regeneration acreage in FY 2016 was 13 percent lower than the five-year mean due to decreasing levels of VRH in recent years. Natural regeneration was not used as a regeneration method in FY 2016.

Vegetation Management

Vegetation management activities in FY 2016 were nine percent lower than the five-year mean (which now encompasses most of the years following funding increases for vegetation management in FY 2012). Hand-cutting and ground herbicide treatments were below the five-year means by seven and 17 percent respectively. Hand pulling was almost double the five-year mean due to increased emphasis on treatment of noxious weeds.

Pre-Commercial Thinning

Eighty-five percent of the acres pre-commercially thinned in FY 2016, or 8,363 acres, occurred in westside HCP planning units not including the OESF; this acreage is 15 percent higher than the five-year mean. The number of acres treated in the OESF and eastside planning units was below the five-year mean by 54 and 25 percent respectively.

Salvage

Salvaged acres are not classified as a discrete harvest type in P&T. Instead, salvage acres are included in the harvest activity type that best fits the silvicultural prescription for the stand being managed. They are then flagged so they can be tracked separately. Table 9 compares the FY 2016 completed salvage acres to the five-year mean annual salvage acres by P&T timber harvest activity type. Overall, 97 percent of salvaged acres in FY 2016, or 863 acres, occurred in eastern Washington planning units. This level of salvage is 18 percent above the five-year mean and is the result of above-average wildfire season intensity.

Table 8: Acres of Completed Silvicultural Activities on State Trust Lands Managed under the HCP from FY 2012–FY 2016.

	FY 2016							FY 2016 Totals				FY 12–16 Mean Annual Acres ¹			
	EAST ²		WEST					East	West	OESF	Total	East	West	OESF	Total
	Klickitat	Yakima	Columbia	North Puget	South Coast	South Puget	Straits								
Timber Harvest															
Clearcut	-	-	-	-	2	13	-	-	15	-	15	-	11	-	11
Commercial thinning	-	-	620	160	1,016	383	2	-	2,181	1,046	3,227	240	1,710	430	2,379
Seed tree removal cut	-	-	-	-	-	-	-	-	-	-	-	51	-	-	51
Selective product logging	-	-	-	-	-	-	-	-	-	-	-	-	84	-	84
Shelterwood intermediate cut	-	-	-	-	-	-	-	-	-	-	-	23	-	-	23
Shelterwood removal cut	-	-	-	-	-	-	-	-	-	-	-	15	-	-	15
Uneven-aged management	1,004	-	-	-	44	-	16	1,004	60	-	1,064	558	48	-	606
Variable density thinning	-	573	43	6	16	314	-	573	379	2,098	3,050	905	808	570	2,283
Variable retention harvest	229	-	2,127	1,194	3,065	1,255	1,614	229	9,255	336	9,820	256	10,062	819	11,138
Salvage³	Salvage is not a stand-alone timber harvest activity type. Instead, it is included in other timber harvest types. Refer to Table 9 for more information.														
Total timber harvest	1,233	573	2,790	1,360	4,143	1,965	1,632	1,806	11,890	3,480	17,176	2,046	12,723	1,819	16,589
Forest Site Preparation															
Aerial herbicide	-	-	1,096	280	924	-	-	-	2,300	-	2,300	-	4,672	-	4,672
Ground herbicide	-	-	1,017	623	1,313	963	941	-	4,857	292	5,149	108	3,551	498	4,157
Ground mechanical	-	-	-	-	-	-	-	-	-	-	-	344	0	-	345
Pile and burn⁴	-	892	26	-	8	-	-	892	34	16	942	832	127	3	962
Total forest site preparation	-	892	2,139	903	2,245	963	941	892	7,191	308	8,391	1,284	8,350	502	10,136
Forest Regeneration															
Hand planting	131	892	2,635	2,883	2,536	1,662	1,189	1,023	10,905	519	12,447	980	11,845	990	13,815
Natural regeneration	-	-	-	-	-	-	-	-	-	-	-	443	3	-	445
Total forest regeneration	131	892	2,635	2,883	2,536	1,662	1,189	1,023	10,905	519	12,447	1,423	11,848	990	14,261
Vegetation Management															
Aerial herbicide	-	-	-	-	-	-	-	-	-	-	-	-	351	-	351
Ground herbicide⁵	-	-	64	1,527	336	-	996	-	2,923	139	3,062	-	3,501	182	3,683
Hand cutting⁶	-	-	807	3,490	1,669	851	1,126	-	7,943	352	8,295	121	8,525	288	8,934

	FY 2016							FY 2016 Totals				FY 12–16 Mean Annual Acres ¹			
	EAST ²		WEST					East	West	OESF	Total	East	West	OESF	Total
	Klickitat	Yakima	Columbia	North Puget	South Coast	South Puget	Straits								
Hand pulling	-	-	-	-	701	122	-	-	823	-	823	-	418	-	418
Seeding grass⁷	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1
Total vegetation management	-	-	871	5,017	2,706	973	2,122	-	11,689	491	12,180	122	12,795	470	13,387
Pre-Commercial Thinning															
Total pre-commercial thinning	-	1,319	354	5,224	885	2,644	521	1,319	9,628	309	11,256	1,221	5,618	849	7,688
Other															
Shielding or fencing⁸	-	-	119	-	248	-	-	-	367	-	367	-	335	37	372
Ground fertilization	-	-	-	-	-	-	-	-	-	-	-	-	37	-	37
Biomass piles	-	-	-	-	-	-	142	-	142	-	142	-	286	-	286
Total other	-	-	119	-	248	-	142	-	509	-	509	-	657	37	695
Grand Total	1,364	3,434	9,439	10,772	14,724	7,532	8,080	4,798	50,547	5,208	60,553	6,311	53,642	4,714	64,667

¹ Completed acres from P&T as of December 12, 2016, have been converted to mean annual acres for the time period of July 1, 2011–June 30, 2016. Data has been rounded to the nearest whole acre.

² There were no completed activities in Chelan planning unit in FY 16

³ Salvage activities are recorded in P&T under the harvest activity type that best fits the silvicultural prescription for the stand being managed.

⁴ Data reporting for “pile and burn” is highly inconsistent. In some cases, spatial data for the footprints of the burn piles is included, while in other cases, acreage data for entire units is counted.

⁵ Ground herbicide acres include multiple types of vegetation management activities including foliar direct/broadcast, hack and squirt, ground herbicide, and low-volume basal applications.

⁶ Hand cutting acres include ground thinline treatment acres, typically used to thin out bigleaf maple clumps.

⁷ Seeding grass is rarely implemented as a silvicultural prescription, usually for wildfire restoration or for addressing large noxious weed infestations.

⁸ Shielding and fencing are tracked Pest Management activities in P&T, and typically involve protecting seedlings and young trees from ungulate browse.

Table 9: Completed Salvage Acres for FY 2016 and Mean Annual Salvage Acres for 2012–2016 by Harvest Type.

		FY 2016 Completed Salvaged Acres				FY 2012–2016 Completed Mean Annual Salvaged Acres ¹			
		East	West	OESF	Total	East	West	OESF	Total
Harvest Type	Clearcut	-	-	-	-	-	3	-	3
	Selective product logging	-	-	-	-	-	-	-	-
	Uneven-aged management	634	-	-	634	174	4	-	179
	Variable density thinning	-	-	-	-	389	0	-	389
	Variable retention harvest	229	25	6	260	167	44	1	212
	Total	863	25	6	894	731	51	1	783

¹ Completed acres from P&T as of December 12, 2016 have been converted to mean annual acres for the time period of July 1, 2011–June 30, 2016. Data has been rounded to the nearest whole acre.

Road Management Activity

[Appendix: Background on Road Management Activity](#)

Forest Roads Program

The Forest Roads Program continues to improve DNR’s forest-road infrastructure across the state. Unlike most activities described in this report, DNR reports road management activities by calendar year instead of fiscal year because of the complexities of collecting data and reporting road-related activities during the height of the construction season. The information presented here is for calendar year 2015 and is rounded to the nearest tenth mile.

During the 2015 legislative session, DNR’s Forest Roads Program requested \$11.6 million for fish barrier correction and other road improvement projects. DNR received \$4 million through the State Building Construction Account for the 2015–2017 biennium in addition to \$747,300 in re-appropriations from the 2013–2015 biennium.

In 2015, a total of 67 barriers were removed from the fish-barrier work list, representing an investment of \$3.03 million dollars. DNR physically removed or replaced 61 of the barriers, opening an estimated 31 miles of fish habitat on DNR-managed lands (Figure 23). Six other fish-passage barriers were removed from the work list for the following reasons:

- The stream designation was downgraded from “fish” to “non-fish” following protocol survey requirements.
- The fish-passage barrier would result in very limited habitat gain (usually less than 200 meters). These barriers were reprioritized for replacement at the end of the culvert’s useful life with consensus from WDFW and DNR Forest Practices Division staff.

Through land transactions and inventory activities in 2015, DNR acquired 38 new fish passage barriers that will need to be corrected. The Forest Roads Program has committed to remediating these “newly-identified barriers” within six years of their identification. At the end of 2015, 114 fish barriers remained on DNR-managed lands.

On lands managed under the HCP, 82.6 miles of road were abandoned or decommissioned and 89.7 miles were constructed in 2015. There was a net gain of total road miles on HCP-managed lands from 10,727 to 11,104 due to land transactions and updates to the road inventory. Table 10 summarizes DNR’s road management activity on both HCP- and non-HCP-covered lands in 2015.



Figure 23: Fish-barrier Removal on Nelson Creek, a Tributary to the Copalis River. This project removed two 48” culverts (pictured) and a 36” culvert, and reconstructed an 18’-wide new main channel (pictured) and a 6’-wide side channel. A total of 4.4 miles of salmon habitat were opened up as a result of this project. Photos courtesy of Candace Montoya.

Table 10: Road Management Activity Summary for Calendar Year 2015, including HCP- and Non-HCP-Covered Lands.

	Chelan	Columbia	Klickitat	North Puget	OESF	South Coast	South Puget	Straits	Yakima	Non-HCP Lands	Total
Miles of New Road Constructed¹	-	25.9	0.12	20.3	3.1	14.3	14.5	9.7	1.8	16.0	105.7
Miles of Road Reconstructed	-	18.2	-	20.2	7.0	9.7	3.0	4.0	0.0	11.0	73.1
Miles of Forest Road Abandoned	-	12.1	0.5	39.2	-	2.6	0.4	3.4	8.7	1.4	68.3
Miles of Forest Road Decommissioned	-	0.7	-	1.0	5.4	0.1	0.4	2.5	5.7	2.3	18.0

	Chelan	Columbia	Klickitat	North Puget	OESF	South Coast	South Puget	Straits	Yakima	Non-HCP Lands	Total
Miles of Inventoried Road	45.9	1,648.9	587.6	1,505.0	1,837.0	1,902.9	1,323.7	865.0	1,388.4	3,450.0	14,554.3
Fish Barriers Removed	-	9	-	3	36	7	4	3	2	3	67

¹ All mileage data has been rounded to the nearest tenth mile.

Easements

Appendix: Background on Easements

Easements are granted by DNR across state trust lands to private individuals, entities, or other agencies for a variety of purposes including road and utilities access. DNR also acquires easements to provide access to DNR-managed lands across private or other public lands. In addition to granting and acquiring easements, DNR acquires new lands that are subject to existing easement rights.

Road Easement GIS and Spatial Nature

DNR is digitally mapping all existing and new easements in the Road Easement GIS. Mapping of easements granted to DNR by private individuals, entities, or other agencies was completed in 2014. Initial mapping of road easements granted over DNR-managed trust lands in all regions was completed at the end of 2016. In calendar year 2017, DNR will begin the Spatial Nature project, which will map encumbrances on state lands that are not connected to DNR's road system, such as utility corridors, irrigation infrastructure, railroads, and land use restrictions.

Road Easements, Road Use Permits, and Utility Easements

Easement grants that affected state trust lands in FY 2016 are summarized in Tables 11 and 12. Table 11 reports the new easements and road use permits that created a new footprint (i.e., timber was cut to create open space). In this reporting period no new footprint was created for utility easements. Table 12 reports the acres and mileage of utility easements granted during FY 2016 that did not create a new footprint because they overlap with existing easements or agricultural leases.

Table 11: Road Easements and Road Use Permits (New Footprint) Granted in FY 2016.

	HCP Planning Unit			Total
	OESF	Columbia	North Puget	
Miles of Road Constructed	1.1	0.88	0.22	2.2
Acres Impacted	8	6.4	1.42	15.82

Table 12: Utility Easements (No New Footprint) Granted in FY 2016.

	HCP Planning Unit		Total
	North Puget	South Puget	
Miles Constructed	1.37	0.03	1.4
Acres Impacted	1.7	0.11	1.81

Land Transaction Activity

Appendix: Background on Land Transaction Activity

Below is a summary of land acquisitions, dispositions, and transfers completed in FY 2016 by HCP planning unit. Planning units not listed had no transaction activity. All newly acquired parcels listed in this section are covered under the HCP and have been designated as “no role for northern spotted owl habitat” although this designation may be revised based on the outcome of future field surveys. All disposed parcels were classified as “no role for northern spotted owl habitat” and are no longer covered under the HCP.

Because the narrative portion of this section incorporates acreage data from land surveys conducted during transactions and Table 13 incorporates numbers from DNR’s GIS layers, the numbers may not match exactly. The acreage data in the narrative is rounded to the nearest whole acre.

Activity by HCP Planning Unit

Chelan

Acquired: DNR added 10 acres to the Camas Meadows Natural Area Preserve (NAP) in Chelan County.

Disposed: None.

Trust Land Transfer/State Forest Transfer (TLT/SFT): None

Columbia

Acquired: None.

Disposed: DNR transferred one 81-acre school trust parcel to the Camas School District. The parcel is located in a developing area and is no longer suitable for natural resource management use.

TLT/SFT: One 90-acre parcel was transferred out of trust status in 2016 and was added to Stevenson Ridge Natural Resource Conservation Area (NRCA). The property will remain part of the HCP permit lands as nesting, roosting and foraging habitat for northern spotted owl.

North Puget

Acquired: DNR purchased 165 forested acres in Snohomish County for the school and community college trusts. Middle Fork Snoqualmie NRCA and Mt. Si NRCA in King County (Figure 24) acquired 81 acres and 153 acres, respectively, for a total of 399 acres added within this planning unit.



Figure 24: 153-Acre Addition to Mt. Si NRCA in King County.
Photo courtesy of Julie Armbruster.

Disposed: DNR sold 123 acres to King County that will be added to King County's Patterson Creek Natural Area. Approximately 104 acres of this disposal were in the North Puget HCP planning unit and approximately 19 acres were in the South Puget HCP planning unit.

TLT/SFT: None.

South Coast

Acquired: DNR acquired 279 acres of forestland in Grays Harbor County for the school trust.

Disposed: None.

TLT/SFT: None.

South Puget

Acquired: DNR acquired 15 acres for the school trust in two parcels: 13 acres in Thurston County and two acres in King County. Three natural areas acquired a total of 62 acres: five acres for Kennedy Creek NAP in Thurston County, 10 acres for Woodard Bay NRCA in Thurston County, and 47 acres for Stavis NRCA in Kitsap County.

Disposed: DNR sold 123 acres to King County that will be added to King County's Patterson Creek Natural Area. Approximately 104 acres of this disposal were in the North Puget HCP planning unit and approximately 19 acres were in the South Puget HCP planning unit.

TLT/SFT: None.

Straits

Acquired: DNR acquired 1,311 forested acres for the school trust in Jefferson County and 265 acres for Dabob Bay NRCA in Jefferson County.

Disposed: The City of Tacoma received 70 acres of forest land in the Lake Cushman area of Mason County that will be managed for recreation, wildlife habitat, and open space.

TLT/SFT: None.

Table 13: HCP-Covered Land Transactions for FY 2016.

		HCP Planning Unit ¹									
		Chelan	Columbia	Klickitat	North Puget	OESF	South Coast	South Puget	Straits	Yakima	Totals
Acquired Lands											
Stream miles by stream type ²	Type 1	-	-	-	-	-	0.2	-	-	-	0.2
	Type 2	-	-	-	-	-	-	-	-	-	-
	Type 3	-	-	-	0.6	-	0.3	0.4	0.9	-	2.3
	Type 4	-	-	-	0.2	-	0.3	0.2	0.3	-	1.0
	Type 5	-	-	-	1.1	-	0.6	0.1	8.5	-	10.3
	Type 9	0.1	-	-	1.3	-	0.9	0.2	0.3	-	2.7
	Total miles acquired	0.1	-	-	3.2	-	2.3	1.0	10.0	-	16.6
Acres acquired in rain-on-snow zones³		-	-	-	-	-	-	-	-	-	-
Acres per asset class ³	Forested	-	-	-	166	-	281	15	1,338	-	1,799
	Conservation	10	-	-	217	-	-	61	263	-	551
Total acres acquired		10	-	-	383	-	281	76	1,601	-	2,350
Disposed Lands											
Stream miles by stream type ²	Type 1	-	-	-	-	-	-	-	-	-	-
	Type 2	-	-	-	-	-	-	-	-	-	-
	Type 3	-	-	-	0.2	-	-	-	-	-	0.2
	Type 4	-	-	-	-	-	-	-	-	-	-
	Type 5	-	-	-	-	-	-	-	-	-	-
	Type 9	-	-	-	-	-	-	-	0.3	-	0.3
	Total miles disposed	-	-	-	0.2	-	-	-	0.3	-	0.5
Acres disposed in rain-on-snow zones⁴		-	-	-	-	-	-	-	-	-	-
Acres per age class	Open (0–10 years)	-	-	-	-	-	-	-	-	-	-
	Regeneration (11–20 years)	-	81	-	-	-	-	-	-	-	81
	Pole (21–40 years)	-	-	-	-	-	-	-	-	-	-
	Closed (41–70 years)	-	-	-	7	-	-	-	15	-	22
	Complex (71–100 years)	-	-	-	81	-	-	13	55	-	149
	Complex (101–150 years)	-	-	-	5	-	-	-	-	-	5
	Functional (150+ years)	-	-	-	-	-	-	-	-	-	-
	Non-forested	-	-	-	11	-	-	6	-	-	17
Unknown	-	-	-	-	-	-	-	-	-	-	
Total acres disposed		-	81	-	104	-	-	19	70	-	273

¹ This data is intended to provide a broad picture of transaction activities for the reporting period. Data for acquired lands are estimates that have not yet been field verified. This information is provided to the Services through the HCP annual reports to provide a general

understanding of what stand types and habitat conditions are being transacted. Mileage data is rounded to the nearest tenth mile and acreage data is rounded to the nearest whole acre.

² Stream-type data is reported according to the Forest Practices Hydro Layer (that includes water types 1–5 and 9) which has been used in State Trust Lands HCP annual reports since the first report was published in 1999.

³ Asset-class data on acquired lands is obtained from deeds and other information relative to the holdings on the land. Over time, DNR will inventory acquired parcels and replace asset class information with more specific age-class data.

⁴ Rain-on-Snow (ROS) data is derived from DNR's corporate ROS GIS layer.

Natural Areas Program

Appendix: Background on the Natural Areas Program

In FY 2016, the Natural Areas Program protected an additional 660 acres in Natural Area Preserves (NAPs) and Natural Resources Conservation Areas (NRCAs), all of which fall within the area covered by the HCP. These protection efforts added to eight existing natural areas. The most significant of these were:

- **Dabob Bay NAP/NRCA:** DNR added 264.9 acres to the Dabob Bay Natural Area to provide additional protection for nearshore, estuarine, and riparian habitats supporting listed salmon and forage fish species, as well as adjacent upland forest (Figure 25).
- **Stevenson Ridge NRCA:** This site was substantially expanded by a 90-acre addition of mature and late-successional forest that provides northern spotted owl nesting habitat.
- **Mt. Si NRCA:** DNR added 153.1 acres to the Mt. Si NRCA, protecting high-elevation old-growth forest, talus, and cliffs and enhancing habitat connectivity to federal wilderness lands.



Figure 25: Shoreline Habitat on Recently Acquired Lands at Dabob Bay Natural Area. Photo courtesy of David Wilderman.

In addition to land acquisitions, the Natural Areas Program continued to actively manage and enhance habitat on natural areas in FY 2016 to benefit federally listed species such as Bradshaw's Lomatium (Lacamas Prairie NAP/NRCA), Golden Paintbrush (Rocky Prairie NAP), Oregon Spotted Frog (Trout Lake NAP), and Puget Sound/Hood Canal salmon runs (Dabob Bay NAP/NRCA).

Table 14 lists the natural areas that are located in areas managed under the HCP and indicates which natural areas are composed primarily of mature forests and/or late-seral forests. Minor adjustments were made to the acreage figures for Bone River NAP, Cypress Highlands NAP, Elk River NRCA, and Rattlesnake Mountain Scenic Area since the 2015 HCP Annual Report to resolve accounting discrepancies found in DNR's database.

Table 14: Acres Added to Natural Areas within HCP-Covered Lands in FY 2016.

Natural Area	County	Primarily Mature/Late-Seral Forest	Acres Added in FY 2016 ¹	Total Current Acres
Admiralty Inlet NAP	Island	No	-	79.5
Ashford NRCA	Pierce	Yes	-	78.4
Bald Hill NAP	Thurston	No	-	313.7
Bone River NAP	Pacific	No	-	2,720.0
Camas Meadows NAP	Chelan	No	9.8	2,016.8
Carlisle Bog NAP	Grays Harbor	No	-	310.0
Cattle Point NRCA	San Juan	No	-	112.1
Charley Creek NAP	King	Yes	-	1,966.0
Chehalis River Surge Plain NAP	Grays Harbor	No	-	3,024.4
Clearwater Bogs NAP	Jefferson	No	-	504.1
Clearwater Corridor NRCA	Jefferson	Yes	-	2,323.0
Columbia Falls NAP	Skamania	Yes	-	1,233.8
Cypress Highlands NAP	Skagit	No	-	1,072.4
Cypress Island NRCA	Skagit	No	-	4,135.1
Dabob Bay NAP/NRCA	Jefferson	No	264.9	2,770.8
Dailey Prairie NAP	Whatcom	No	-	228.8
Devils Lake NRCA	Jefferson	No	-	80.0
Elk River NRCA	Grays Harbor	No	-	5,560.0
Ellsworth Creek NRCA	Pacific	Yes	-	557.0
Goose Island NAP	Grays Harbor	No	-	12.0
Granite Lakes NRCA	Skagit	Yes	-	603.2
Gunpowder Island NAP	Pacific	No	-	152.0
Hamma Hamma Balds NAP	Mason	No	-	957.0
Hat Island NRCA	Skagit	No	-	91.2
Hendrickson Canyon NRCA	Wahkiakum	Yes	-	159.0
Ink Blot NAP	Mason	No	-	183.6
Kennedy Creek NAP	Mason	No	4.9	212.9
Kings Lake Bog NAP	King	No	-	309.2
Kitsap Forest NAP	Kitsap	Yes	-	571.9
Klickitat Canyon NRCA	Yakima	Yes	-	2,335.2
Lacamas Prairie NAP/NRCA	Clallam	No	-	201.1
Lake Louise NRCA	Whatcom	No	-	137.7
Lummi Island NRCA	Whatcom	No	-	671.5
Merrill Lake NRCA	Cowlitz	No	-	114.2
Middle Fork Snoqualmie NRCA	King	Yes	80.1	9,080.1

Natural Area	County	Primarily Mature/Late-Seral Forest	Acres Added in FY 2016 ¹	Total Current Acres
Mima Mounds NAP	Thurston	No	-	640.5
Monte Cristo NAP	Klickitat	Yes	-	1,151.0
Morning Star NRCA	Snohomish	Yes	-	36,037.0
Mt. Si NRCA	King	Yes	153.1	13,226.0
Naselle Highlands NRCA	Pacific	Yes	-	44.6
Niawiakum River NAP	Pacific	No	-	1,097.8
North Bay NAP	Grays Harbor	No	-	1,214.9
Oak Patch NAP	Mason	No	-	17.3
Olivine Bridge NAP	Skagit	No	-	148.0
Point Doughty NAP	San Juan	No	-	56.5
Rattlesnake Mtn Scenic Area	King	Yes	-	1,851.4
Rocky Prairie NAP	Thurston	No	-	35.0
Sand Island NAP	Grays Harbor	No	-	8.0
Shipwreck Point NRCA	Clallam	No	-	471.8
Schumacher Creek NAP	Mason	No	-	493.7
Skagit Bald Eagle NAP	Skagit	Yes	-	1,546.0
Skamokawa Creek NRCA	Wahkiakum	Yes	-	115.9
Skookum Inlet NAP	Mason	No	-	142.6
Snoqualmie Bog NAP	King	No	-	110.5
South Nemah NRCA	Pacific	Yes	-	2,439.5
South Nolan NRCA	Jefferson	Yes	-	213.0
Stavis NRCA	Kitsap	Yes	47.3	2,903.7
Stevenson Ridge NRCA	Skamania	Yes	90.0	217.9
Table Mountain NRCA	Skamania	Yes	-	2,836.5
Tahoma Forest NRCA	Lewis	Yes	-	230.0
Teal Slough NRCA	Pacific	No	-	8.4
Trout Lake NAP	Klickitat	No	-	2,014.0
Washougal Oaks NAP/NRCA	Clark	No	-	264.2
West Tiger Mtn NRCA	King	Yes	-	3,907.9
Whitcomb Flats NAP	Grays Harbor	No	-	5.0
White Salmon Oak NRCA	Klickitat	No	-	551.2
Willapa Divide NAP	Pacific	Yes	-	587.0
Woodard Bay NRCA	Thurston	No	10.3	896.8
Total Acres			660	120,361

¹ Acreage data in this column comes from the TransactionsAll database maintained by the Land Transactions Program. This data represents acreage determined through surveys at the time of transaction and may not necessarily match the "GIS acres" of transacted land as calculated by DNR's GIS system.

Table 15 lists the federally threatened and endangered species found in natural areas located in areas managed under the HCP, and Table 16 lists other species of concern in these areas.

Table 15: Federally Threatened and Endangered Species on Natural Areas Covered by the HCP.

Species	Federal Status	Natural Area
Northern Spotted Owl	Threatened	Camas Meadows NAP, Granite Lakes NRCA, Skagit Bald Eagle NAP, Morning Star NRCA, South Nemah NRCA, Stevenson Ridge NRCA, Table Mountain NRCA, Teal Slough NRCA, Trout Lake NAP
Marbled Murrelet	Threatened	Ashford NRCA, Bone River NAP, Clearwater Bogs NAP, Clearwater Corridor NRCA, Dabob Bay NAP/NRCA, Elk River NRCA, Morning Star NRCA, Naselle Highlands NRCA, Niawiakum River NAP, Skamokawa Creek NRCA, South Nemah NRCA, South Nolan NRCA, Teal Slough NRCA, Willapa Divide NAP
Bull Trout	Threatened	Chehalis River Surge Plain NAP, Carlisle Bog NAP, Olivine Bridge NAP, Skagit Bald Eagle NAP, Morning Star NRCA
Chinook Salmon – Puget Sound	Threatened	Dabob Bay NAP/NRCA, Kitsap Forest NAP, Mt. Si NRCA, West Tiger Mountain NRCA, Olivine Bridge NAP, Skagit Bald Eagle NAP, Stavis NRCA
Chinook Salmon – Lower Columbia	Threatened	Klickitat Canyon NRCA
Steelhead – Lower Columbia	Threatened	Klickitat Canyon NRCA, Table Mountain NRCA, Washougal Oaks NAP/NRCA
Steelhead – Puget Sound	Threatened	Dabob Bay NAP/NRCA, Stavis NRCA
Coho Salmon – Lower Columbia/ SW Washington	Threatened	Washougal Oaks NAP/NRCA
Chum Salmon – Hood Canal	Threatened	Dabob Bay NAP/NRCA
Oregon Spotted Frog	Threatened	Trout Lake NAP
Eulachon	Threatened	Dabob Bay NAP/NRCA
Mazama Pocket Gopher	Threatened	Rocky Prairie NAP
Bradshaw’s Lomatium	Endangered	Lacamas Prairie NAP/NRCA
Golden Paintbrush	Threatened	Rocky Prairie NAP, Admiralty Inlet NAP
Wenatchee Mts. Checker-Mallow	Endangered	Camas Meadows NAP

Table 16: Special Status Species Located in Natural Areas Covered by the HCP.

Species	Natural Area ¹
Federal Species of Concern	
Beller’s Ground Beetle	Snoqualmie Bog NAP, Kings Lake Bog NAP
California Bighorn Sheep	Morning Star NRCA
Cascades Frog	Mt. Pilchuck NRCA
Columbia Torrent Salamander	Ellsworth Creek NRCA

Species	Natural Area ¹
Fringed Myotis	Camas Meadows NAP
Gorge Daisy	Columbia Falls NAP
Harlequin Duck	Morning Star NRCA
Hatch's Click Beetle	Kings Lake Bog NAP
Howell's Daisy	Columbia Falls NAP, Table Mt. NRCA
Larch Mountain Salamander	Table Mt. NRCA, Columbia Falls NAP
Makah Copper	North Bay NAP, Carlisle Bog NAP, Clearwater Bogs NAP
Northern Goshawk	Clearwater Corridor NRCA, Morning Star NRCA
Northern Red-Legged Frog	Carlisle Bog NAP, North Bay NAP, Table Mountain NRCA, Morning Star NRCA, Ellsworth Creek NRCA, Kings Lake Bog NAP
Olive-Sided Flycatcher	Numerous sites
Oregon Sullivantia	Columbia Falls NAP
Pale Blue-Eyed Grass	Trout Lake NAP
Peregrine Falcon	Table Mountain NRCA, Cypress Island NAP, Mt. Si NRCA, Elk River NRCA, Hat Island NRCA, Lummi Island NRCA, North Bay NAP
Slender-Billed White-Breasted Nuthatch	Washougal Oaks NAP/NRCA, Lacamas Prairie NAP/NRCA
Suksdorf's Desert-Parsley	White Salmon Oak NRCA
Tailed Frog	Table Mountain NRCA, Morning Star NRCA
Tall Bugbane	Washougal Oaks NAP, Columbia Falls NAP
Valley Silverspot	Mima Mounds NAP
Van Dyke's Salamander	South Nemah NRCA, Ellsworth Creek NRCA
Wenatchee Larkspur	Camas Meadows NAP
White-Top Aster	Rocky Prairie NAP, Mima Mounds NAP
Yuma Myotis	Woodard Bay NRCA
State Listed – No Federal Status	
Sandhill Crane (State Endangered)	Trout Lake NAP, Klickitat Canyon NRCA
State Candidate – No Federal Status	
Dunn's Salamander	Teal Slough NRCA, South Nemah NRCA
Olympia Oyster	Dabob Bay NAP/NRCA
Pacific Herring	Dabob Bay NAP/NRCA, Stavis NRCA
Pileated Woodpecker	Table Mountain NRCA, Morning Star NRCA, Kitsap Forest NAP, and others
Puget Blue	Rocky Prairie NAP
Puget Sound Coho Salmon	Dabob Bay NAP/NRCA
Purple Martin	Woodard Bay NRCA, Kennedy Creek NAP
Western Toad	Dabob Bay NAP/NRCA, Morningstar NRCA, Oak Patch NAP, Stavis NRCA
Vaux's Swift	Numerous sites
State Sensitive or State Monitor Species	

Species	Natural Area ¹
Bald Eagle	Numerous sites
Olympic Mudminnow	Carlisle Bog NAP, Chehalis River Surge Plain NAP, West Tiger Mountain NRCA
Western Bluebird	Rocky Prairie NAP, Mima Mounds NAP

¹ Location information was determined by consulting the Washington Natural Heritage database and the following WDFW databases: Animal Occurrences, Northern Spotted Owl Site Centers, Priority Habitat, and Streamnet.

Non-Timber Management Activity

Special Forest Products

[Appendix: Background on Special Forest Products](#)

DNR's South Puget, Olympic, and Pacific Cascade region offices auction leases and sell permits to gather special forest products in the OESF, South Coast, South Puget, Columbia, and Straits HCP planning units. These leases and permits provide small businesses and individuals access to gather a variety of valuable non-timber forest products including Christmas trees, brush, boughs, beargrass, evergreen huckleberry, moss, salal, and sword fern though not every lease or permit includes all these products.

DNR also offers direct sales of some of the same special forest products. In South Puget Region and Pacific Cascade Region, direct sales are made for products gathered from areas too small to be offered under a lease. Direct sales are also made to existing lessees within their lease areas if DNR approves their request to gather products not included in their original lease. Table 17 summarizes DNR's sales of special forest products on HCP-covered forestlands in FY 2016.

Table 17: Special Forest Product Sales on HCP-Covered Areas in FY 2016.

Region	Permits		Leases		Direct Sales	
	Occurrences	Acres	Occurrences	Acres	Occurrences	Acres
South Puget	251	96,000	21	64,435	5	23,294
Olympic	88	270,133	-	-	-	-
Pacific Cascade ¹	74	220,570	-	-	2	100
Total	413	586,703	21	64,435	7	23,394

¹ Due to improved data collection methods, sales of special forest products in PC Region are included in this year's HCP annual report.

Leases

[Appendix: Background on Leases](#)

Oil and Gas Leases

DNR did not have any active oil and gas leases in FY 2016.

Grazing Permits and Leases

In FY 2016, there were 157 acres of grazing leases on the west side. However, some of this land is not forested and is therefore not managed under the HCP. There were no grazing permits active on the west side in FY 2016.

In Southeast Region, as of January 9, 2017, there were 80,176 acres of grazing leases and 75,096 acres of grazing permits on land covered by the HCP. Spatial data on grazing leases and permits is not regularly updated for Northeast Region. However, only 0.2 percent, or approximately 4,019 acres, of land covered under the HCP is in Northeast Region.

Communication Sites and Leases

In FY 2016, there were 75 leased communication sites on DNR lands covered by the HCP, totaling 61 acres. There are a total of 319 leases from individual tenants on the 75 communication sites.

Valuable Material Sales

Appendix: Background on Valuable Material Sales

In FY 2016, DNR had six active commercial sand, gravel, and rock contracts within the HCP boundary, totaling approximately 665 acres. Table 18 summarizes those contracts.

Table 18: Sand, Gravel and Rock Leases active in FY 2016.

Lease Name	Commodity	HCP Planning Unit	Acres
Lewis Gravel Pit – Winthrop	Sand, gravel, rock	Chelan	40
Livingston Quarry	Road rock	Columbia	170
Glenwood Pit ¹	Sand, gravel	Klickitat	40
Kilowatt Quarry	Road rock	Klickitat	15
High Rock	Sand, gravel, rock	North Puget	320
Jordan Road	Sand, gravel	North Puget	80
Total Acres:			665

¹ The Glenwood Pit mine in the Klickitat HCP Planning Unit has been mined out and is in the process of being reclaimed.

Recreation Program

Appendix: Background on Recreation Program

In calendar year 2016, DNR’s Recreation Program completed several projects, many of which included measures to control erosion and eliminate barriers to fish passage. DNR continued to work with numerous volunteer groups and Washington Conservation Corps (WCC) crews to develop new projects and improve existing recreation sites for public use. Highlights of this past year’s work are summarized below.

Development

Northwest Region

Blanchard Forest, Skagit County: In 2016, DNR completed the reconstruction of the Samish Bay Trail, one of the most heavily used trails in Blanchard Forest. DNR also decommissioned approximately 500 feet of unauthorized trail and removed hazard trees at the Samish Overlook day use area to improve safety for hang gliders and paragliders. DNR hosted an event on National Trails Day during which 80 volunteers, representing numerous user groups, conducted trail maintenance and clean-up of day use areas.

Harry Osborne Forest, Skagit County: DNR reconstructed 1,000 feet of Donna’s Trail with new rock surfacing and reconstructed 2,000 feet of the Butterfly Trail to improve trail safety and reduce resource impacts. DNR also maintained five miles of trail to mitigate soil erosion and trail degradation and rerouted 500 feet of trail to address wetland impacts. The final trail easement was signed to provide public access from DNR’s Les Hilde trailhead to state lands.

Morning Star NRCA, Snohomish County: The Natural Areas Program installed a new bridge and trail improvements along the Ashland Lakes Trail with the help of a WCC crew (Figure 26).

Darrington Bike Park, Skagit County: DNR completed 3.7 miles of mountain bike trails.

Reiter Foothills Forest, Snohomish County: DNR completed 0.7 miles of motorcycle trail, 1.9 miles of all-terrain vehicle trail, 1.0 mile of 4x4 trail, and 2.25 miles of non-motorized trail.

Walker Valley, Skagit County: The Recreation Program completed a number of maintenance projects in Walker Valley during this reporting period that contribute to a more environmentally sustainable ORV trail system. With the help of WCC crews, two trail bridges were replaced with significantly longer spans to reduce sediment delivery to streams, a bridge crossing was removed and a trail segment was rerouted out of a riparian zone, and the permit process was completed for a third bridge removal project. WCC trail crews also installed and maintained numerous culverts, water bars, drain dips, and ditches. DNR also initiated a road sign messaging campaign to increase awareness of how public resources can be damaged by unauthorized motorized use.



Figure 26: Washington Conservation Corps Crew on a new Bridge along Ashland Lakes Trail. Photo courtesy of David Way.

Olympic Region

Bear Creek Trail, Clallam County: With the help of WCC crews, the Recreation Program constructed steps and improved drainage along a steep, 30-foot section of trail accessing the Sol Duc River.

Foothills ORV and Sadie Multi-Use Trails, Clallam County: Working with WCC crews, Strait TEQ (an adopt-a-trail group), and DNR’s maintenance and operations crew, the Recreation Program completed a variety of maintenance projects that provide a safer experience for users while promoting environmental stewardship. Some examples include installing multiple culverts, hardening 250 feet of existing trail to reduce seasonal influxes of sediment to nearby streams, and converting 50 feet of a puncheon bridge into rock turnpike with cross drains. DNR also installed and maintained 65 water dips/bars to improve drainage and reduce soil erosion and installed signs and barriers to reduce unauthorized spur trails.

Hoh Oxbow Campground, Jefferson County: DNR removed a failing cross drain that was blocking fish passage. Although habitat upstream of the drain removal site is not suitable for spawning, fish may use the area as off-channel shelter during high-water events.

Minnie Peterson Campground, Clallam County: DNR removed and replaced two undersized and failing culverts with engineered fish passage pipes, opening up approximately 1,000 feet of spawning habitat on a tributary of the Hoh River.

River access areas, Clallam County: Volunteers cleaned up DNR-managed river access points around the city of Forks and gathered over 1,300 pounds of trash.

Southeast Little River Trail, Clallam County: The Recreation Program protected a 30-foot bridge crossing the north fork of the Little River by armoring the toe of the river bank with large rock and live willow stakes to support the existing bridge sill. DNR also reconstructed 100 feet of trail near the Olympic National Park boundary to allow hillside seeps to move across and along drainage features without transporting sediment from recreational activities.

Striped Peak Trail, Clallam County: DNR installed 35 steps using rock found on site to prevent erosion and resource damage along a spur trail accessing a serene cove along the Strait of Juan de Fuca (Figure 27).



Figure 27: Installation of Rock Steps on Striped Peak Trail. Photo courtesy of Justin Zarzeczny.

Pacific Cascade Region

Elochoman State Forest, Wahkiakum County: DNR re-established two miles of the Bradley Trail for off road vehicle trails.

Mitchell Peak Trail System, Clark County: The Recreation Program completed several maintenance projects on the Mitchell Peak Trail System to repair damage from numerous winter storms and contribute to a more environmentally sustainable trail. With the help of volunteers and Larch Correctional Camp Crews, DNR cleared the blow down along approximately five miles of trail and began reestablishing water bars, drain dips, and ditches to address resource damage.

Radar Ridge State Forest, Pacific County: With the help of Naselle Youth Camp, DNR re-established and restored 0.5 miles of connector trail between sites that were damaged by historical windstorms at the Snag Lake and Western Lake campgrounds, and replaced old restroom facilities with two new vault restrooms.

Yacolt Burn State Forest, Clark County: The Recreation Program established a 0.3-mile connector trail between the Thrillium Mountain Bike Trail and Yacolt Burn Trailhead and installed a 55-foot non-motorized bridge across Cold Creek in the Tarbell Trail System. New vault restrooms were installed to replace old structures at Rock Creek Campground and Day Use Area. Construction continued on trails in the Hagan Creek Trail System for motorized use. The Recreation Program held the 14th annual “Pick up the Burn” event during which volunteers removed more than 60 cubic yards of garbage from the Yacolt Burn State Forest.

Winston Creek Forest, Lewis County: DNR removed a culvert that was blocking fish passage in the Winston Creek Campground.

South Puget Sound Region

Capitol Forest, Thurston County: The Recreation Program installed three new bridges and replaced undersized or blocked culverts on motorized and non-motorized trails in Capitol Forest. DNR also installed three new restrooms to replace old structures and placed additional abutments under a bridge crossing a stream on the motorized trail system (Figure 28). The bridge is now higher than the trail, which will minimize tracking of sediment on to the structure. DNR also maintained 40 miles of non-motorized trail and 30 miles of motorized trail, eliminated two stream-adjacent campgrounds to protect Cedar Creek, and converted a campground to a trailhead thereby lowering use impact on the adjacent forest.

Middle Fork Snoqualmie NRCA, King County: DNR's Recreation and Natural Areas programs coordinated with the Federal Highway Administration to develop roadside adjacent trailhead parking areas for several day use recreation sites along the south side of the Middle Fork Snoqualmie River including Mailbox Peak Trailhead overflow parking, Mine Creek Day Use Site, and Champion Beach. DNR completed construction of the 1.3-mile Granite Creek Connector Trail and constructed approximately two miles of the planned three-mile reroute of Dirty Harry's Peak Trail. In addition, DNR completed approximately 0.5 miles of trail renovation and rerouting on the upper Mailbox Peak Trail.

Mt. Si NRCA, King County: DNR's Recreation and Natural Areas programs coordinated with the Federal Highway Administration to develop a roadside-adjacent trailhead parking area for the Russian Butte View picnic day use site on the north side of the Middle Fork Snoqualmie River.

Raging River State Forest, King County: The Recreation Program completed construction of approximately seven miles of the 15 miles of trail under development as part of the planned Phase 1 trail system development project.

Rattlesnake Mountain Scenic Area, King County: In collaboration with the Natural Areas Program, DNR's Recreation Program completed a 0.5 mile length reroute to create a more sustainable segment of the Rattlesnake Mountain Trail.

Tiger Mountain State Forest, King County: The Recreation Program completed 4.4 miles of new mountain bike trails and began construction of 3.5 miles of additional mountain bike trails in the eastern zone of the forest.

Southeast Region

Ahtanum State Forest, Yakima County: DNR's Recreation Program removed culverts acting as fish barriers from the Tree Phones Horse Camp and decommissioned the campground. DNR also constructed a new two mile multi-use ORV/ATV groomed snowmobile route and replaced old restroom structures with new vault toilets in Island Camp and Ahtanum Campground.

Teanaway Community Forest, Kittitas County: DNR removed hazard trees at three campgrounds and is installing a storage shed for volunteer maintenance supplies.



Figure 28: A Bridge in Capitol Forest is Elevated to Reduce Transport of Sediment. Photo courtesy of Philip Wolff.

Planning and Design

Northwest Region

Baker to Bellingham Recreation Plan, Whatcom County: DNR launched the process to develop a plan to guide recreation on DNR-managed forests across Whatcom County for the next 10 to 15 years. DNR held planning committee meetings and a public meeting to provide updates on planning efforts and progress.

Blanchard Forest, Skagit County: DNR began planning the installation of a fiberglass bridge to cross a small stream to reduce the impacts of the existing wet trail crossing.

Harry Osborne Forest, Skagit County: DNR continued planning with the Skagit Backcountry Horsemen of Washington to reconstruct and improve the safety of the Butterfly Trail.

Morning Star NRCA, Snohomish County: DNR's Natural Areas Program began the planning process to guide development and management of low-impact recreational opportunities and facilities in the Morning Star NRCA (Figure 29). DNR initiated public outreach and held a public meeting.

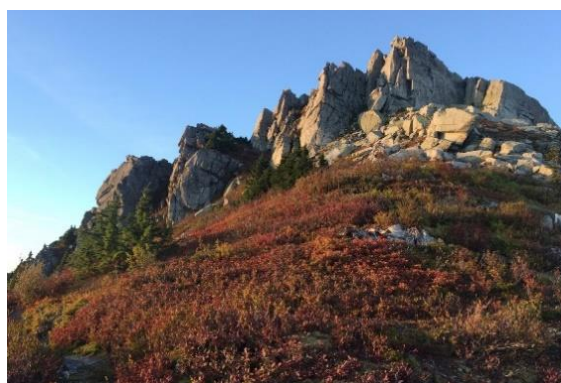


Figure 29: Bald Mountain in Morning Star NRCA.
Photo courtesy of David Way.

Reiter Foothills Forest, Snohomish County: In cooperation with Washington State Parks, DNR continued planning for a non-motorized trail system near Wallace Falls State Park.

Pacific Cascade Region

Yacolt Burn State Forest, Clark County: DNR designed 23.5 miles of non-motorized trails for mountain bike, hiking, and equestrian recreation.

South Puget Sound Region

Elbe ORV Trailhead, Pierce County: Design and bidding were completed for the trailhead which will be constructed in 2017 and provide parking for 27 trucks with trailers. The project features a retaining wall to protect a nearby wetland.

Southeast Region

Manastash Ridge, Kittitas County: DNR and WDFW are partnering on WDFW's planning grant from the Washington State Recreation and Conservation Office for the Manastash Ridge Trail System outside of Ellensburg. The trails are all user-built for hiking and mountain biking, and the agencies are working with a stakeholder group to develop a plan for the management of the trails. Controlling erosion and construction of unauthorized trails will be prioritized to maintain the sustainability of the trail system. The planning committee held its first of several meetings which will occur over the next year.

Teanaway Community Forest, Kittitas County: In partnership with WDFW, DNR launched the process to develop a recreation plan for the community forest. DNR and WDFW held a public outreach meeting and formed a citizen planning committee that will make recommendations to the agencies to guide current and future development of recreation opportunities.

HCP Implementation Documentation

HCP consultation represents the cooperative problem solving that is necessary in the course of HCP implementation. Documentation of these discussions and agreements includes the following:

- **Implementation consultations:** Agreements between DNR's HCP and Scientific Consultation Section and regions or programs related to operational challenges where assistance and approval for a mitigation plan has been requested.
- **Joint concurrences:** Agreements between DNR and the Services related to strategy modifications and updates.
- **Non-compliances:** Unapproved deviations from HCP conservation strategies and/or objectives.
- **Other:** Informational documented issues and activities associated with HCP strategies, objectives, or implementation.

Click [here](#) for documentation of consultations and other discussions from FY 2016.

Appendix A: Background

This appendix contains background information about DNR management of forested state trust lands under the *State Trust Lands Habitat Conservation Plan*.

State Trust Lands Habitat Conservation Plan

The *State Trust Lands Habitat Conservation Plan* (HCP) is a long-term land management plan that is authorized under the Endangered Species Act (ESA) and prepared in partnership with the United States Fish and Wildlife Service and NOAA Fisheries (the Services). The HCP describes, in a suite of habitat conservation strategies, how Washington State Department of Natural Resources (DNR) will restore and enhance habitat for threatened and endangered species such as the northern spotted owl, marbled murrelet, and salmon in conjunction with timber harvest and other forest management activities. These strategies range from passive (for example, protecting unique habitats such as cliffs and springs) to active (thinning forests to speed development of habitat). Each strategy is written in the context of an integrated approach to management, in which commercial forest stands are managed to provide both revenue and ecological values such as biodiversity. Through these strategies, DNR offsets the potential harm of forest management activities on individual members of a species by providing for conservation of the species as a whole.

Land managed by DNR under the HCP and covered by the incidental take permit (ITP) are referred to in the HCP, ITP, and implementation agreement variously as “DNR-managed lands in the area covered by the HCP,” “PERMIT LANDS,” the “DNR forest lands,” the “DNR-managed lands,” the “lands within the planning units,” and other similar terms. All such terms, unless otherwise indicated used in the HCP, ITP, or the implementation agreement refer to those lands identified in Map I.1 of the HCP as “DNR-managed HCP lands” in addition to those lands that have been added to the HCP planning units through land transactions. (See HCP Appendix B, p. 3, 15.0 for further discussion.)

An HCP is required to obtain an incidental take permit, which allows incidental take of a threatened or endangered species. Incidental take means harming or killing individuals of a listed species “if such taking is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity” such as a timber harvest [16 U.S. Code 1539 (a)(1)(B)].

By meeting the terms of the HCP and incidental take permit, DNR fulfills its obligations under the ESA. In this way, the HCP and incidental take permit provide DNR the stability, certainty, and flexibility it needs to meet its fiduciary and ecological responsibilities as a trust lands manager to provide a perpetual source of revenue to trust beneficiaries while simultaneously developing a



The Changing Landscape

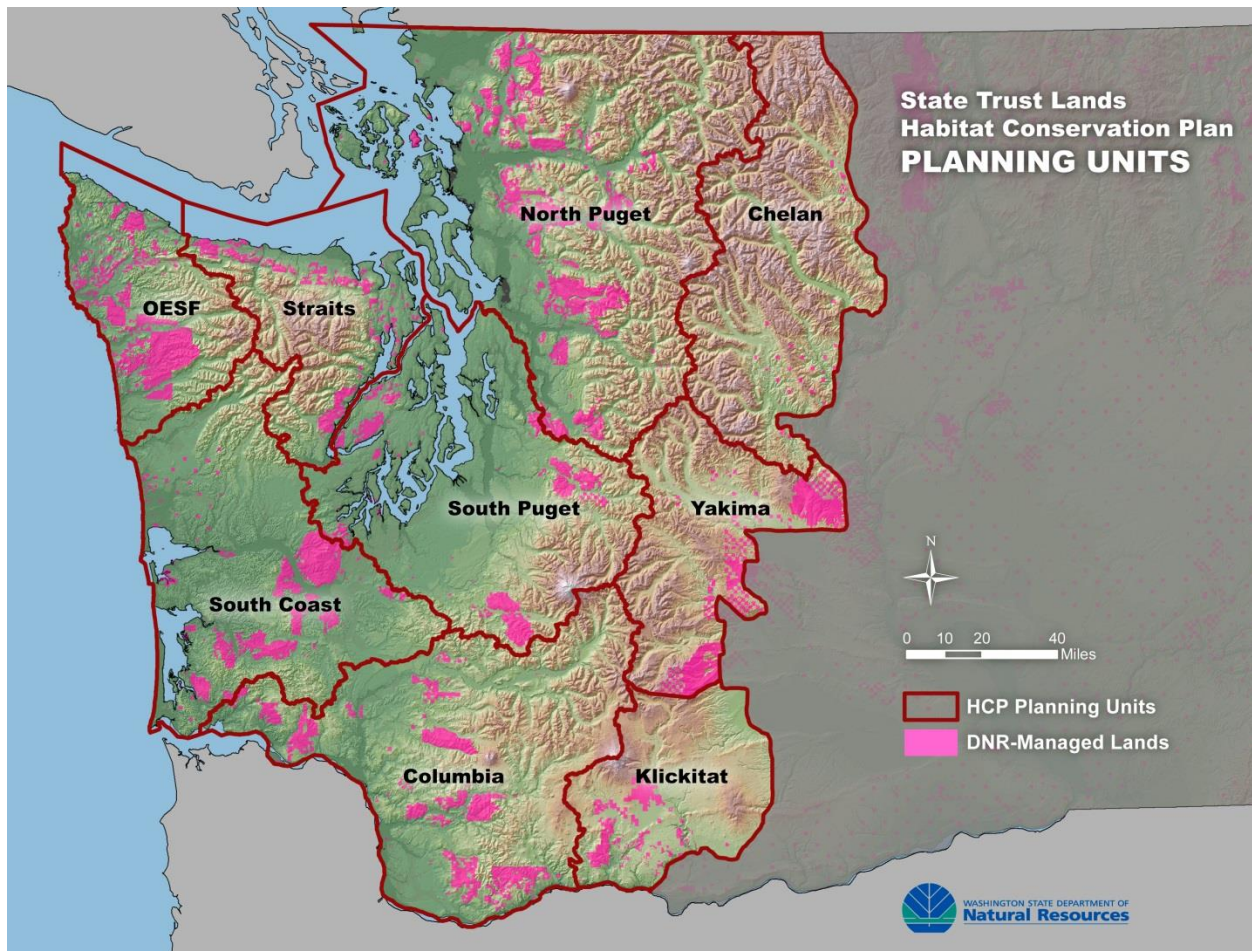
DNR uses harvest methods that promote development of structurally diverse forests. These harvest methods, in combination with the HCP’s northern spotted owl, riparian, and other habitat conservation strategies, promote biodiversity and fundamentally change the landscape from past forest practices.

complex, healthy, resilient forest ecosystem capable of supporting native species. The HCP was signed in January 1997.

Lands Covered by the HCP

DNR manages 2.1 million acres of forested state trust lands statewide. Of this amount, the HCP guides management of approximately 1.8 million acres of land within the range of the northern spotted owl (*Strix occidentalis caurina*). In general, these 1.8 million acres are located on the western and eastern slopes of the Cascade Range in Washington, from the Canadian border to the Columbia River. To manage these areas more effectively and efficiently, DNR divided this area into nine planning units based primarily on large watersheds (Map A-1).

Map A-1: HCP Planning Units.



Implementation of DNR’s HCP conservation objectives for the nine HCP planning units is grouped into the five westside planning units except for the OESF (HCP, p. IV.3), the OESF (HCP, p. IV.86), and the three eastside planning units (HCP, p.IV.19). The five westside planning units are the Straits, North Puget, South Puget, South Coast, and Columbia. The three eastside planning units are the Yakima, Chelan, and Klickitat.

DNR provides [GIS data for lands covered by the HCP](#). This data has been made available to allow for public analysis and to facilitate comparisons between DNR’s data on HCP lands and relevant GIS layers maintained by the Services.

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Comprehensive Reviews

The HCP Implementation Agreement (Section 21.0, p. B.8) requires periodic comprehensive reviews of the HCP, the Incidental Take Permit, and the Implementation Agreement, as well as consultation in good faith between DNR and the Federal Services to identify amendments that might more effectively and economically mitigate incidental take. In 2012, DNR and the Federal Services agreed to conduct the comprehensive review by subject over the next few years, as funding and staffing allow. Table A-1 provides a summary of the comprehensive reviews completed since 2012.

Table A-1: Comprehensive Reviews Developed for HCP Annual Reports

Link to Report ¹	Program
FY 2012 Annual Report	Road Management
FY 2013 Annual Report	Silviculture Activities
	Northern Spotted Owl Data
FY 2014 Annual Report	Land Transactions
	Natural Areas
FY 2016 Annual Report	Implementation Monitoring
	Effectiveness Monitoring

¹A comprehensive review was not completed for the FY 2015 report due to staffing levels.

[Back to the 2016 HCP Annual Report](#)

Conservation Objectives for ESA-Listed and Other Species

The HCP includes habitat conservation strategies for the northern spotted owl, the marbled murrelet, riparian areas, and other species of concern. These four strategies are individually described in the HCP, but each is linked to and benefits from the other strategies.

Northern Spotted Owl Conservation Strategy

Northern Spotted Owl Management Areas

DNR is committed to providing habitat to help maintain nesting and foraging areas for northern spotted owls and to facilitate the owl's movement through the landscape. When the HCP was developed, DNR identified DNR-managed lands that were most important to northern spotted owl conservation. These designated northern spotted owl management areas include three subsets:

- Nesting, roosting, and foraging (NRF) management areas:** Areas likely to provide demographic support and contribute to maintaining species distribution. Demographic support is the contribution of individual, territorial northern spotted owls or clusters of northern spotted owl sites to the stability and viability of the entire population. Maintenance of species distribution supports the continued presence of a northern spotted owl population in as much of its historic range as possible (HCP, p. IV.1).

- **Dispersal management areas:** Areas important for facilitating northern spotted owl dispersal (movement of young owls from nesting sites to new breeding sites).
- **OESF management area:** DNR-managed lands in the OESF; refer to [Northern Spotted Owl Conservation in the OESF HCP Planning Unit](#) later in this section for more information.

In 2006, DNR designated another type of northern spotted owl management area called an “owl area.” Owl areas are lands outlined in section I.C.1 of the Settlement Agreement *Washington Environmental Council, et al v. Sutherland, et al* (King County Superior Court No. 04-2-26461-8SEA, vacated April 7, 2006). These areas were a) designated in HCP Implementation Memorandum No. 1 (January 12, 1998), (b) located within Washington Department of Fish and Wildlife (WDFW) Status 1-R (reproductive) owl circles, and (c) located within the four areas identified in DNR’s Standard Practice Memorandum 03-07 (*Management of Northern Spotted Owl Circles and the Identification of Northern Spotted Owl Habitat in Southwest Washington*). Owl areas are intended to sunset when the commitments of the Settlement Agreement are met.

Northern Spotted Owl Habitat Classes and Types

Each northern spotted owl management area is managed for certain habitat classes, and each habitat class includes specific habitat types. For example:

- Within NRF management areas, DNR manages for NRF habitat. NRF habitat is primarily high-quality roosting and foraging habitat with enough interspersed nesting structure to allow the whole area to be utilized by reproducing owls.
- NRF habitat is composed of two habitat classes: high-quality habitat and sub-mature habitat. High-quality habitat includes high-quality nesting, Type A, and Type B habitats.
- The OESF contains two habitat classes: Old Forest and structural habitat. Old Forest includes Old Forest, high-quality nesting, Type A, and Type B habitats. Structural habitat includes both sub-mature and young forest marginal habitat types.

Through HCP research and monitoring commitments, DNR is working to develop a better understanding of what constitutes functional northern spotted owl habitat and to learn which silvicultural techniques create owl habitat.

Table A-2 provides habitat classifications and types for each westside northern spotted owl management area, and Table A-3 includes the definitions of each habitat type as well as the data queries DNR uses to identify it.

Table A-2: Habitat Classifications and Types for Each Westside Northern Spotted Owl Management Area.

Northern Spotted Owl Management Area		Habitat Class		Habitat Type
NRF		NRF habitat	High-quality habitat	High-quality nesting
				Type A
				Type B
			Sub-mature habitat	Sub-mature
Dispersal	All other westside planning units	Dispersal habitat	High-quality habitat	High-quality nesting
				Type A
				Type B

Northern Spotted Owl Management Area		Habitat Class		Habitat Type
South Puget HCP Planning Unit only			Sub-mature habitat	Sub-mature
			Dispersal habitat	Young forest marginal Dispersal
	Dispersal habitat	Movement, roosting, and foraging (MoRF) plus habitat		High-quality nesting Type A
				Type B MoRF
				Sub-mature Young forest marginal Movement
		Movement plus habitat		Sub-mature Young forest marginal Movement
				Old forest High-quality nesting Type A Type B
				Structural habitat Sub-mature Young forest marginal
	Owl Area	High-quality habitat		High-quality nesting Type A Type B
			Low quality habitat	Sub-mature Young forest marginal

Table A-3: Northern Spotted Owl Habitat Types, Definitions, and Data Queries.

Habitat Type	Habitat Definitions (HCP p. IV.11 through 12 and WAC 222-16-085)	Data Query Used to Interpret Habitat Definitions
High-Quality Nesting	At least 31 trees per acre are greater than or equal to 21 inches diameter at breast height (dbh) with at least 15 trees, of those 31 trees, per acre greater than or equal to 31" dbh	(Live trees ≥ 21" diameter class) ≥ 31 trees per acre and
		(Live trees ≥ 31" diameter class) ≥ 15 trees per acre and
	At least 12 snags per acre larger than 21" dbh	(Snags ≥ 21" diameter class and ≥ 16' tall) ≥ 12 trees per acre and
	A minimum of 70% canopy closure	(Relative density of live trees ≥ 4" diameter class) ≥ 48 and

Habitat Type	Habitat Definitions (HCP p. IV.11 through 12 and WAC 222-16-085)	Data Query Used to Interpret Habitat Definitions	
	A minimum of 5% ground cover of large woody debris	(Down wood \geq 4" diameter class) \geq 2,400 ft. ³ per acre	
	At least three of the 31 trees \geq 21" dbh have broken tops	Not in query	
Type A	A multi-layered, multispecies canopy dominated by large (\geq 30" dbh) overstory trees (typically 15–75 trees per acre)	(FVS-derived number of canopy layers) \geq 2 and (Primary species \geq 4 diameter class) $>$ 10% and (Primary species \geq 4 dbh) \leq 80% (multispec = yes) and (Live trees \geq 30" diameter class) \geq 15 trees per acre and \leq 75 trees per acre and	
	Greater than 70% canopy closure	(Relative density of live trees \geq 4" diameter class) \geq 48 and	
	More than two large snags per acre, 30" dbh or larger	(Snags \geq 30" diameter class and \geq 16' tall) \geq 2.5 trees per acre and	
	Large accumulations of fallen trees and other woody debris on the ground	(Down wood \geq 4" diameter class) \geq 2,400 ft. ³ per acre	
	A high incidence of large trees with various deformities such as large cavities, broken tops, and dwarf mistletoe infection	Not in query	
	Type B	Few canopy layers, multispecies canopy dominated by large (greater than 20" dbh) overstory trees (typically 75–100 trees per acre, but can be fewer if larger trees are present)	(FVS-derived number of canopy layers) \geq 2 and Primary species $>$ 10% and primary species \leq 80% (multispec = yes) and (Live trees \geq 20" diameter class) \geq 75 trees per acre and \leq 100 trees per acre and
		Greater than 70% canopy closure	(Relative density of live trees \geq 4" diameter class) \geq 48 and
Large (greater than 20" dbh) snags present		(Snags \geq 20" diameter class and \geq 16 ft. tall) \geq 1 tree per acre and	
Accumulations of fallen trees and other woody debris on the ground		(Down wood \geq 4" diameter class) \geq 2,400 ft. ³ per acre	

Habitat Type	Habitat Definitions (HCP p. IV.11 through 12 and WAC 222-16-085)	Data Query Used to Interpret Habitat Definitions
	Some large trees with various deformities	Not in query
MoRF	Forest community dominated by conifers, or in mixed conifer/hardwood forest, community composed of at least 30% conifers (measured as stems per acre dominant, co-dominant, and intermediate trees)	(Live conifers \geq 4" diameter class) \geq 30% of all live trees per acre and
	At least 70% canopy closure	(Relative density of live trees \geq 4" diameter class) \geq 48 and
	Tree density between 115 and 280 trees greater than 4" dbh per acre	(Live trees \geq 4" diameter class) \geq 115 and \leq 280 trees per acre and
	Dominant and co-dominant trees at least 85' tall	(Largest 40 live trees per acre) \geq 85' tall and
	Minimum of 5% ground cover of large down woody debris	(Down wood \geq 4" diameter class) \geq 2,400 ft. ³ per acre and
	At least three snags or cavity trees per acre that are at least 15" dbh	(Snags \geq 15" diameter class and \geq 16 ft. tall) \geq 3 trees/acre and
	At least two canopy layers	(FVS-derived number of canopy layers) \geq 2
Sub-Mature	Forest community dominated by conifers, or in mixed conifer/hardwood forest, community composed of at least 30% conifers (measured as stems per acre dominant, co-dominant, and intermediate trees)	(Live conifers \geq 4" diameter class) \geq 30% of all live tree/acres and
	At least 70% canopy closure	(Relative density of live trees \geq 4" diameter class) \geq 48 and
	Tree density of between 115 and 280 trees greater than 4" dbh per acre	(Live trees \geq 4" diameter class) \geq 115 and \leq 280 trees per acre and
	Dominant and co-dominant trees at least 85' tall	(Largest 40 live trees/acre) \geq 85' tall and
	At least three snags or cavity trees per acre that are at least 20"	(Snags \geq 20" diameter class and \geq 16 ft. tall) \geq 3 trees per acre and
	Minimum of 5% ground cover of large down woody debris	(Down wood \geq 4" diameter class) \geq 2,400 ft. ³ per acre

Habitat Type	Habitat Definitions (HCP p. IV.11 through 12 and WAC 222-16-085)	Data Query Used to Interpret Habitat Definitions
Young Forest Marginal (Same as Sub-Mature Except for Snag and Down Wood Requirements)	Forest community dominated by conifers, or in mixed conifer/hardwood forest, community composed of at least 30% conifers (measured as stems per acre dominant, co-dominant, and intermediate trees)	(Live conifers ≥ 4" diameter class) ≥ 30% of all live trees per acre and
	At least 70% canopy closure	(Relative density of live trees ≥ 4"diameter class) ≥ 48 and
	Tree density between 115 and 280 trees greater than 4" dbh per acre	(Live trees ≥ 4" diameter class) ≥ 115 and ≤ 280 trees per acre and
	Dominant and co-dominant trees at least 85 feet tall	(Largest 40 live trees/acre) ≥ 85' tall and
	Snags greater than or equal to 2 per acre (greater than or equal to 20 inches dbh and 16" tall) OR ≥ 10% of the ground covered with 4" diameter or larger wood, with 25–60% shrub cover	(Snags ≥ 20" diameter class and ≥ 16 ft. tall) ≥ 2 trees per acre or (Down wood ≥ 4" diameter class) ≥ 4,800 ft. ³ per acre
Movement	Canopy closure at least 70%	(Relative density of live trees ≥ 4" diameter class) ≥ 48 and
	Quadratic mean diameter of 11" dbh for the 100 largest trees per acre in a stand	(Largest 100 live trees per acre) ≥ 11" quadratic mean diameter (QMD) and
	Forest community dominated by conifers, or in mixed conifer/hardwood forest, community composed of at least 30% conifers (measured as stems per acre dominant, co-dominant, and intermediate trees)	(Live conifers ≥ 4" diameter class) ≥ 30% of all live trees per acre and
	Tree density no more than 280 trees per acre ≥ 3; 5" dbh	(Live trees ≥ 4" diameter class ≤ 280 trees per acre and
	Top height of at least 85 feet (top height is the average height of the 40 largest diameter trees per acre)	(Largest 40 live trees per acre) ≥ 85' tall
At least four trees per acre from the largest size class retained for future snag and cavity tree recruitment	Not in query	

Habitat Type	Habitat Definitions (HCP p. IV.11 through 12 and WAC 222-16-085)	Data Query Used to Interpret Habitat Definitions
Dispersal	Canopy cover at least 70%	(Relative density of live trees \geq 4" diameter class) \geq 48 and
	Quadratic mean diameter of 11" dbh for 100 largest trees per acre in a stand	(Largest 100 live trees per acre) \geq 11" QMD and
	Top height of at least 85'	(Largest 40 live trees per acre) \geq 85' tall
	At least four trees per acre from the largest size class retained for future snag and cavity tree recruitment	Not in query

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Tracking Northern Spotted Owl Habitat

Within each northern spotted owl management area, DNR tracks habitat using spotted owl management units (SOMUs).

- In most HCP planning units, SOMUs are derived from 1997 watershed administrative units (WAUs) and in some cases modified, in accordance with the HCP, to improve conservation and management capability. For eastside dispersal management areas, SOMUs are derived from ¼ townships.
- In the OESF HCP Planning Unit, SOMUs are derived from landscape planning units, not WAUs (the OESF is divided into 11 landscape planning units, which are administrative areas designated primarily along watershed boundaries).
- In the South Puget HCP Planning Unit, SOMUs are based on designated dispersal management landscapes (dispersal management landscapes are used only in the South Puget HCP Planning Unit and were defined through forest land planning).
- For the Klickitat HCP Planning unit, SOMUs are based on sub-landscapes (sub-landscapes are used only in the Klickitat Planning unit and were defined through an [amendment to the HCP](#)).

The HCP's northern spotted owl conservation strategy involves maintaining thresholds of habitat in each SOMU.

- Most designated NRF and dispersal SOMUs have a 50 percent overall habitat threshold objective.
- For the OESF and South Puget HCP Planning Units, habitat thresholds are two-tiered or have two threshold objectives. For example, the OESF has a 40 percent overall habitat threshold objective. This threshold is further defined as restoring and maintaining at least 20 percent of each SOMU as Old Forest Habitat with the rest made up of structural or better habitat. In the South Puget HCP Planning Unit, dispersal management areas have an overall 50 percent threshold, 35 percent of which is MoRF plus habitat, and 15 percent of which is movement plus habitat.

Appendix A

Table A-4 describes habitat thresholds for selected HCP planning units. Refer to Table A-3 for habitat definitions.

Table A-4: Habitat Thresholds for HCP Planning Units

HCP Planning Unit	Habitat Threshold		Habitat Classification	Habitat Types
OESF	40% of each SOMU	At least 20%	Old Forest Habitat	Old Forest
				High-quality nesting
				Type A
				Type B
		20%	Structural habitat	Sub-mature
			Young forest marginal	
South Puget	50% of each NRF SOMU		High-quality habitat	High-quality nesting
				Type A
				Type B
			Sub-mature habitat	Sub-mature
	50% of each dispersal SOMU	At least 35%	MoRF plus habitat	High-quality nesting
				Type A
				Type B
		15%	Movement plus habitat	Sub-mature
			Young forest marginal	
			Movement	
All Other West-Side Planning Units	50% of each NRF SOMU		High-quality habitat	High-quality nesting
				Type A
				Type B
			Sub-mature habitat	Sub-mature
	50% of each dispersal SOMU		High-quality habitat	High-quality nesting
				Type A
				Type B
			Dispersal habitat	Sub-mature
			Young forest marginal	
			Dispersal	

In general, harvest activities must not increase the amount of time required to achieve habitat goals beyond what would be expected in an unmanaged stand. To ensure that procedures are being followed and goals are being met, DNR tracks the types and amounts of silvicultural activities in designated NRF and dispersal management areas.

Northern Spotted Owl Conservation in the OESF HCP Planning Unit

The HCP describes the management approach for the OESF as “unzoned,” in that no special zones are set aside for either ecological values or revenue production. The goal behind this experimental management approach is to learn how to integrate revenue production and ecological values across state trust lands in the OESF.

However, DNR acknowledges that the OESF has fixed geographic features that require special management considerations. Examples include riparian areas, wetlands, potentially unstable slopes, and talus fields. Therefore, DNR currently uses the term “integrated” instead of “unzoned” to describe the management approach for the OESF.

Under this approach, DNR does not designate NRF or dispersal areas. Instead, in each of the OESF’s 11 SOMUs, DNR restores and maintains the following minimum habitat thresholds: 40 percent northern spotted owl habitat, of which at least 20 percent is Old Forest Habitat, and the remaining 20 percent is Structural Habitat or better. This strategy, which restores northern spotted owl habitat capability, is based on working hypotheses concerning the necessary quality, quantity, and distribution of habitat.

For more information on integrated management, refer to the [OESF HCP Planning Unit Forest Land Plan](#).

Northern Spotted Owl Conservation in the Klickitat HCP Planning Unit

In the Klickitat HCP Planning Unit, many stands are overstocked with tree species that are susceptible to stand-replacing fires, drought, disease, and insect infestations. In addition, some lands originally designated as NRF management areas are not—nor will they ever be—capable of sustaining northern spotted owl habitat. This makes the original habitat goal for this unit difficult to achieve.

In April 2004, DNR implemented an amended spotted owl conservation strategy (*HCP Amendment No.1, Administrative Amendment to the Northern Spotted Owl Conservation Strategy for the Klickitat HCP Planning Unit*) to address these issues in the Klickitat HCP Planning Unit. This amended strategy involves designating four sub-landscapes within the planning unit and using field assessments, forest inventory data, and spotted owl demography data to create habitat targets for each sub-landscape.

In addition, DNR renamed dispersal management areas as desired future condition (DFC) management areas. Klickitat DFC management areas have the same habitat commitments as dispersal management areas, but they are managed by vegetation series with the goal of maintaining 50 percent of each vegetation series, by sub-landscape, in a mature DFC (at least 60 years old). Areas incapable of growing and sustaining habitat, and those better suited for a different habitat classification, have been reclassified.

DNR also adjusted the Klickitat HCP Planning Unit boundaries to exclude approximately 23,000 acres of dispersal management area. These acres, which are located north of Yakama Nation Lands, are now part of the Yakima HCP Planning Unit.

Northern Spotted Owl Habitat Data

DNR's tracking and management of northern spotted owl data for westside HCP planning units and the OESF has evolved since the HCP was implemented. This section initially appeared in the *2013 State Trust Lands HCP Annual Report*.

In writing the HCP, DNR identified those lands that were most important to northern spotted owl conservation using age class. These lands were designated as northern spotted owl management areas. Three types of areas were identified in the HCP: nesting, roosting, and foraging (NRF) management areas; dispersal management areas; and the OESF.

The HCP's northern spotted owl conservation strategy involves maintaining thresholds of habitat in each northern spotted owl management area or OESF landscape unit. Per the HCP, the spatial unit at which DNR would track habitat thresholds differed by HCP planning unit.

The HCP's northern spotted owl conservation strategy involves maintaining thresholds of habitat in each northern spotted owl management area or OESF landscape unit. Per the HCP, the spatial unit at which DNR would track habitat thresholds differed by HCP planning unit.

- In most westside HCP planning units, DNR would maintain at least 50 percent of designated NRF and dispersal watershed administrative units (WAUs) as habitat.
- In the OESF HCP planning unit, DNR would maintain at least 40 percent of each landscape planning unit as habitat. (The OESF is divided into 11 landscape planning units, which are administrative areas designated primarily along watershed boundaries.)

To help DNR implement the northern spotted owl conservation strategy, the department developed the RIUOWLWAW spatial data layer using the best data available at that time. DNR used forest resource inventory system (FRIS) data to screen for habitat parameters and identified forest inventory units that were expected to meet HCP northern spotted habitat requirements.

The RIUOWLWAW data layer was used to calculate the percentage of northern spotted owl habitat within each WAW. However, in this calculation DNR evaluated only the minimum habitat type for each NRF and dispersal management area (for example, sub-mature habitat for NRF and dispersal habitat for dispersal management areas). This process essentially missed higher-quality habitat and resulted in an erroneous (lower) habitat percentage for each WAW. This was a major shortcoming of the RIUOWLWAW data layer.

In addition, WAW boundaries were originally based on the 1997 forest practices designation. Since that time, WAW boundaries have shifted based on new or more current hydrographic information. Managing multiple WAW layers for different HCP objectives became problematic (that is, DNR used one WAW layer for northern spotted owl management and another layer to manage hydrologic maturity). Also, the RIUOWLWAW data layer was not corrected for any timber sales until 2002, when DNR's Forest Resources Inventory Program implemented a system to model growth and activity updates of the sample inventory.

With the completion of the 2004 sustainable harvest calculation (*Final EIS on Alternatives for Sustainable Forest Management of State Trust Lands in Western Washington and for Determining the Sustainable Harvest Level, July 2004*), the onset of forest land planning, and the implementation



Northern Spotted Owl.
Photo courtesy of USFWS.

of a new northern spotted owl procedure (PR 14-004-120, September 2004), the Forest Resources Inventory Program initiated development of an improved, detailed dataset for northern spotted owl habitat in western Washington. For this northern spotted owl dataset (2004 dataset), DNR used model-grown data that was updated from a 2004 inventory dataset and sample inventory. The 2004 dataset identified all northern spotted owl habitat types in western Washington as determined by a hierarchical assessment. When forest stands met multiple habitat types, DNR assigned them the highest quality habitat type and corresponding habitat code. Any given area had to meet each of multiple parameter thresholds in order to be identified as a specific habitat type (see [habitat types and definitions](#)).

However, before the 2004 dataset could be fully implemented as a core dataset, DNR entered into the 2006 Settlement Agreement (*Washington Environmental Council, et al v. Sutherland, et al (King County Superior court No. 04-2-26461-8SEA, vacated April 7, 2006)*). As a result of this agreement:

- DNR designated a fourth type of owl management area, called an “owl area.” Owl areas are those areas which were (a) designated in HCP Implementation Memorandum No. 1 (January 12, 1998), (b) located within Washington Department of Fish and Wildlife (WDFW) Status 1-R (reproductive) owl circles, and (c) located within the four areas identified in Standard Practice Memorandum SPM 03-07 (*Management of Northern Spotted Owl Circles And The Identification Of Northern Spotted Owl Habitat In Southwest Washington*). Owl areas do not include any areas within NRF or dispersal management areas or the OESF.
- DNR used the 2004 dataset, along with maps and acreage summaries, to re-delineate northern spotted owl habitat in all northern spotted owl management areas in western Washington, including the new owl areas. The 2004 dataset was renamed the Settlement Agreement habitat layer.
- For the OESF, DNR included non-FRIS identified older forest stands in the Settlement Agreement habitat layer as “Old Forest.” These stands had been identified through a field and map review and approval process.

Around this time, DNR obtained a concurrence letter from USFWS allowing the WAU boundaries used for habitat thresholds to be modified slightly and renamed as spotted owl management units (SOMUs) to distinguish them from WAUs. A spatial layer was created displaying SOMU boundaries. This SOMU layer contained a table showing the percent of habitat for NRF and dispersal management areas using the habitat categories in the Settlement Agreement habitat layer. The SOMU layer also displays habitat percentages in the 11 landscape planning units of the OESF.

Also around this time, DNR compared the method used to evaluate each habitat parameter for the 2004 dataset and for the Settlement Agreement habitat layer. With a few exceptions, it became apparent that most habitat parameters were evaluated in the same way. DNR also recognized the importance of updating and maintaining the Settlement Agreement habitat layer in an accurate and current status.

Between 2007 and 2009, DNR held conversations with the settlement partner representatives to negotiate the best way to update the Settlement Agreement habitat layer and habitat maps outlined in section 1.D.1 of the Settlement Agreement. From those discussions, it was concluded that DNR would update the Settlement Agreement habitat layer (renamed the NSO habitat layer) as needed to respond to information accuracy triggers and would consult with settlement partner representatives and the Services, should updates be required due to habitat-based triggers. Information accuracy triggers are day-to-day operational updates that need to take place in order for the maps to reflect accurate on-the-ground conditions (for example, timber harvest events, new or updated inventory,

data clarification, next best designations, land transactions, and resolved settlement agreement items). Habitat-based triggers are those updates involving habitat type changes that require consultation and/or approval from the settlement partners and the Services (for example, re-designation of northern spotted owl management areas and habitat definition adjustments).

Currently, DNR uses the NSO habitat layer to track acres of both habitat and non-habitat within northern spotted owl management areas. Per the agreement, DNR updates this layer regularly to reflect accurate on-the-ground conditions (information accuracy triggers).

Age Class versus Structure

Estimates of current and future northern spotted owl habitat have evolved over time. Initially, the HCP used age-class distribution as a surrogate for habitat, acknowledging that age-class does not necessarily equate to habitat (p. IV.29). Table IV.16 in the “Forest Management Activities” section of the HCP (p. IV.212) provides an estimate of the number of acres of habitat expected to develop on state trust lands managed under the HCP in westside planning units including the OESF at the end of the first decade, based on age class. Table IV.16 from the HCP has been reproduced below.

Table A-5: Estimated amount of habitat on DNR-Managed lands in the area covered by the HCP at the end of the first decade of the HCP.

Type of Habitat	Eastside Planning Units	Westside Planning Units	OESF Planning Unit
Dispersal	34,000	58,000	N/A
NRF ¹	25,000	66,000	56,000
Riparian	N/A	23,000	10,000

¹ NRF habitat, not to be confused with NRF management areas; refer to p. IV.88 in the HCP and Hanson et al 1993.

Since the HCP was adopted, DNR has transitioned to northern spotted owl habitat definitions that are based on forest structure (rather than age class) because forest structure is a more effective way to define habitat. For example, it is difficult to predict the development of forest structures such as down wood or snags through age class alone. DNR has also, through planning processes such as development of the South Puget HCP Planning Unit Forest Land Plan, adjusted habitat definitions to better reflect the owls’ needs in particular areas. Because of these changes, and because DNR is no longer using age class as a surrogate for habitat, it is not possible to directly compare NSO habitat estimates from 1997 (Table IV.16 in the HCP) to current estimates. The most appropriate and accurate way to capture current acreages is to report habitat within northern spotted owl management areas at a particular point in time. Estimates as of August 28, 2013 are presented in Table A-6.

Table A-6: Estimated Number of Acres of Habitat and Non-Habitat in NSO Management Areas in Westside and OESF HCP Planning Units as of 8/28/2013.

Northern spotted owl (NSO) management area	Habitat class	Habitat type ¹	Habitat acres	Non-habitat acres	Unknown acres ²	Next best acres ³	Total NSO mgmt. area acres
NRF	NRF habitat	High quality habitat	0	64,582	12,750	69,492	166,132
		Type A	1,122				
		Type B	150				

Northern spotted owl (NSO) management area		Habitat class	Habitat type ¹	Habitat acres	Non-habitat acres	Unknown acres ²	Next best acres ³	Total NSO mgmt. area acres				
		Sub-mature habitat	Sub-mature	18,036								
Dispersal	All west-side planning units other than South Puget HCP Planning Unit	High quality habitat	High-quality nesting	0	18,832	1,674	2,919	125,245				
			Type A	74								
			Type B	0								
		Sub-mature habitat	Sub-mature	4,064								
		Dispersal habitat	Young forest marginal	3,751								
			Dispersal	15,892								
	South Puget HCP Planning Unit	Dispersal habitat	Movement, roosting, and foraging (MoRF) plus habitat	High-quality nesting	0	31,410	7,152		19,671			
				Type A	522							
				Type B	107							
				MoRF	2,097							
		Movement plus habitat	Sub-mature	461								
			Young forest marginal	3,075								
			Movement	13,546								
	OESF	Old Forest	Old Forest	40,085	199,839	9,513	n/a		271,867			
High-quality nesting			8									
Type A			541									
Type B			99									
Structural habitat		Sub-mature	7,486									
		Young forest marginal	14,297									
Owl area		High-quality habitat	High-quality nesting	0				87,421		5,378	n/a	97,860
			Type A	2								
	Type B		0									

Northern spotted owl (NSO) management area	Habitat class	Habitat type ¹	Habitat acres	Non-habitat acres	Unknown acres ²	Next best acres ³	Total NSO mgmt. area acres
	Low quality habitat	Sub-mature	536				
		Young forest marginal	4,523				

¹ Definitions of northern spotted owl habitat types can be found in the Northern Spotted Owl Conservation Strategy background section.

² Unknown stands are stands containing insufficient FRIS information to query and classify the stand. Any unknown stands greater than 25 years of age must have a FRIS inventory conducted to adequately classify it prior to any harvest activity. Once a new inventory is completed for the stand, it will be updated according to the new/updated inventory trigger and subsequent habitat classification. Stand ages are based upon the current FRIS origin date and are assessed at each layer update.

³ Next best stands are those non-habitat or unknown stands that have been identified as most likely to meet a northern spotted owl habitat classification in the shortest possible time, with or without silvicultural treatment.

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Riparian Conservation Strategy

For the five westside HCP planning units, the HCP riparian conservation strategy was developed with the following specific objectives:

- Maintain or restore freshwater habitat for salmonids on state trust lands, and
- Contribute to the conservation of other species that depend on aquatic and riparian habitats, including wetlands (HCP, p. IV.55).

Meeting these objectives means providing clean water, shade, and large logs for streams through the use of riparian and wetland management zones. It also means preventing sediment delivery to streams and wetlands through management standards for road building and for conducting forest management activities on potentially unstable slopes and rain-on-snow areas.

Adopted in 2006, the [Riparian Forest Restoration Strategy \(RFRS\)](#) is part of the HCP riparian conservation strategy. The RFRS applies to all HCP planning units except the OESF, and was developed by a technical review committee consisting of technical staff from DNR, NOAA, USFWS, Northwest Indian Fisheries Commission, and WDFW.

Under the RFRS, DNR designs riparian forest thinnings to restore older forest species and forest structure in streamside forests in which historic timber harvest created forest stands that were even-aged and often overstocked. DNR uses canopy gaps and “skips”—areas that are left unmanaged—to help increase structural diversity and accelerate the development of habitat. Accelerating the growth of large conifer trees is an important part of the RFRS. Over time, these trees will provide shade and nutrient-rich litter-fall to the stream when they are alive, and large woody debris to the stream channel when they die and fall over. Large woody debris in the stream channel creates pools and cover, which are important for salmon habitat. Once the riparian forest is on a developmental trajectory to reach an older forest structural condition, there will be no further harvest next to the stream.

During the three-year RFRS implementation period, thinning in stands 70 years of age or older was addressed on a site-specific basis with the Services. This restriction was lifted in 2012 through a [joint concurrence letter](#) signed by DNR and the Services.

When the HCP was adopted in 1997, DNR did not have enough information on the functions and protection needs of headwater streams (also known as first-order streams or type 5 streams) to develop a full strategy for these streams. For this reason, headwater streams are currently managed through an interim strategy. The interim strategy protects these streams when they are associated with unstable slopes and when such protection is necessary for water quality, fish habitat, stream banks, wildlife, and other important elements of the aquatic system. In addition, the HCP specifies that DNR will conduct research on the effects of forest management on headwater streams, in preparation for developing a long-term headwater strategy. Research and writing of this strategy is complete. However, competing priorities have prevented DNR from completing the steps necessary for adoption and implementation.

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Marbled Murrelet Conservation Strategy

When the HCP was signed in 1997, DNR had insufficient information to create a long-term conservation strategy for the marbled murrelet. Murrelet ecology and habitat use were not well understood at the time, particularly in relation to nesting habitat on DNR-managed lands. To address this, the HCP specified that an interim strategy be implemented while DNR conducted inventories, surveys, and additional research to support development of a long-term strategy.

Following extensive research and input from an independent science team, DNR now has enough information to develop a long-term strategy. Although previously delayed by budgetary and staffing shortfalls, development of the long-term conservation strategy resumed as a top agency priority.

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Multispecies Conservation Strategy

In addition to providing habitat for ESA-listed species, the conservation objectives developed for the HCP were designed to provide appropriate habitat protection for many native species not currently listed or protected under the ESA. The HCP also specifies habitat protection for numerous Washington State-listed plant and animal species of concern.

Uncommon Habitat Objectives

The multispecies conservation strategy involves identification and protection of uncommon habitat types for unlisted species. These habitat types include caves, cliffs, talus slopes, wetlands, balds, mineral springs, snags, oak woodlands, and large structurally unique trees. These habitat types provide nesting, roosting, hiding, and foraging opportunities for many species.



Marbled Murrelet Nest

Marbled murrelets nest on large limbs covered with moss or other natural substances that create a relatively flat platform. Their nests are usually in mature or old conifer forests. Photo courtesy of Tom Bloxton.

Adaptive Management and the Conservation Strategies

New scientific developments and information obtained through research and monitoring can identify changes in management practices that would help address the needs of specific species or improve habitat conditions. For this reason, the HCP includes provisions for a dynamic, scientifically based adaptive management process that allows for continual improvement of its implementation.

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Monitoring, Research and Adaptive Management

Monitoring and research provide the information necessary to improve the implementation and effectiveness of the conservation strategies in the HCP. Monitoring and research also help DNR document how well different plans and actions are working to achieve the desired outcomes. The information gained can be used to adjust or adapt DNR's management practices as needed.

Since the HCP was adopted in 1997, there have been advances in understanding the ecology of northern spotted owls, marbled murrelets, and other species addressed by the HCP and how they are affected by land management. However, much remains to be learned, and new systems and techniques continue to be developed and tested. Monitoring and research support the completion of conservation strategies, evaluate their implementation and effectiveness, test promising alternatives to current conservation approaches, and contribute to the ecological foundation of DNR's management.

The HCP's adaptive management process allows changes to DNR's forest management when results from the research and monitoring programs or new information from scientific literature indicate that such changes are warranted. For example, adaptive management has resulted in management modifications such as the [Riparian Forest Restoration Strategy](#), the [Administrative Amendment to the Northern Spotted Owl Conservation Strategy for the Klickitat HCP Planning Unit](#), and a [legacy tree procedure for eastern Washington](#) that protects old-growth trees and stands.

Implementation, Effectiveness, and Validation Monitoring

A science-informed adaptive management program relies primarily on research and monitoring to provide new, relevant information for increasing confidence in current management or developing new management options. A system consisting of three types of monitoring—implementation, effectiveness, and validation—has become a common organizational framework for monitoring programs in forest management.

- **Implementation monitoring** determines whether or not the HCP is being implemented properly on the ground, and is sometimes referred to as compliance monitoring.
- **Effectiveness monitoring** determines whether or not the HCP strategies are producing the desired habitat conditions.
- **Validation monitoring** determines whether or not a certain species responds to the desired habitat conditions as anticipated.

Implementation Monitoring

The HCP requires DNR to monitor implementation of the conservation strategies to ensure that the physical outcomes of management activities match DNR’s intention as described in the HCP. Conservation strategies are selected for implementation monitoring based on a number of criteria. These criteria may include the level of risk or uncertainty associated with the strategy, the level of management discretion, the cost and timeliness of monitoring results, new information, and input from the Services and DNR managers. Examples of monitoring projects include monitoring large, structurally unique trees left on timber sales following harvest, monitoring for compliance with the marbled murrelet interim conservation strategy and the northern spotted owl conservation strategy, and monitoring of wetland and riparian management areas.

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Effectiveness Monitoring and Research for HCP Conservation Strategies

Effectiveness monitoring documents changes in habitat conditions, including general forest structure and specialized habitat features that result from timber harvest and other forest management activities. Only habitat areas addressed by the conservation strategies are monitored for effectiveness.

Information from this type of monitoring increases DNR’s ability to understand the influence of land management on aquatic and upland habitat conditions, and to effectively implement the conservation strategies to reach the goals of the HCP.

Northern Spotted Owl Conservation Strategy Effectiveness Monitoring

The objective of northern spotted owl research and effectiveness monitoring is to help DNR better understand the habitat needs of the northern spotted owl and how to effectively manage forest stands and landscapes to create and sustain suitable habitat. The effectiveness monitoring program evaluates whether the HCP strategies and associated silvicultural treatments maintain or enhance NRF and dispersal habitat.

Effectiveness monitoring also supports the adaptive management goals for the northern spotted owl conservation strategy, such as developing better stand- and landscape-level habitat definitions.

The NSO Effectiveness Monitoring Program currently consists of four components:

1. Long-term tracking of the effects of variable density thinnings (VDTs) to improve habitat structure in stands designated as habitat.
2. Measurement of the response of habitat features to small-gap creation within thinned stands.
3. Comparison of the spatial structure of both thinned and unthinned stands designated as habitat to late-successional reference stands known to function as NSO habitat.
4. Landscape-scale monitoring of basic habitat indicators across the entire westside HCP land base.

The first component was initiated in 2004–2007 across five VDTs in the North Puget (Whitehorse Flat timber sale), South Puget (Big Beaver and Cougarilla timber sales), Columbia (Lyons Share timber sale), and Klickitat (Loop timber sale) Planning Units. These five timber sales were designed to maintain or accelerate the development of structural NSO habitat in stands ranging from approximately 50 to 80 years old. The study design includes two or three replications of treated

stands and one untreated control stand at each site. All stands were measured prior to treatment and again immediately after treatment. This process will allow DNR to observe how the trajectories of stand development differ between thinned and unthinned stands and evaluate these findings against the habitat definitions described in the HCP (p. IV.22). Consistent with the monitoring objectives in the HCP (p. V.2), DNR's intent is to track habitat conditions in these treatments at approximately five-year intervals over the life of the HCP.

The second component of the NSO Effectiveness Monitoring Program is being conducted in the Olympic Experimental State Forest (OESF) with a focus on silvicultural gap treatments. Much of the managed landscape is regrowing after past harvests and is in a relatively uniform stage of competitive exclusion with simple canopy structure. DNR has been creating gaps within VDTs to introduce structural heterogeneity to encourage variable light environments; greater canopy complexity; multiple canopy layers; and specific habitat features such as crown expansion, branch platforms, and deadwood. Recently acquired LiDAR data for the OESF will be used to analyze effects on canopy complexity relative to thinned stands without gaps, unthinned second growth, and older forest habitats.

The third component of the NSO Effectiveness Monitoring Program aims to develop innovative approaches for using spatial structure analysis to create higher-quality habitat in managed second-growth forests. Current habitat definitions are based on the relatively simple presence or abundance of certain structural features (such as large trees and snags), but they do not capture the fine-scale spatial structure of older forests that function as habitat, such as the arrangement of large and small trees that determines cover, flyways, and prey distribution for forest raptors such as NSOs. Adapting recently developed methods for restoration thinnings on the eastern slopes of the Cascades, this study aims to characterize patterns of stems in old forest reference stands (focusing on known NSO nest sites and territories) and evaluate the degree to which these patterns can be emulated in VDT treatments. Methodologies to evaluate these patterns will include field stem-mapping as well as analysis of LiDAR data in a series of old forest sites, unthinned second growth, and recently thinned second growth (using other monitored stands described above in the first two components). This project is being conducted in partial collaboration with University of Washington forest scientists. Stem-mapping has begun in monitoring sites, and DNR is currently identifying candidate old forest reference stands.

The fourth component of the program is a landscape-scale assessment of HCP effectiveness for NSO habitat across all westside HCP lands. The objective is to determine whether broad-scale trends in basic habitat features such as tree height, mean tree size, and canopy layering meet HCP goals. To accomplish this, DNR is using Gradient Nearest Neighbor (GNN) data, a regional data set produced by the U. S. Forest Service (USFS) that covers all forestland in all Pacific Coast states. GNN data map the distribution of vegetative characteristics across the landscape, and despite limitations at the single-pixel or small-stand scale, it is sufficiently accurate for assessments over broad spatial extents. GNN also provides an independent, quantitative dataset back to 1984, affording a look at both pre-HCP and post-HCP trends. Of particular interest is whether SOMUs are showing different trends than other non-DNR-managed lands.

Status and Trends Monitoring of Aquatic and Riparian Habitat in the OESF

The key objectives of the Status and Trends Monitoring Program are to provide empirical data to evaluate DNR's progress in meeting the HCP riparian conservation objectives and to reduce uncertainties around the integration of habitat conservation and timber production. Starting in 2012, DNR has monitored stream reaches and adjacent riparian forests in 50 Type 3 watersheds representative of the OESF and four reference sites in the Olympic National Park. Nine habitat

attributes such as stream temperature, shade, and microclimate are field-sampled at reach level. Watershed-level disturbances such as windthrow, timber sales and road management are sampled remotely and through operational records. When integrated with information on management activities in the OESF, the monitoring data from this project will allow DNR to make inferences about the effects of specific forest management operations on habitat, thus helping DNR to fulfill its commitments for effectiveness monitoring and implementation of adaptive management under the HCP.

Riparian Silviculture Effectiveness Monitoring

The objective of effectiveness monitoring for riparian silviculture is to determine whether various restoration thinning treatments are resulting in riparian habitat conditions that support salmon recovery efforts and contribute to the conservation of other riparian and aquatic species. To achieve this, DNR has established several permanent monitoring sites in the OESF, North Puget, and South Puget HCP planning units in which various habitat metrics are measured immediately before and after thinning treatments, and periodically thereafter. Thinning treatments are characteristic of treatments implemented under the 2006 Riparian Forest Restoration Strategy and are intended to facilitate the development of structurally complex riparian forests.

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Validation Monitoring

The HCP requires that DNR conduct riparian validation monitoring across the conglomeration of state managed lands on the western portion of the Olympic Peninsula known as the Olympic Experimental State Forest (OESF). Validation monitoring is defined in the HCP as monitoring “to evaluate cause-and-effect relationships between habitat conditions resulting from implementation of the conservation strategies and the animal populations these strategies are intended to benefit (V.2).” The riparian conservation strategy for the OESF in the HCP was designed to protect or improve habitat for viable salmonid populations. The strategy consists of: (1) interior-core buffers to protect soils on floodplains and unstable stream banks, incised stream valleys, and adjoining unstable slopes; (2) exterior, or wind buffers adjacent to interior buffers, as needed, to protect against blowdown; (3) a comprehensive program of road management, maintenance and improvement, including stabilizing and decommissioning particularly risky roads; and (4) protecting forested wetlands. Riparian validation monitoring will determine if the riparian conservation strategy is maintaining or improving salmonid habitat and expressing stable or positive effects on salmonids as anticipated in the HCP.

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OESF Research and Monitoring Program

The OESF is unique among HCP planning units in both management and purpose. This working forest is managed under an experimental approach called “integrated management”. Rather than dividing the land base into one area for harvest and another for ecological values, DNR manages the entire land base for both. This is achieved through innovative silviculture, landscape-level planning, intentional learning, effective information management, communication, and application of new knowledge into operations (i.e. adaptive management). The OESF was founded to implement and intentionally learn from this experimental approach. New knowledge is applied to continually improve land management practices on state lands through a formal process of adaptive management. Knowledge gained is expected to benefit other land managers facing similar challenges of meeting multiple objectives in a working forest.

The long-term vision for the OESF is a productive, resilient, and biologically diverse commercial forest in which both revenue generation for trust beneficiaries and ecological values are maintained through integrated management. The OESF Research and Monitoring Program helps achieve this vision by implementing and coordinating research and monitoring projects; establishing and maintaining research partnerships; managing research and monitoring information; linking management activities and new knowledge through a structured adaptive management process; and fostering communication, outreach, and education.

Past and Current Research and Monitoring in the OESF

Silviculture and fish research has been conducted on state trust lands on the western Olympic Peninsula since the 1970s. After the designation of the OESF in 1992, the research and monitoring activities intensified and broadened to cover forest and wildlife ecology, geology, and riparian management among other topics. The majority of the past research and monitoring activities are listed in the OESF [Research and Monitoring Catalog](#), published by DNR in 2008. More information on [recently completed](#) and [ongoing](#) research in the OESF can be found on the OESF website. These projects are focused on DNR's needs for revenue generation, environmental protection, and long-term sustainability.

Research Partnerships

DNR maintains two formal agreements related to the OESF:

- A memorandum of understanding with USFS Pacific Northwest Research Station for OESF participation in the Experimental Forest and Range Network (a national network of 80 forests and ranches). It encourages collaboration between OESF and USFS scientists and increases the OESF visibility nationwide.
- A memorandum of understanding between DNR, University of Washington Olympic Natural Resources Center, Olympic National Forest, and the USFS Pacific Northwest Research Station. It advances collaboration between the four parties on research, monitoring, and adaptive management of forest ecosystems on the Olympic Peninsula.

Multiple informal partnerships and collaborations are organized and maintained on a project by project basis.

Information Management

The OESF research tracking database includes metadata on ongoing research and monitoring projects related to natural resource management and ecology conducted by DNR or external parties and stores all scientific and administrative documents on projects implementation. The database is available on DNR's intranet and is linked to DNR's state-wide GIS layer on research areas.

The OESF Research and Monitoring Program is currently supplying environmental data to two online databases:

- Stream temperature data from 50 sites in the OESF and four sites in the Olympic National Park are available at the [NorWeST webpage](#).
- Air temperature and precipitation data from the local NOAA stations and stream discharge data from the local USGS stations are available at the [CLIMDB/HYDRODB webpage](#).

Individual project data are available upon request. More information, including contact information, can be found on the [OESF website](#).

Adaptive Management

Adaptive management is an HCP commitment. In the [OESF Forest Land Plan](#), it is defined as a formal process for continually improving management practices by learning from the outcomes of operational and experimental activities. Adaptive management in the OESF focuses on integration of revenue production and ecological values, and its theoretical foundation, goal, and scope are described in the OESF Forest Land Plan. DNR follows an administrative procedure for adaptive management in the OESF, which describes the step-by-step process and identifies the parties responsible for implementation.

Communication, Outreach and Education

Through effective communication, DNR builds public confidence in the sustainability of forest management practices in the OESF and the effectiveness of the HCP conservation strategies. The OESF Research and Monitoring Program maintains several webpages on [DNR's website](#) that contain information about the OESF, ongoing research and monitoring projects, news, and recent publications.

Educational opportunities in the OESF include internships for undergraduate and graduate students, field trips for K-12 and college students, and lectures and presentations at colleges and universities. The topics covered in these activities range from specific ecological questions to descriptions of environmental monitoring and adaptive management.

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Silvicultural Activities

Silviculture is the art and science of managing forests to meet objectives. Through silviculture, DNR works with the number, size, species, and spacing of trees in the forest to provide both quality timber for harvest and ecological values including habitat for threatened and endangered species, healthy watersheds, biodiversity, and resiliency to disease and insects.

Selecting Silvicultural Activities

DNR implements an array of silvicultural activities (harvest, regeneration, vegetation management, etc.). Which activities are implemented, when, and how often are determined through the silvicultural prescription.

The silvicultural prescription defines desired outcomes (objectives) and how DNR will accomplish them (activities) in a forest management unit over an entire rotation. A forest management unit is an area that is ecologically similar enough to be managed to meet common objectives, and a rotation is the length of time between stand replacement harvests.

Objectives

When writing a silvicultural prescription, DNR begins by understanding the unit's contribution to landscape-level objectives set by DNR policies including the HCP and the *Policy for Sustainable Forests*. Examples of landscape-level objectives include maintaining a certain percentage of the forested landscape as northern spotted owl habitat, or maintaining enough hydrologically mature forest in a watershed to prevent periods of peak flow (periods of high stream flow after storm events).

DNR then writes specific “rotation objectives” for the unit in that context. For example, a unit that contributes to northern spotted owl habitat landscape objectives may have a rotation objective to “attain sub-mature NRF habitat.” Rotation objectives are based on the biological capability of the site, including the trees suitable to the site, the site’s productive capacity, the presence or absence of competing vegetation, insect and disease issues, and other considerations. Financial and budget constraints also play a role in the selection of rotation objectives.

Activities

Once DNR defines the rotation objectives and threshold targets, the next step is to determine the sequence of silvicultural activities that are necessary to meet them. The frequency and type of activities DNR selects will depend on the biological capability of the site and the complexity of the prescription. Budget allocations and market conditions also influence the timing and extent of silvicultural activities chosen, and activities may be prioritized based on available resources and relative benefits. Other important considerations include market conditions, ecological constraints, operational constraints (like potentially unstable slopes), new and existing policies and procedures, and new scientific discoveries. As the stand grows, DNR periodically reassess it to ensure it is on track to meet its objectives.

Tracking Silvicultural Activities

Data on silvicultural activities for HCP annual reports comes from DNR’s forest management planning and tracking (P&T) database, in which DNR records information about planned and implemented silvicultural activities. Using P&T, DNR summarizes acres of activities across all state trust lands managed under the HCP in five categories: timber harvest, forest site preparation, forest regeneration, vegetation management, and pre-commercial thinning.

The number of acres of activities DNR reports each year may be different than what actually took place on the ground during that year. These discrepancies are caused by differences in each DNR region’s procedure for recording activities in P&T. For example, some regions may wait to record individual activities until a sequence of activities is completed. If so, activities completed one year may not be entered into P&T until a subsequent year. This is especially true for timber harvests. Most timber sales have multiple units, and it is common for individual units to be completed in different fiscal years. When this occurs, foresters usually do not report an earlier unit as complete in the database until all road abandonment and logging debris cleanup has occurred, which typically happens for an individual sale after all units are complete. When this occurs, the unit where harvesting was completed in the earlier fiscal year will reflect that year because harvesting is considered more reflective of the overall activity than road abandonment or debris cleanup.

Significant increases or decreases in timber harvest volumes will usually be followed by corresponding decreases or increases in the overall level of silvicultural activity. For example, more stand-replacement harvest in one year will typically lead to more site preparation and planting in the next fiscal year, as well as increased levels of other activities in subsequent years. However, because of the possible lag time between when an activity is implemented and when it is recorded, it may be a year or more before changes in timber harvest volume and other activities are reflected in the number of acres summarized in this report.

Descriptions of Silvicultural Activities

Timber Harvest

DNR separately tracks and reports on each of the following types of harvests:

- **Commercial thinning:** Commercial thinning generates revenue and is performed to meet a wide range of objectives including improving the growth of the stand, enhancing stand health, reducing tree mortality, or accelerating the development of habitat. Regeneration of a stand is not an objective of thinning.
- **Variable density thinning:** Variable density thinning is a type of commercial thinning that creates a mixture of small openings (gaps), unthinned patches (skips), and varying stand densities to achieve specific objectives, such as accelerating development of a complex stand structure. Variable density thinning may also include treatments to create or encourage development of large down wood and snags.
- **Selective product logging:** This type of harvest removes trees of certain species and sizes that are highly valuable such as trees that function well as utility poles or logs for cabins.
- **Seed tree intermediate cut:** A seed tree intermediate cut is the first in a series of harvests that is conducted as part of the even-aged seed tree silvicultural harvest system. The purpose of this harvest type is to provide a desirable seed source to establish seedlings. Typically, about ten overstory trees per acre may be left following this harvest; once the new trees are established, some of these seed trees may be harvested in a seed tree removal cut.
- **Shelterwood intermediate cut:** This harvest is the first in a series of harvests conducted as part of the even-aged shelterwood harvest system. The purpose of this harvest is to provide shelter (typically shade) and possibly a seed source for the seedlings that are regenerating in the stand. Compared to a seed tree intermediate cut, a shelterwood cut typically retains more overstory trees per acre following harvest; retained trees are generally dispersed across the stand. Once the new trees are established, some of these shelter trees may be harvested in a shelterwood removal cut.
- **Temporary retention first cut:** This is a partial-cut timber harvest in which selected overstory trees are left for a portion of the next rotation. The purpose of this harvest method is to retain overstory trees without diminishing establishment of a new stand. These overstory trees can be removed through a temporary retention removal cut, or they can be left through the entire rotation, potentially resulting in a two-aged stand.
- **Seed tree, shelterwood, or temporary retention removal cut:** In these cuts, some overstory trees retained in the earlier harvests are removed.
- **Uneven-aged management:** In uneven-aged management, trees are removed from a multi-aged forest stand while maintaining multiple age classes within that stand. Uneven-aged management is often used on sites with poor soils on which more intensive management is



A Variable Density Thinning in the OESF

not cost effective. This type of management may also be used in fire-prone areas to mimic the effects of periodic, lower-intensity fires that do not remove all of the trees.

- **Variable retention harvest:** Variable retention harvest is a type of regeneration, or stand-replacement harvest. With this type of harvest, DNR removes most of the existing forest stand to make room for regeneration of a new stand, while leaving elements of the existing stand, such as down wood, snags, and live leave trees (trees that are not harvested), for incorporation into the new stand. Variable retention harvest is different from a clearcut, in which all or nearly all of the existing stand is removed.
- **Clearcut:** According to Washington forest practices rules, a clearcut is a harvest method in which the entire stand of trees is removed in one timber harvesting operation. In the 1990s, DNR began doing variable retention harvest instead of clearcuts on the majority of its timber sales. However, between the adoption of the HCP in 1997 and fiscal year 2008, variable retention harvests were still reported as clearcuts even though the vast majority of those harvests met the definition of variable retention harvest. From 2009 on, very few acres have been reported as clearcuts.

Forest Site Preparation

After a stand replacement harvest and before planting the new stand, DNR may remove slash (residue of logging, such as tree limbs) and undesirable plants that would compete with seedlings for nutrients, water, and light. Site preparation may be performed during logging, for example by pulling up and disposing of brush clumps, or after logging by piling and burning slash, manually cutting undesirable vegetation, applying herbicide to undesirable tree and brush species, or a combination of methods.

Forest Regeneration

Following a stand-replacing harvest, DNR establishes new stands by planting seedlings or allowing the site to seed naturally from adjacent stands or trees that are retained within the harvested area.

Vegetation Management

After the site has been planted but before the seedlings have become fully established, DNR may remove competing vegetation to give the new seedlings room to grow. Vegetation may be removed by hand, by mechanical means, or through application of herbicide. Vegetation management is done when competing vegetation will have a negative effect on the stand's ability to meet its objectives.

Pre-Commercial Thinning

During a pre-commercial thinning, DNR removes the less-desirable trees to maintain the growth and stability of the retained trees. Pre-commercial thinnings are performed before the trees are large enough to be marketable. This type of thinning does not generate revenue, and cut trees are left on site to decompose.

Pre-commercial thinning is needed in some stands to reduce high stem densities. When implemented within the optimal timeframe, this prescription increases the chances that stand development will lead to desired future forest conditions. Proper thinning helps maintain individual tree vigor and accelerates diameter growth, resulting in more rapid attainment of size requirements for product or habitat goals. Pre-commercial thinning is a particularly important strategy for addressing forest health concerns, because maintaining lower stand densities with good individual tree vigor is important for making stands more resistant to insect attack. In addition, pre-commercial thinning

improves height-to-diameter ratios, a measure of stem stability, reducing risk of windthrow or stem buckling if partial cutting treatments are applied.

Pre-commercial thinning does not immediately create habitat for endangered species such as the northern spotted owl or marbled murrelet. However, it can set thinned stands on a developmental trajectory that is more likely to produce future habitat because thinning accelerates the development of large, live trees with stable tree architecture.

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Non-Timber Management Activities

Road Management Activities

Roads that are improperly constructed or maintained can negatively impact habitat in a number of ways. Such roads can increase the rates of slope failure, contribute sediment to streams, and block fish passages, which can potentially harm salmon and other aquatic and riparian-obligate species. Current road-building and maintenance practices create better roads that minimize damage while also allowing DNR to abandon or improve poorly built roads.

In 2001, Washington's state forest practices rules were updated to reflect "Forests and Fish" legislation passed in 1999. This legislation required all large forest landowners to manage forest roads constructed or used for timber harvest and other forest activities after 1974 under an approved road maintenance and abandonment plan (RMAP) by July 1, 2006. The legislation also stipulated that all forest roads must be improved and maintained to the standards established in WAC 222-24 by 2016. DNR completed a full stream-crossing assessment in 2001 and a road assessment for all forested state trust lands in 2006.

Under the HCP, DNR made a commitment to develop and institute a process to achieve comprehensive, landscape-based road network management. The major components of this process include the following:

- Minimization of active road density.
- A site-specific assessment of alternatives to new road construction (for example, yarding systems) and the use of such alternatives where practicable and consistent with conservation objectives.
- A baseline inventory of all roads and stream crossings.
- Prioritization of roads for decommissioning, upgrading, and maintenance.
- Identification of fish passage blockages caused by stream crossings, and a prioritization of their retrofitting or removal.

DNR evaluates overall active road density through forest land planning (completed for the South Puget and OESF HCP Planning Units). The department conducts site-specific assessments of alternatives to new road construction at the operational level when planning individual activities, and DNR addresses the last three components of this process through implementation of RMAPs.

As part of meeting HCP annual reporting requirements, DNR tracks and reports on the number of road miles constructed (newly built roads), reconstructed (existing roads improved to a timber-haul

standard), decommissioned (roads stabilized and made impassable to vehicular traffic), or abandoned (roads stabilized and abandoned to forest practices standards), as well as total active forest road miles and the total number of fish barriers removed.

Unlike other activities, road management activities are reported on a calendar year (rather than fiscal year) basis because the end of the fiscal year is at the start of the busiest time of the construction season. Most road work is subject to a hydraulic “work window” that limits in- or near-stream work to the summer (typically June 15 through September 30).

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Easements and Road Use Permits

DNR generally grants access across its lands, and acquires access to its lands, through easements and road use permits. Easements are long-term (typically permanent) agreements in which property owners grant the rights to cross their land to another individual or entity. Easements are an interest in real property, and most transfer with the land, serving landowner after landowner. DNR also receives easements when it acquires lands.

Road use permits are usually short-term rights that do not convey any interest in property and are revocable by the entity that grants them. Permits are generally non-transferrable.

DNR primarily grants easements and road use permits to other governmental entities for public roads and utilities, and to forest and agricultural landowners for access to valuable materials such as timber or rock. DNR also grants easements and road use permits for many other uses such as irrigation pipelines and railroads. The department acquires easements and road use permits from private individuals and government agencies to allow staff to access DNR-managed lands.

Unlike other categories of non-timber activities, DNR does not report easements and road use permits on a cumulative basis. Only new easements and permits that create a new “footprint” on state trust lands managed under the HCP are reported for each fiscal year. These include easements for new roads and utilities. DNR does not have a system to tally total easement acres, primarily because many easements were granted in the early 1900s and hand-entered on records that are now archived.

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Land Transactions

DNR’s Land Transactions Program is designed to reposition state trust lands for better long-term management and increased revenue for each of the trusts. Repositioning simply means disposing of properties that do not fit DNR’s management strategies or objectives and acquiring replacement properties that are more suitable. When DNR sells parcels at public auction or transfers (sells) them to other public owners, the department uses the proceeds to acquire replacement lands for the trusts to keep the trust whole.

Land transactions affect the amount of habitat or potential habitat on state trust lands. Transactions may be carried out to consolidate state trust lands in certain areas. Consolidation allows for more cost-effective management and offers opportunities to optimize trust revenue while maintaining habitat and allowing public recreation where appropriate. DNR often consolidates state trust lands by working with owners of adjacent lands to trade their properties for scattered parcels of state trust lands elsewhere.

Often, lands that DNR identifies for disposal are better suited to other public benefits, such as parks or habitat for rare, native species. The department may transfer state trust lands out of trust status into protected status as a NAP or NRCA in the Natural Areas Program. DNR may also transfer state trust lands to other government agencies to be used as parks or open space or for public facilities. When this happens the department compensates the trust at fair market value and acquire replacement properties to maintain trust assets over time. Acquired lands are assessed to determine if they should be included as HCP permit lands (managed subject to the commitments in the HCP). If they are found to qualify, DNR determines whether they should be designated as northern spotted owl NRF or dispersal management areas. DNR also assess their potential role in other HCP conservation strategies.

Some state trust lands have important social or ecological values. These state trust lands are best managed for protection of these special values and uses, rather than for income production. These lands may be candidates for the [Trust Land Transfer Program](#), which applies only to Common School trust lands. Through this program, DNR transfers state trust lands to WDFW, the State Parks and Recreation Commission, county governments, city governments, or the Natural Areas Program. The value of the timber (which is not cut) is given to the common school construction account, which helps fund K–12 schools statewide. The value of the land is used to purchase replacement property for the trust. State trust lands transferred to the Natural Areas Program contribute to the objectives of the HCP. State trust lands that are transferred to entities outside of DNR are evaluated for their HCP conservation value. If their conservation value is high, the department either does not transfer them, or DNR issues a deed restriction stipulating their continued management under the HCP.

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Natural Areas Program

DNR's Natural Areas Program protects outstanding examples of the state's extraordinary biodiversity. Lands managed under this program represent the finest natural, undisturbed ecosystems in state ownership and often have one-of-a-kind features unique to this region.

The Washington State Legislature established the system of Natural Area Preserves (NAPs) in 1972 to protect the highest quality examples of native ecosystems, rare plant and animal species, and other natural features of state, regional, or national significance. The Washington State Legislature established the system of Natural Resources Conservation Areas (NRCAs) in 1987 to protect areas that are a high priority for conservation because they contain critical wildlife habitat, prime natural features, or examples of native ecological communities. Together, these natural areas include Puget prairies, estuaries, native forests, bogs, ponderosa pine forests, shrub steppe communities, alpine lakes and meadows, scenic vistas, and significant geological features. These areas provide opportunities for research, education and, where appropriate, low-impact public use. In addition, these areas help meet statewide conservation priorities and DNR's HCP obligations.

Habitat for Listed, Candidate, and Sensitive Species

Statewide, Washington's natural areas protect nearly 158,000 acres in 56 NAPs and 36 NRCAs. More than 120,000 of those acres fall within the area managed under the HCP, protecting habitat for 15 species listed as threatened or endangered under the ESA and another 38 special status species. This total includes 75,000 acres that DNR has added to the program since the HCP was signed in 1997. An additional 17,800 acres have been added to the program since 1997 in areas not managed under the HCP. Outside of HCP-managed areas, the Canada lynx (*Lynx canadensis*) is found in the Loomis NRCA, the Loomis NRCA and Chopaka Mountain NAP support substantial populations of

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whitebark pine (*Pinus albicaulis*) (determined in 2011 to be a candidate species for federal listing), and several natural areas provide suitable habitat for grizzly bears (*Ursus arctos horribilis*).

Federally listed species living on natural areas include the largest and healthiest population of golden paintbrush (*Castilleja levisecta*); the largest and most viable population of Wenatchee Mountain checker-mallow (*Sidalcea oregana* var. *calva*); the only Washington population of Bradshaw's lomatium (*Lomatium bradshawii*); the second-largest population and Washington's highest-quality native habitat for the Oregon spotted frog (*Rana pretiosa*), one occurrence of the Tenino subspecies of the Mazama pocket gopher (*Thomomys mazama*), more than 15 established territories for the northern spotted owl (*Strix occidentalis caurina*); and waters that contain listed runs of Lower Columbia and Puget Sound Chinook salmon (*Oncorhynchus tshawytscha*), coho salmon (*Oncorhynchus kisutch*); steelhead trout (*Oncorhynchus mykiss*), and bull trout (*Salvelinus confluentus*). Ten of DNR's natural areas contain occupied marbled murrelet (*Brachyramphus marmoratus*) sites. At South Nema NRCA, more than 30 marbled murrelet occupancies have been recorded, including a confirmed murrelet nest site.



Golden Paintbrush at Rocky Prairie NAP
DNR's natural areas provide habitat for federally listed species such as the Golden Paintbrush (*Castilleja levisecta*). Photo courtesy of David Wilderman.

Natural areas also provide habitat for other sensitive species (federal species of concern, state-listed, state candidate, and others) identified in the HCP. Examples include butterflies like the Valley silverspot (*Speyeria zerene bremnerii*) and Puget blue (*Icaricia icarioides blackmorei*) that are associated with prairie habitat, amphibians like the Larch Mountain salamander (*Plethodon larselli*) that depend on forested talus slopes, birds like the harlequin duck (*Histrionicus histrionicus*) that are associated with mountain streams and rivers, bats that depend on maternal colonies like the colony found at Woodard Bay NRCA, and mammals like the California bighorn sheep (*Ovis canadensis sierrae*) in Morningstar NRCA that depend on high-elevation rocky outcrops and alpine communities.

Native Forests

A number of DNR's natural areas were established because of their high-quality native forest ecosystems. These areas are dominated by mature and/or late-seral forests. Late-seral forests and trees with potential nesting platforms are important to both the northern spotted owl and the marbled murrelet. The native forests on these natural areas also represent some of the highest quality examples of globally imperiled forest ecosystems.

Estuaries

In the Natural Areas Program, there are five high-quality estuaries, including three on Washington's coast and two on the shores of the Puget Sound. These sites protect rare tidal wetland communities and provide important foraging and cover habitat for anadromous fish during the critical transition from a freshwater to a marine environment. In addition, estuaries help dissipate potentially damaging wave energy before it reaches the land and provide a sink for sediments and wastes derived from both land and sea. Estuaries are some of the most biologically productive systems in the world.

Rare Species

NAPs and NRCAs protect a broad representation of ecological communities and contribute to the conservation of many species, which is important since DNR’s inventory of the state’s biodiversity is incomplete. For example, Mima Mounds NAP was originally established to protect unusual geologic formations and high-quality prairie habitat. DNR recently learned that it also has the only known population of the ground-dwelling lichen *Cladonia ciliata* in the United States. Similarly, North Bay and Carlisle Bog NAPs were established to protect high-quality wetlands. DNR later discovered that they both contain populations of the rare Makah copper butterfly (*Lycaena mariposa charlottensis*).

Restoration and Research

DNR is actively working to restore and enhance habitat for special-status species at a number of NAPs and NRCAs. At Mima Mounds and Rocky Prairie NAPs, for example, DNR is using prescribed fire, invasive species control, and seeding of native grassland plants to restore native prairie habitats that have been heavily fragmented and degraded over most of their range. The Natural Areas Program is restoring and enhancing oak woodland habitat at two sites (Washougal Oaks NAP/NRCA and Bald Hill NAP) by removing competing conifer trees, planting oak seedlings, and replanting native understory species. In addition, DNR is restoring Puget Sound estuary and near-shore habitats at Stavis and Woodard Bay NRCAs by removing bulkheads, fill, and creosote-treated structures.



Oregon Spotted Frog

DNR’s natural areas provide habitat for Oregon spotted frogs (*Rana pretiosa*) and other amphibians. Photo courtesy of W.P. Leonard.

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Special Forest Products

Special forest products are Christmas greens, medicinal plants, western greens (typically used by florists), mushrooms, or other items that can be harvested from forested state trust lands but do not fall into traditional timber or fiber categories. DNR promotes commercial and/or recreational harvest of special forest products when doing so will benefit the trusts and will have an insignificant, or *de minimis*, impact on the environment. Permits are selectively granted to prevent habitat degradation.

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Oil and Gas Leases

Oil and gas exploration leases allow a lessee to reserve the right to explore for underground deposits. With a DNR-approved plan of operations and the proper drill permit, the lessee has the sole and exclusive right to explore for, drill, extract, or remove oil and gas. However, any proposed on-the-ground activities must undergo State Environmental Policy Act (SEPA) review and have a plan of operations, which must be approved by DNR.

If the lessee wants to actively drill or thump (measure seismological tremors caused by the dropping of large weights or detonation of explosives), the lessee must obtain an “active” lease, which also includes acquiring a drilling permit. Regulations exist to protect water and air quality, and any

exploration holes must be plugged following use. Any new permits are subject to SEPA review. There has been only one active oil and gas lease involving drilling on lands that are now managed under the HCP (in 1996), and the well has since been abandoned and plugged.

Prospecting Leases and Mining Contracts

Like oil and gas leases, prospecting and mining leases are exploration agreements that allow a lessee to search for mineral deposits. A lease must be converted to a contract before the lessee can begin active mining operations. Before any surface-disturbing work is conducted, the lessee must submit a plan of operations for review and approval. In 1996, when the HCP was written, there were no active mining operations (activities that actually extract minerals) on lands managed under the HCP. There have not been any since.

Grazing Permits and Leases

Most DNR-managed grazing takes place on non-forested state trust lands east of the Cascade crest on lands that are not managed under the HCP. Grazing is selectively allowed on forested state trust lands managed under the HCP in both eastern and western Washington, though the number of acres permitted in western Washington is minimal.

In eastern Washington, state trust lands are grazed under permits and leases. Permits cover large acreages, and each permit includes a resource management plan with ecosystem standards that must be met, such as turnout and removal dates and the number of animals allowed on the range. Leases cover smaller areas than permits, and they include a resource management plan. These leases can allow grazing at any time during the year, as long as guidelines in the plan are followed.

DNR's current tracking methodology does not distinguish acres of grazing on forested versus non-forested state trust lands in eastern Washington. Thus the number of acres reported for grazing may be inflated. As that tracking methodology is refined, DNR should be able to separate forested from non-forested grazing to improve the accuracy of reports.

Land transactions, including large-scale exchanges can influence which lands will be managed under the HCP and where grazing will be allowed.

Communication Site Leases

Communication site leases allow private and public entities to build new towers or attach communication equipment to existing towers (for example, cell phone towers). These sites typically are located on non-forested mountaintops or along second-growth highway corridors and are less than an acre in size. They are accessed by the same road systems used for forest management activities and are subject to the same management practices.

Special-Use Leases

Special-use leases are issued for a wide variety of commercial and other uses on state trust lands. Some examples include golf courses, small commercial businesses and buildings, commercial recreation facilities, colleges, takeoff or landing sites for paragliding, governmental or public use facilities, honeybee hive sites, and stockpile sites. Special use leases do not cover major urban commercial uses or aquatic land uses. Often, but not always, these leases are for "interim uses," and, as such, they contain language that allows for termination should DNR choose to take advantage of a "higher and better use" of the land.

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Valuable Materials Sales

Rock, sand, and gravel (valuable materials) sales from commercial pits are handled under special sale contracts. Most of DNR's active commercial pits are not in forested areas. Generally, the few commercial contracts DNR maintains on forested trust lands are small sales from silvicultural pits (pits used primarily for construction of forest roads).

The number of silvicultural pits and inactive commercial pits was not tracked until fiscal year 2003, when DNR initiated an inventory of all such pits. Since the initial inventory, changes—such as abandoning pits or creating new ones—have not been consistently tracked.

Early in the implementation of the HCP, DNR had a substantial number of rock, sand, and gravel sales. Since then, that number has decreased. This primarily is due to two factors: (1) the lengthy contract-development process, including requirements for more valuable or long-term contracts to be reviewed and approved by the Board of Natural Resources; and (2) periodic changes to keep contracts alive regardless of whether or not there were removals. Most rock, sand, and gravel sales are now from private pits, which have fewer time and procedural constraints. Direct sales are one-time agreements that remove only small amounts of a resource (a maximum of \$25,000 in value) and do not require Board of Natural Resources approval. Other (non-direct) sales are active for longer periods of time and/or have larger maximum removal value limits.

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Recreation Sites

Recreation sites allow public recreation on forested state trust lands as long as it is compatible with state laws and the objectives of the *Policy for Sustainable Forests* and the HCP. Sanctioned recreational activities on state trust lands include hiking, biking, horseback riding, off-road vehicle use, hunting, fishing, gathering, and camping. DNR's vision statement for recreation and public access is to "Manage public and trust lands in a manner that provides quality, safe recreational experiences that are sustainable and consistent with DNR's environmental, financial and social responsibilities." DNR is developing recreation plans for many of the areas it manages. Plans are developed with extensive involvement of local recreation groups and the public, many of whom also volunteer to help maintain recreation sites.

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Appendix B: Glossary

This appendix contains a glossary of terms used in this annual report.

A

Abandoned road: A road that is stabilized and removed from use to Washington forest practices standards, including removing water crossings, providing erosion control, and making the road impassible to vehicles.

Activity objective: A measurable and possibly transient condition sought at the conclusion of an activity, such as a certain number of trees left following a timber harvest to serve as habitat and a seed source.

Adaptive management: A process of periodically reviewing and adjusting management practices based on feedback from internal and external research and monitoring.

Aerial herbicide: Application of herbicides from a helicopter or plane to achieve site preparation or vegetation management objectives.

Aerial pesticide: Application of an insecticide or other pesticide from a helicopter or airplane.

Age class: A grouping of trees in the same age group used to simplify data that describes age composition for a stand or landscape. Age classes are often divided into decadal groups to portray the distribution of tree ages within a stand, or stand origin dates on a landscape.

Animal repellent: Chemicals or other products applied to discourage animals from damaging seedlings.

B

Biosolids: The nutrient-rich organic materials resulting from the treatment of sewage sludge. When properly treated and processed in a sewage treatment facility, biosolids can be safely applied as fertilizer to maintain productive soil and stimulate tree growth.

Blowdown (windthrow): A tree that has been knocked over or had its top blown out by wind.

Broadcast burn: Allowing prescribed fire to burn over a designated area to achieve site preparation or vegetation management objectives.

C

Certification: See forest certification.

Clearcut: According to Washington forest practices rules, a clearcut is a harvest method in which the entire stand of trees is removed in one timber harvesting operation. In the 1990s, DNR began doing variable retention harvest instead of clearcuts on the majority of its timber sales. However, between the adoption of the State Trust Lands Habitat Conservation Plan in 1997 and fiscal year 2008, variable retention harvests were still being reported as clearcuts even though the majority of

those harvests met the definition for variable retention harvest. Since 2009, few acres have been reported as clearcuts.

Commercial thinning: Commercial thinning generates revenue and is performed to meet a wide range of objectives including improving the growth of the stand, enhancing stand health, reducing tree mortality, or accelerating the development of habitat. Regeneration of a stand is not an objective of thinning.

D

dbh: Diameter at breast height, which is the diameter of a tree measured 4.5 feet above the ground on the uphill side of the tree.

De minimis: A legal term for a level of activity that is too small or insignificant to merit consideration.

Decommissioned road: A road made impassible to vehicles.

Demography: The study of populations or communities, including births, deaths, movement, and distribution.

Desired future condition: A set of parameters that can be compared to current conditions, showing any management changes needed to achieve specific goals. In the Administrative Amendment to the Northern Spotted Owl Conservation Strategy for the Klickitat Habitat Conservation Plan Planning Unit, DFC habitat represents a sustainable set of stand characteristics (canopy closure level, maximum tree height, etc.) that could realistically be achieved in a 60-year old stand that has been properly managed.

Direct sale: A one-time agreement that removes only small amounts (a maximum of \$25,000 in value) of a resource such as gravel or trees from state trust lands and is not subject to public auction or advertisement.

Dispersal habitat: Habitat used by northern spotted owls when moving from one area of nesting, roosting, and foraging habitat to another, often to establish new breeding sites.

Dispersal: The movement of an animal from one subpopulation to another or movement from one area to another, often to establish a new nesting area.

E

Easement: Permission given by one person or business to another, allowing one to access their property by crossing through property owned by the other.

Ecoregion: An area with generally similar ecosystems and types, quality, and quantities of environmental resources. It is designed to provide a spatial framework for research and monitoring of ecosystems and their components.

Effectiveness monitoring: For the State Trust Lands Habitat Conservation Plan, a system used to determine whether or not a management plan and its specific strategies are producing the desired habitat conditions.

Endemic: A species that is a native of, prevalent in, or confined to a specific region.

Equestrian highline: A rope stretched taut between two secure uprights above the animal’s head. The stretched rope has tie loops spaced for securing horses or other stock with lead ropes. Sturdy trees are used as anchors for highlines. When trees are not available, posts set in concrete may serve as uprights.

Even-aged management: A set of final harvest systems defined as a method to “regenerate a stand with a single age-class” (Society of American Foresters). For purposes of managing forested state trust lands, even-aged includes final harvest systems of clearcut, seed tree, variable retention harvest, and shelterwood.

F

Fencing: See shielding

Final harvest: The harvest that signifies the end of a rotation by harvesting trees within a forest management unit in order to make room for regeneration of a new stand.

First order stream: A stream that does not have any other streams intersecting or feeding into it.

Forest certification: A confirmation process by an independent auditor that shows that a landowner manages forests by a set of standards that demonstrate environmentally responsible, socially beneficial, and economically viable practices. It is also known as “green” certification.

Forest fertilization: Ground or aerial-based fertilization of forest stands using chemical fertilizers or biosolids to enhance growth.

Forest land planning: A DNR process—focused at the scale of State Trust Lands Habitat Conservation Plan planning units—to integrate sociocultural, economic, and ecological issues into management strategies for forested state trust lands.

Forest management unit: A forested area with conditions that are ecologically similar enough to allow it to be managed to obtain specific objectives; the unit for which a silvicultural prescription is written.

Forest practice: Any activity conducted on or directly pertaining to forestland and relating to growing, harvesting, or processing timber or forest biomass, including but not limited to road and trail construction, harvesting (final and intermediate), pre-commercial thinning, reforestation, fertilization, prevention and suppression of diseases and insects, tree salvage, and brush control.

Forest Practices: The administrative branch of DNR responsible for regulating forest-practice activities on all state and private forestlands.

G

Grazing lease: A DNR lease agreement covering smaller areas of land (as compared to the larger rangeland of a grazing permit) which includes a resource management plan to protect natural resources. It allows grazing at any time of year as long as the plan’s guidelines are followed.

Grazing permit: A DNR agreement covering large areas that includes a resource management plan containing specific details regarding the number of animals allowed and when the animals may be on the land.

Ground herbicide: Ground-based applications of herbicides used to achieve site preparation or vegetation management objectives. Using ground herbicides allows for application in smaller work areas, thus avoiding spraying areas where herbicides are not desired (i.e., streams, wetlands, and adjacent properties).

Ground mechanical: In forestry, using mechanized equipment to achieve site preparation objectives.

H

Habitat conservation plan: A long-term management plan authorized under the Endangered Species Act to conserve threatened and endangered species across a large landscape while allowing activities to occur under specific conditions.

Hand planting: In forestry, planting seedlings of various species or species mixes.

Hand cutting: In forestry, using hand-held equipment to cut stems of existing vegetation to achieve site preparation or vegetation management objectives, such as removing invasive species.

Habitat Conservation Plan permit lands: Lands that are managed subject to the commitments in the State Trust Lands Habitat Conservation Plan.

Headwater stream: A small, first- or second-order stream that forms the beginning of a river. It is often seasonal and forms where saturated ground flow first emerges as a recognizable watercourse.

I

Implementation monitoring: A form of monitoring that determines whether or not a management plan (for example, the State Trust Lands Habitat Conservation Plan) or its components are implemented as written.

Inholding: A parcel of land owned by one party that is entirely surrounded by another ownership. In terms of DNR land transactions, private land surrounded by state-owned property.

L

Landslide hazard zonation: A screening tool in which watershed-scale maps are created that show and describe all areas of potentially unstable slopes in a watershed as well as potential mitigation measures to minimize damage.

Large, structurally unique tree: A tree that is tall and/or has a large diameter and contains structural elements which are important for habitat such as a hollow trunk, broken top, open crown, or large strong limbs.

Late-rotation thinning (or, older-stand thinning): A partial-cut timber harvest that extends the rotation age of a stand, generally to more than 80 years, or achieves a visual or habitat objective that requires larger trees. Stands eligible for late-rotation thinning are typically 45 to 70 years old and contain a diversity of tree sizes.

Leave tree: A live tree left on a timber sale after harvest, intended to provide habitat and structure in the developing stand.

LiDAR: Short for “light detection and ranging,” a remote sensing technology that uses lasers to detect distant objects and determine their position, velocity, or other characteristics by analyzing reflections. It has a wide variety of uses, including measuring tree canopy heights, making topographical maps, and mapping floodplains.

M

Marbled murrelet management area: Proposed areas managed to protect occupied sites and develop future marbled murrelet habitat in areas that are not occupied.

N

Natural area preserve: A state-designated area that protects a high-quality, ecologically important natural feature or rare plant and animal species and their habitat. It often contains a unique feature or one that is typical of Washington State or the Pacific Northwest.

Natural regeneration: Allowing naturally produced seedlings to grow after harvest and produce a new forest without human intervention. DNR assesses success by carrying out a thorough regeneration survey of the stand.

Natural resources conservation area: A state-designated area managed to protect an out-standing example of a native ecosystem or natural feature; habitat for endangered, threatened, or sensitive species; or a scenic landscape.

Nesting, roosting, and foraging habitat: A forested area with the right forest structure, a large enough size, and adequate food to meet the needs of a nesting pair of northern spotted owls.

Next-best stands: Within spotted owl management units that are below the habitat threshold, next-best stands are considered non-habitat, but are predicted to attain the structural characteristics that define northern spotted owl habitat either through passive or active management relatively sooner than other non-habitat stands. Next best stands count towards the target amount of suitable habitat, but are still considered non-habitat. Remaining stands not identified as habitat or next best are available for the full range of silvicultural activities.

No-role lands: A term used by DNR’s Land Transactions Program to refer to lands not designated as a nesting, roosting, and foraging, dispersal, or desired future condition management area and thus having no role in northern spotted owl management under the State Trust Lands Habitat Conservation Plan.

Non-commercial pit: Also called a “silvicultural pit.” A rock, sand, or gravel pit primarily used to supply materials for DNR’s silviculture-related activities, primarily building forest roads and logging landings.

O

Oil and gas lease: An agreement that allows the leaseholder to reserve the right to explore for underground oil and/or gas deposits on state trust land. Before active drilling or thumping can occur, the proposal must undergo State Environmental Policy Act review and have a plan of operations approved by DNR.

Overstory: The upper canopy in a multi-canopy stand.

P

Pest management: Treatments or management decisions designed to prevent pest populations from reaching levels that present an unacceptable risk of damage to forest stands.

Phased patch regeneration cut: An even-age timber harvest method using small patch cuts (one to five acres) to progressively harvest and regenerate a single stand over a period of up to 15 years. Several separate patches are simultaneously harvested within a forest management unit. After an adequate green-up period (five to ten years), additional patches are harvested and the process is repeated until the forest management unit is completely harvested.

Pile and burn: A process where logging slash is placed in piles, generally using mechanized equipment, and the piles are burned under controlled conditions.

Planning unit: In the State Trust Lands Habitat Conservation Plan, a management unit based on large watersheds. The approximately 1.8 million acres managed under the Habitat Conservation Plan are divided into nine planning units to allow for more efficient planning and management.

Pre-commercial thinning: Removal of less desirable trees to maintain the growth and stability of retained trees. Pre-commercial thinning is performed before the trees are large enough to be marketable. This type of thinning does not generate revenue, and cut trees are left on site to decompose.

Prospecting and mining lease: An exploration agreement that allows the holder to search for mineral deposits on state lands; if the leaseholder wants to begin active mining operations (extraction and removal of valuable materials) that could alter habitat, they must convert the lease to a contract which includes a plan of operations and undergoes State Environmental Policy Act review.

Q

Quadratic mean diameter: The measure of average tree diameter, conventionally used in forestry. The quadratic mean diameter is the diameter of a tree with average stand basal area.

R

Radio telemetry: A tracking system in which wildlife are outfitted with collars that transmit individual signals that can be monitored to track their movement.

Rain-on-snow zone: Generally, an elevation band in which it is common for snow pack to be partially or completely melted during rainstorms several times during the winter.

Relative density: A mathematically derived parameter that indicates the level of intra-stand competition between trees, and consequently, a theoretical optimal range for thinning. Relative density guidelines for thinning vary by species and sometimes other factors, such as climatic zones. A commonly used version of relative density is formally known as Curtis' RD after Bob Curtis, a United States Forest Service biometrician who developed the measure.

Reclassified habitat: Two classes of marbled murrelet habitat, identified based on a predictive model:

5. Marginal habitat: Those lands expected to contain a maximum of five percent of the occupied sites on state trust lands within each State Trust Lands HCP planning unit. These areas were

made available for harvest. All known occupied sites were deferred from harvest, and were not included in this habitat designation.

6. Higher-quality habitat: In contrast to marginal habitat, those lands expected to contain at least 95 percent of the occupied sites on state trust lands within each HCP planning unit. This habitat is frequently referred to simply as “reclassified habitat.”

Recreation plan: A DNR document for a forest block or landscape outlining what types of recreation are appropriate in what portions of that block or landscape, as well as what facilities are needed. It includes broad management guidelines and a plan to implement them.

Regeneration: The act of renewing or reestablishing tree cover in a forest by establishing young trees through natural seeding or planting sites—usually those sites that were harvested or burned in a wildfire.

Repositioning: A land transaction process in which DNR exchanges, sells, or transfers state trust land, using the proceeds to acquire more suitable property for the affected trust(s). Repositioning occurs on lands that do not fit with management strategies or that are not appropriate for long-term revenue production for the trusts.

Riparian desired future condition: In the Riparian Forest Management Strategy, the riparian desired future condition refers to six measureable target stand conditions that are intended to eventually develop into the Fully Functional stand development stage.

Riparian management zone: A buffer of trees and shrubs applied along a stream to protect the stream and habitat for salmon and other species.

Road abandonment: The permanent closure of forest roads in compliance with DNR guidelines and state forest practices standards. Abandonment work includes placing road barriers to prevent vehicle traffic, removing all culverts and bridges, and vegetating exposed soils to prevent erosion and sediment delivery to surface waters. In some circumstances, the road prism is rehabilitated to resemble the conditions that existed prior to road building. Abandoned roads are exempt from further maintenance.

Road construction: The building of new roads in compliance with DNR policy and state forest practices standards.

Road maintenance and abandonment plan: A plan that covers all forest roads on a landowner’s property constructed or used for forest practices after 1974. It is based on a complete inventory that also shows streams and wetlands adjacent to or crossed by roads. The plan lays out a strategy for maintaining existing roads to meet state standards and shows areas of planned or potential road abandonment.

Road reconstruction: A process of bringing existing roads back to drivable conditions in compliance with DNR policy and state forest practices standards.

Rotation: The length of time between when a stand of trees is planted or naturally regenerates and when a final harvest occurs.

S

Salvage cut: A type of timber harvest used to log trees that are dead, dying, or deteriorating due to fire, insect damage, wind, disease, or injuries.

Seed tree intermediate cut: The first timber harvest in a series conducted as part of the even-aged seed tree silvicultural harvest system. The purpose is to provide a desirable seed source to establish seedlings. Typically, about ten trees per acre may be left following this harvest; once the new trees are established, some of these seed trees may be harvested.

Selective product logging (selective cutting): A timber harvest that removes only specific species from certain size classes which are highly valuable, for example trees that function well as poles or logs for cabins.

Seral: Relating to the stages of an ecological sere.

Sere: The sequential stages in forest succession; the gradual replacement of one community of plants by another.

Shelterwood intermediate cut: The first harvest in a series of harvests conducted as part of the even-age shelterwood harvest system. The purpose of this harvest is to provide shelter (typically shade) and possibly a seed source for the seedlings that are regenerating in the stand. Compared to a seed tree intermediate cut, a shelterwood typically retains more trees per acre following harvest; retained trees are generally dispersed across the stand.

Shelterwood removal cut: The second or final harvest in a series of harvests conducted as part of the even-aged shelterwood harvest system. The purpose is to remove overstory trees that create shade levels that are too high to allow the new understory to thrive.

Shielding: Using a physical barrier to prevent animals from entering an area and damaging trees or other resources.

Silvicultural pit: Also called a non-commercial pit. A rock, sand, or gravel pit primarily used for construction of DNR forest roads and timber sale landings. DNR sometimes sells valuable materials (rock, sand, or gravel) from silvicultural pits through a one-time direct sale (a sale with a value of no more than \$25,000). Silvicultural pits are distinct from commercial pits, from which DNR sells rock, sand or gravel through direct sales or longer-term leases.

Silvicultural regime: The specific sequence of activities defined in a silvicultural prescription.

Silviculture: The art and science of managing or cultivating trees and forests to achieve particular goals and objectives.

Site preparation: Activities performed to increase the probability of successful regeneration in a harvested unit by reducing slash and/or undesirable plants that would compete with seedlings for nutrients, water, and light. Site preparation may be performed concurrently with logging (by, for example, pulling up and disposing of brush clumps or it may be performed through piling and burning logging slash; through broadcast- or under-burning logging slash; by manually cutting undesirable vegetation; by applying herbicide (aerial or ground) to undesirable tree and brush species prior to planting; or by other methods or combinations of methods.

Slash: The residue (for example, tree tops and branches) that is left on the ground after logging or following a storm, fire, girdling, or delimiting.

Smallwood thinning: A partial-cut timber harvest in young stands (typically less than 40 years of age) that maintains or enhances the stand's growth potential and improves the quality of the remaining trees.

Special forest products: Items that can be harvested from forests but do not fall in traditional timber or fiber categories, such as Christmas trees and boughs, medicinal plants, and floral greens.

Special use lease: A DNR lease for state trust lands that is issued for one of a wide variety of commercial or other uses, often best described as “miscellaneous” uses (for example, golf courses, paragliding landing sites, and public use facilities).

Stand: A group of trees that is similar enough in composition, structure, age, spatial arrangement, or condition to distinguish it from adjacent groups of trees.

Stand development stage: A developmental phase of a forest, defined using a classification system based on the structural conditions and developmental processes occurring within a forest stand.

State Environmental Policy Act: A state law that provides a process for reviewing proposals that require permits or other forms of agency approval. It requires government agencies to consider the potential environmental consequences of their actions and incorporate environmental values into their decision-making processes. It also involves the public and provides the agency decision-maker with supplemental authority to mitigate identified impacts.

State Forest Transfer (State Forest Trust Replacement): A program in which State Forest Trust (formerly known as Forest Board) lands in timber-dependent counties are transferred from trust status to natural resources conservation areas. The state legislature provides funds to pay for the land and timber on certain properties considered not harvestable due to the presence of federally listed endangered species. The timber value is distributed to the counties as revenue, and the land value is placed in an account for purchasing replacement property for the State Forest Trust.

State trust lands: DNR-managed lands held as a fiduciary trust and managed to benefit specific trust beneficiaries (public K–12 schools and universities, capitol buildings, counties, and local services such as libraries).

T

Take: As used in the Endangered Species Act, refers to harming, hunting, wounding, collecting, capturing, or killing an endangered or threatened species or disturbing habitat in a way that disrupts a species’s normal behavior.

Temporary retention first cut: A partial-cut timber harvest in which selected overstory trees are left for a portion of the next rotation. The purpose of this harvest method is to retain overstory trees without diminishing establishment of a new stand. If these overstory trees are left through the entire rotation, the result may be a two-aged stand.

Thumping: The exploration for oil or gas deposits by measuring seismological tremors caused by dropping large weights or by detonating explosives.

Trust land transfer program: A program in which Common School state trust land is transferred from DNR to another public agency or conservation program. The state legislature provides the value of the timber (which is not cut) to the Common School Construction account to build K–12 public schools. The value of the land is placed in an account used to purchase replacement property for the school trust. Land can be transferred to the State Parks and Recreation Commission, Washington Department of Fish and Wildlife, a county or city government, or DNR’s Natural Areas Program.

Trust: A legal term for a relationship in which one person, company, or entity (the trustee) holds title to a property and/or manages it for the benefit of another person, company, or entity (the beneficiary).

Type II thinning: A commercial thinning that increases stand stability and diameter growth, protects existing legacy structures, maintains species diversity, and provides large woody and down woody debris to the forest system.

U

Uneven-aged management: Removal of trees from a multi-aged forest stand while maintaining multiple age classes within that stand. Uneven-aged management is often used on sites with poor soils on which more intensive management is not cost effective. This type of management also may be used in fire-prone areas to mimic the effects of periodic, lower-intensity fires that do not remove all of the trees.

V

Validation monitoring: For the State Trust Lands Habitat Conservation Plan, a data-collection system that determines whether or not certain species respond as expected to habitat conditions created by following a management plan and its strategies.

Variable density thinning: Thinning to create a mosaic of different stand densities, with canopy openings generally between 0.25 and one acre that capitalizes on landforms and stand features. DNR uses variable density thinning to encourage development of structural diversity in areas where spotted owl habitat is needed or to meet other objectives. Diversity is created by thinning to different residual tree densities, retaining large trees, and, in some cases, adding down woody debris and snags.

Variable retention harvest: An approach to harvesting based on the retention of structural elements or biological legacies (trees, snags, logs, etc.) from the harvested stand for integration into the new stand to achieve various ecological objectives. The following threshold targets apply under the State Trust Lands Habitat Conservation Plan:

- Retention of at least eight trees per acre. Of these:
 - At least two per acre are suitable for wildlife, and are from the largest size class,
 - At least three per acre are snag recruits, and
 - At least three per acre are snags, provided that safety requirements are met; if snags are not available, then three live trees will be retained.
- There are at least two down logs per acre of largest size class (but at least 12” on small end by 20’ long).

Vegetation management: Using hand-cutting, herbicide, mechanical, or other means to remove undesirable competing vegetation in a stand after planting but before seedlings become fully established.

Vegetation series: A conceptual grouping of related plant associations that have, in the absence of disturbance, the same predicted, dominant conifer species; also known as potential vegetation. In practice, vegetation series represents a way to stratify growing sites by ecological characteristics that

determine the bounds of tree species occurrence, growth rates, management potential, and vulnerabilities to climate change and other risk factors.

W

Washington Administrative Code: Administrative regulations, or rules, adopted by state agencies to enact legislation and the [Revised Code of Washington \(RCW\)](#).

Windthrow (blowdown): A tree that has been knocked over or had its top blown out by wind.

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