NATURAL RESOURCES

State Trust Lands Habitat Conservation Plan 2019 Annual Report

For Fiscal Year 2019

Published July 2020

▲ A marbled murrelet occupied site in the South Coast HCP Planning Unit. Occupied sites are habitat patches of varying size in which murrelets are assumed to nest based on field observations. The Board of Natural Resources adopted a long-term conservation strategy for the marbled murrelet at its meeting in December 2019.

WASHINGTON STATE DEPT OF NATURAL RESOURCES

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Washington State Department
of Natural Resources
Forest Resources Division

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Acronyms

CEP&RI	Charitable, educational, penal, and reformatory institutions
DAP	Digital aerial photogrammetry
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
GIS	Geographic information system
GNN	Gradient nearest neighbor
HCP	State Trust Lands Habitat Conservation Plan
LPU	Landscape planning unit
LiDAR	Light detection and ranging
LRM	Land Resource Manager
MoRF	Movement, roosting, and foraging
NAIP	National Agriculture Imagery Program
NAP	Natural area preserve
NEPA	National Environmental Policy Act
NRCA	Natural resources conservation area
NRF	Nesting, roosting, and foraging
NSO	Northern spotted owl
NOAA	National Oceanic and Atmospheric Administration
OESF	Olympic Experimental State Forest
ONRC	(University of Washington) Olympic Natural Resource Center
P&T	Planning and tracking
PCT	Precommercial thinning
PhoDAR	Photogrammetric Detection and Ranging
QMD	Quadratic mean diameter
RCW	Revised Code of Washington
RD	Relative density
RFRS	Riparian Forest Restoration Strategy
RMAP	Road maintenance and abandonment plan
ROD	Record of decision
RS-FRIS	Remote-Sensing Forest Resource Inventory System
RVMP	Riparian Validation Monitoring Program
SEPA	(Washington) State Environmental Policy Act
SFT	State forest transfer
SOMU	(Northern) Spotted owl management unit
TLT	Trust land transfer
UAS	Unmanned aircraft system
USFWS	United States Fish and Wildlife Service
USFS	United States Forest Service
WAU	Watershed administrative unit
WCC	Washington Conservation Corps
WDFW	Washington Department of Fish and Wildlife
WTA	Washington Trails Association

Introduction

Appendix: Background on the State Trust Lands Habitat Conservation Plan

Each year, the Washington State Department of Natural Resources (DNR) develops a State Trust Lands Habitat Conservation Plan (HCP) Annual Report based on commitments outlined in the HCP Implementation Agreement. The intended audience is the U.S. Fish and Wildlife Service (USFWS) and the National Oceanic and Atmospheric Administration (NOAA) Fisheries (collectively, "the Services"), and other interested parties.

The HCP Annual Report is a summary of management activities completed on DNR lands managed under the HCP, monitoring and research efforts, and conservation strategy progress. Unless otherwise noted, information about DNR programs included in this report covers fiscal year (FY) 2019 (July 1, 2018–June 30, 2019). In some cases, significant program activities that occurred in FY 2020 are also reported, including DNR's collaboration with the Services on the Marbled Murrelet Long-Term Conservation Strategy.

In FY 2019, DNR's Forest Resources Division continued producing comprehensive reviews of program activities for the HCP Annual Report. This year's comprehensive review focuses on DNR's forest inventory program and the recent transition from a field-based inventory to one largely based on remotely sensed data.

Highlights

In FY 2019 and early FY 2020, DNR accomplished several objectives affecting lands managed under the HCP. Highlights include:

- **The Board of Natural Resources adopted a long-term conservation strategy for the marbled murrelet at its meeting in December 2019.** The adopted murrelet conservation strategy is the product of more than two decades of research and collaboration with scientists and community members throughout western Washington to develop a conservation plan for the federally threatened species. More information can be found in the section on Marbled Murrelet Conservation Strategy Development.
- **The Board of Natural Resources set the sustainable harvest level for timber on state trust lands in western Washington at 4.65 billion board feet for the fiscal year 2015 to 2024 planning decade at its meeting in December 2019.** Using advanced forest modeling techniques, DNR determined a level of timber harvest for present and future trust beneficiaries that balances revenue production with ecological values such as healthy forest ecosystems and habitat for threatened and endangered species.
- **DNR added 931 acres to natural area preserves (NAPs) and natural resource conservation areas (NRCAs) within the area covered by the HCP.** These protection efforts added to 12 existing natural areas. More information can be found in the section on Natural Areas.

Progress Toward Conservation Objectives

Appendix: Background on Conservation Objectives

FY 2019 Northern Spotted Owl Habitat

Appendix: Habitat Type Definitions

DNR's northern spotted owl (NSO) conservation strategy west of the Cascades involves maintaining thresholds of habitat in each spotted owl management unit (SOMU). Most designated nesting, roosting, and foraging (NRF) and dispersal SOMUs have a 50 percent overall habitat target. The Olympic Experimental State Forest (OESF) and South Puget HCP Planning Units each have two-tiered habitat threshold targets which are described later in this section.

Figures 1–3 below show NSO habitat percentages, by HCP planning unit, as they existed on August 15, 2019 when the data was extracted from DNR's geographic information system (GIS).

Five primary factors can affect habitat percentages reported from year to year:

- Land is acquired or disposed through a land transaction;
- Stands are inventoried and their boundaries are refined and/or their habitat type is updated due to growth or an enhancement thinning;
- A regeneration harvest is conducted within habitat in a SOMU that is over the habitat threshold target;
- Refinements are made to cadaster data across the state; or
- Candidate stands in the OESF are thinned to meet habitat requirements.

In some years, none of these factors may occur, while in other years, one or more of these factors may increase or decrease habitat percentages in a SOMU.

Columbia and North Puget HCP Planning Units

In the Columbia and North Puget HCP Planning Units, DNR's habitat goal is to restore and maintain at least 50 percent of NRF and dispersal SOMUs as habitat. Figure 1 shows percent habitat for SOMUs in the Columbia and North Puget HCP Planning Units. Within these units, the Upper Washougal, Upper Skagit South, and Alder SOMUs are above the habitat threshold.

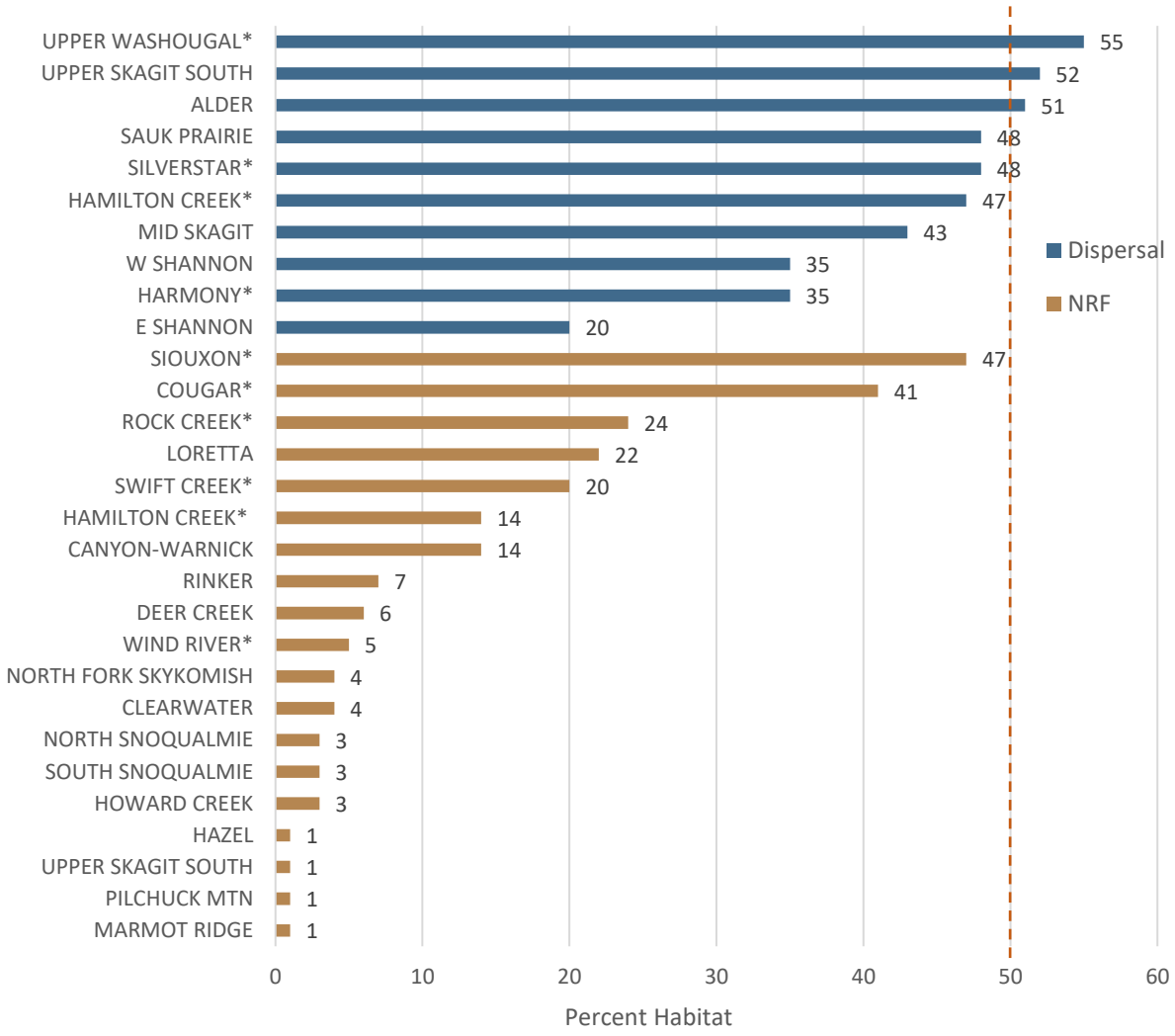


Figure 1: Habitat Percentages by SOMU in the Columbia (*) and North Puget HCP Planning Units as of 8/15/2019. The dashed line represents the habitat target. Habitat has been rounded to the nearest percent. The following NRF SOMUs, all in the North Puget HCP Planning Unit, are not included because they have less than one percent habitat: Sauk Prairie, French Boulder, Spada, Cavanaugh, East Shannon, Ebey Hill, Mid Skagit, Silverton, South Fork Skykomish, Tenas, Upper North Fork Stilly, Upper Skagit North, West Shannon, and Wallace River. Data is from DNR's Forest Resource Inventory System (FRIS). Beginning in FY 20, NSO habitat data in the Columbia and North Puget HCP planning units will be derived from Remote-Sensing Forest Resource Inventory System (RS-FRIS) data.

Olympic Experimental State Forest HCP Planning Unit

In the OESF HCP Planning Unit, habitat is tracked based on 11 Landscape Planning Units (LPUs, also generically referred to as SOMUs). DNR does not designate NRF or dispersal areas in the OESF. In each SOMU, DNR's habitat goal is to restore and maintain a minimum of 40 percent NSO habitat. Of that 40 percent, at least one-half, or 20 percent of the SOMU, must be Old Forest Habitat and the remaining habitat must be Structural or better. Figure 2 shows current total NSO habitat percentages in OESF Planning Unit SOMUs.

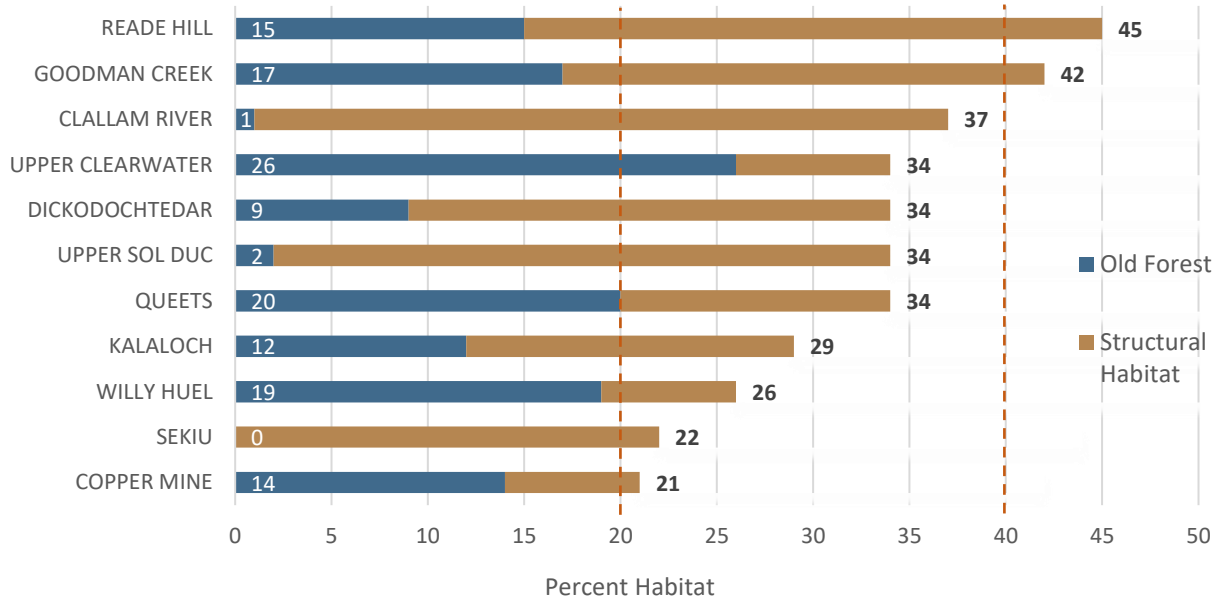


Figure 2: Old Forest and Total Habitat Percentages by SOMU in the OESF HCP Planning Unit as of 8/15/2019. Dashed lines represent habitat targets. Habitat has been rounded to the nearest percent. Data is from FRIS. Beginning in FY 21, NSO habitat data in the OESF HCP Planning Unit will be derived from RS-FRIS data.

South Puget HCP Planning Unit

The South Puget HCP Planning Unit has an overall habitat threshold target of 50 percent for each SOMU. Dispersal management areas have an additional target that at least 35 percent of each SOMU will be movement, roosting, and foraging (MoRF) habitat or better (MoRF Plus). The remaining habitat must be Movement habitat or better (Movement Plus). MoRF and Movement are two habitat types specific to dispersal management areas in South Puget HCP Planning Unit SOMUs identified in the 2010 *South Puget HCP Planning Unit Forest Land Plan Final EIS*. 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 NSO habitat percentages by SOMU in the South Puget HCP Planning Unit.

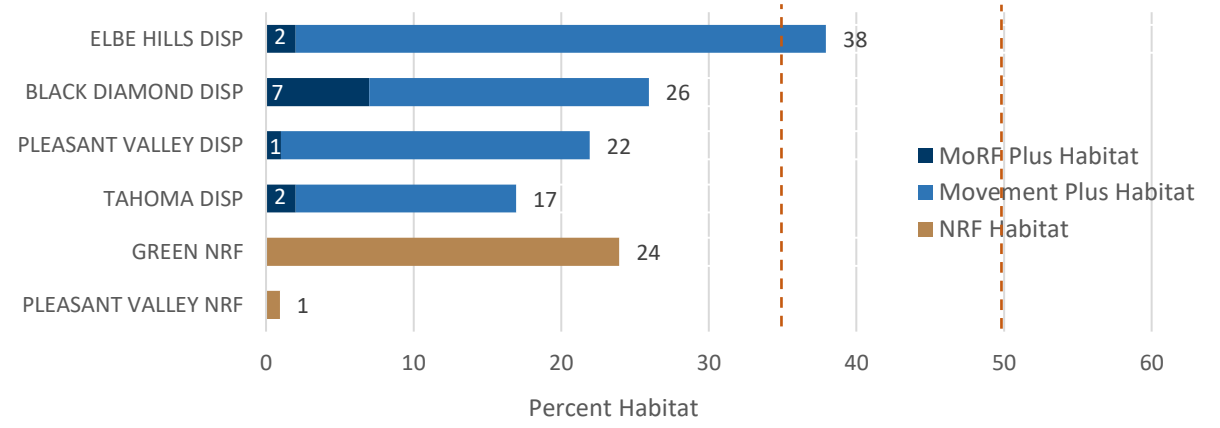


Figure 3: MoRF Plus and Total Habitat Percentages by SOMU in the South Puget HCP Planning Unit as of 8/15/2019. Dashed lines represent habitat targets. Habitat has been rounded to the nearest percent. Data is from FRIS. Beginning in FY 20, NSO habitat data in the South Puget HCP Planning Unit will be derived from RS-FRIS data.

Riparian Forest Habitat Restoration

Appendix: Background on the Riparian Conservation Strategy

Restoration thinning in riparian management zones is conducted under guidance of the Riparian Forest Restoration Strategy (RFRS), the 2006 implementation procedures for the HCP Riparian Conservation Strategy. The RFRS applies to all westside planning units except the OESF and is implemented in concert with the timber sales program. Riparian restoration thinnings are designed to provide growing space to encourage more complex stand structure, maintain overstory tree growth, enhance understory development, and provide large wood to streams. DNR tracks timber sales that include RFRS treatments to ensure that stand conditions are appropriate for treatment and to better understand the role of active management in meeting the HCP's long-term riparian habitat restoration goals.

Figure 4 shows the estimated acreage treated, by DNR region, under the RFRS. Since 2012, more than 2,500 acres have been treated to accelerate development of complex forest structure. DNR does not track riparian stands that would benefit from restoration but where the RFRS was not applied due to stand conditions or operational infeasibility.

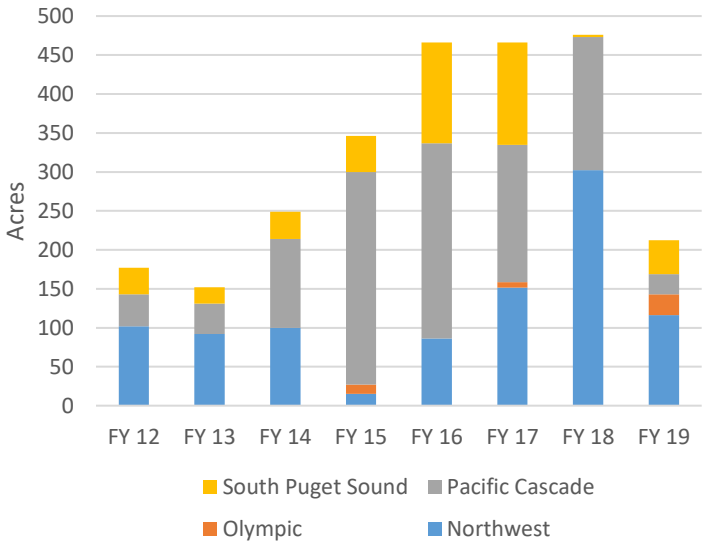


Figure 4: Estimated Acreage of RFRS Treatments by Region. Data for Olympic Region excludes the OESF where the RFRS does not apply. Acreage data for FY 2019 was derived from LRM and reflects RFRS treatments associated with timber sales that were sold in FY 2019. Chart courtesy of Zak Thomas and Hannah Yourd.

For FY 2012–2018, acreage was reported using data from NaturE and Planning and Tracking (P&T), DNR's financial management and previous forest management tracking software, respectively. Beginning in FY 2019, acreage is reported using data from Land Resource Manager (LRM), DNR's forest management tracking system that replaced P&T. LRM is better equipped to track RFRS treatments.

Acreage data for FY 2019 reflects RFRS treatments associated with timber sales sold in FY 2019. This is consistent with DNR's timber sales program which reports volume of timber sold (rather than planned volume or volume of timber removed) to evaluate progress towards sustainable harvest targets. Although LRM was launched in FY 2018, timber sales data in LRM may not yet be complete because the process to plan, sell, and harvest a timber sale typically takes several years. For example, some sales sold in FY 2019 may have been planned using P&T, so data from those sales is not fully captured in LRM. The acreage of RFRS treatments for FY 2019 (Figure 4) may be lower than in previous years due to the ongoing transition from P&T to LRM.

Marbled Murrelet Conservation Strategy Development

Appendix: Background on the Marbled Murrelet Conservation Strategy

Long-Term Conservation Strategy

In September 2019, DNR and the USFWS released a final environmental impact statement (FEIS) on a long-term strategy for marbled murrelet conservation for the six western Washington HCP planning units. The FEIS reanalyzed the eight alternatives from the 2018 revised draft environmental impact statement with updated data. Alternative H in the FEIS, developed to reflect direction from the Board of Natural Resources, was identified as the preferred alternative for both DNR and the USFWS. As described in the FEIS, the preferred alternative protects all occupied sites (Figure 5) with 100-meter buffers (approximately 92,000 acres), creates 20 special habitat areas (approximately 45,000 acres), delays harvest of some habitat until after the first decade of the planning period, and maintains approximately 567,000 acres of land already in conservation status. The preferred alternative also contains conservation measures to manage the impacts of forest management activities including harvest, recreation, road building and maintenance, and other activities that could cause audio-visual disturbance to nesting murrelets.

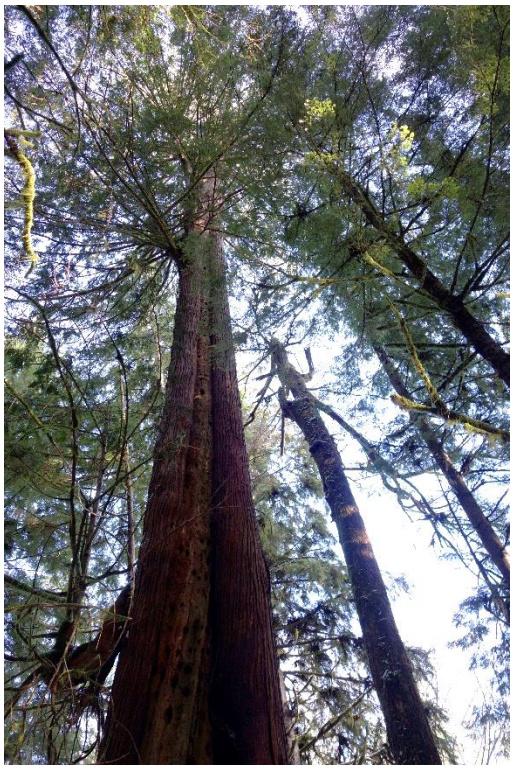


Figure 5: An Occupied Site in the OESF HCP Planning Unit. Photo courtesy of Heidi Tate.

Concurrent with the release of the FEIS, DNR published a proposed amendment to the HCP that would replace the interim marbled murrelet conservation strategy with a long-term strategy representing Alternative H. To more accurately offset take with mitigation, the proposed amendment was modified slightly from Alternative H in the FEIS, with approximately 440 additional acres of long-term forest cover located within three special habitat areas in southwest Washington, and a corresponding reduction of approximately 100 acres in the amount of habitat conserved.

In early November 2019, USFWS published several documents related to the proposed long-term conservation strategy:

- Biological Opinion. This document represents USFWS's biological opinion based on its review of the proposed amendment to the HCP. In it, USFWS concluded that the proposed HCP amendment "is not likely to jeopardize the continued existence of the marbled murrelet or is not likely to destroy or adversely modify designated critical habitat."

- Record of Decision (ROD). In accordance with the National Environmental Policy Act (NEPA), the ROD documents USFWS's decision in response to DNR's application to amend the existing incidental take permit and HCP to include a long-term conservation strategy. The ROD recommended issuance of the amended incidental take permit in accordance with the proposed amendment to the HCP.

- Findings and Recommendations. This document recommended approval of the proposed HCP amendment and the amended incidental take permit in accordance with Section 10 of the Endangered Species Act.
- Incidental Take Permit. USFWS approved the amended incidental take permit on November 14, 2019.

On December 3, 2019, the Board of Natural Resources heard a final presentation on the proposed HCP amendment and voted to approve the amendment through Resolution #1559. Following board approval, DNR began to implement the long-term strategy, including developing procedures for implementing the HCP amendment in compliance with the incidental take permit, providing staff training, and developing methods to track habitat metering, take of habitat, and mitigation.

Interim Conservation Strategy

Negotiations between DNR and the USFWS on the long-term strategy for marbled murrelet conservation began on July 8, 2013, and concluded on December 3, 2019, when the Board of Natural Resources adopted the long-term conservation strategy for the marbled murrelet. More information about the long-term conservation strategy can be found in the previous section on the Marbled Murrelet Long-Term Conservation Strategy. DNR continued to implement the interim conservation strategy described in the HCP until December 3, 2019 when implementation of the interim strategy concluded and the long-term strategy began. This section reports on implementation of the interim strategy through December 3, 2019. The FY 2020 HCP Annual Report will only include data on implementation of the long-term conservation strategy.

In keeping with the 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 the 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 42,358 acres of unoccupied reclassified habitat. Some of that 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). As described in Step 4b of the interim conservation strategy, reclassified habitat within the South Coast and Columbia Planning Units in Southwest Washington was made available for some harvests because more than 12 months had passed since the initiation of 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 the portion of the South Coast Planning Unit that is located south of state Route 8 and south of U.S. Highway 12 between Elma and Aberdeen.

Of the 13,418 acres that were available for harvest under the interim conservation strategy, 3,563 acres, or 27 percent of available acres, were harvested. Table 1 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) as of December 3, 2019 when implementation of the interim strategy concluded.

Table 1: Released Reclassified Marbled Murrelet Habitat.

WAU[1]	Total Acres of Reclassified Habitat	Acres of Released, Reclassified Habitat Available for Harvest	Acres Harvested as of 12/3/2019[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	580	473
Dungeness Valley	1,409	264	129
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	1,440	154	118
Salt	2,417	745	252
Sequim Bay	1,958	450	262
Siebert McDonald	1,856	607	200
Skokomish, Lower NF	71	36	10
Sutherland-Aldwell	1,924	560	242
Twins	731	347	71
South Coast HCP Planning Unit, East of I-5			
Newaukum, Lower NF	5	3	0
Scatter Creek	167	84	22
Skookumchuck, Lower	91	45	35
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
Humptulips, Middle	110	55	66
Humptulips, WF	253	30	1
Joe-Moclips	635	158	33
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	185	0	0
Black River	553	276	1

WAU[1]	Total Acres of Reclassified Habitat	Acres of Released, Reclassified Habitat Available for Harvest	Acres Harvested as of 12/3/2019[2, 3]
Cedar Creek	2,565	1,283	168
Chinook	40	0	0
Cloquallum	2	1	0
Curtis	54	27	0
Delezene	4	0	0
Elk Creek	162	81	2
Elk River	40	20	0
Elochoman, Main	955	478	0
Garrard Creek	1,619	809	1
Grays Bay	846	43	0
Headwaters	688	344	0
Johns River	24	12	0
Lincoln Creek	337	169	33
Main Fork	300	0	0
Mill Creek	1,503	751	244
Mox Chehalis	578	289	11
Naselle Headwaters	1,243	194	0
Naselle, Lower	725	69	0
Nemah	1,450	0	0
Palix	670	161	0
Porter Creek	2,443	1,221	489
Rock-Jones	39	19	0
Skamokawa	2,975	319	0
Smith Creek	34	0	0
South Fork	566	28	0
Waddel Creek	885	443	158
Willapa Headwaters	1,731	866	244
Willapa, Lower	94	44	1
Willapa, SF	728	187	78
Wilson Creek	1	0	1
TOTAL	**42,358**	**13,418**	**3,563**

[1] The Skokomish (Straits); Wishkah, Lower (South Coast, North of Highways 8 and 12); Hanaford (South Coast, East of I-5); and Kennedy Creek (Southwest Washington) WAUs have no reclassified habitat, so they are not displayed in this table.
[2] Data originated in LRM. The LRM data have been overlaid with the Marbled Murrelet Habitat GIS layer, queried 12/13/2019 to identify timber sale activities (sold and completed, FY 2004–Dec. 3, 2019) in released habitat. Values have been rounded to the nearest acre.
[3] Harvested acreage includes blowdown salvage sales as well as traditional harvest treatments.

Adaptive Management

Appendix: Background on Adaptive Management

In FY 2019, DNR's State Lands Adaptive Management Program continued to develop links between scientific research and management. Several projects were published in technical reports and peer-

reviewed journals (see Publications section). Findings from recently completed projects will be presented at the State Lands Adaptive Management Committee meeting in the fall of 2020.

The OESF adaptive management process, which is described in an administrative procedure adopted after the publication of the OESF Forest Land Plan, requires two annual meetings of DNR managers and scientists to identify priority research projects and report project findings and their management implications. The OESF Adaptive Management Advisory Group met in February 2019 to prioritize OESF research and monitoring projects for the FY 19-21 biennium. Eight ongoing and proposed projects were reviewed and ranked. The group also discussed the different types of management adjustments that could be made through the adaptive management process such as changes to staff training, policies, procedures, or guidelines, or updates to the conservation strategies in the HCP.

Implementation Monitoring

Appendix: Background on Implementation Monitoring

DNR-managed state uplands are subject to complex forest management strategies necessary to achieve a variety of economic and ecological objectives. The Implementation Monitoring Program confirms that these strategies are appropriately implemented, identifies areas for continuous improvement, and responds to changing conditions and new information. Implementation monitoring findings are used by DNR managers and field staff to improve practices and reduce the frequency of inconsistencies on the ground.

The 2019 Implementation Monitoring Report described results of a project that compared and tested different remote monitoring methodologies to assess leave tree quantity and spacing in recently harvested stands. The remote methods included mapping of leave trees using four data sources: 1) Photogrammetric detection and ranging (PhoDAR)-derived 3D point clouds produced by unmanned aircraft systems (UAS) imagery; 2) PhoDAR-derived 3D point clouds produced by National Agriculture Imagery Program (NAIP) imagery; 3) NAIP-derived 3D stereo imagery; and 4) light detection and ranging (LiDAR)-derived 3D point clouds. On-the-ground data collection of leave tree locations was also conducted for comparison with the remote methodologies and to assess leave-tree species diversity and post-harvest blowdown frequency. Key findings include:

- Differing results between the data sources highlight the need to use caution when interpreting remotely sensed data.
- For the majority of field-sampled units, species of retained leave trees were generally representative of species present prior to harvest, and Douglas fir was the most common species of leave tree (Figure 6).
- Average leave tree quantity across all field-sampled units exceeded the minimum number required under the multispecies conservation strategy in the HCP.
- Field sampling, while time-intensive, is still the most reliable method to determine operational compliance with leave tree spacing and quantity requirements.

Overall, results indicate field staff are taking a balanced approach to their leave tree strategies by accounting for ecological and operational safety considerations.

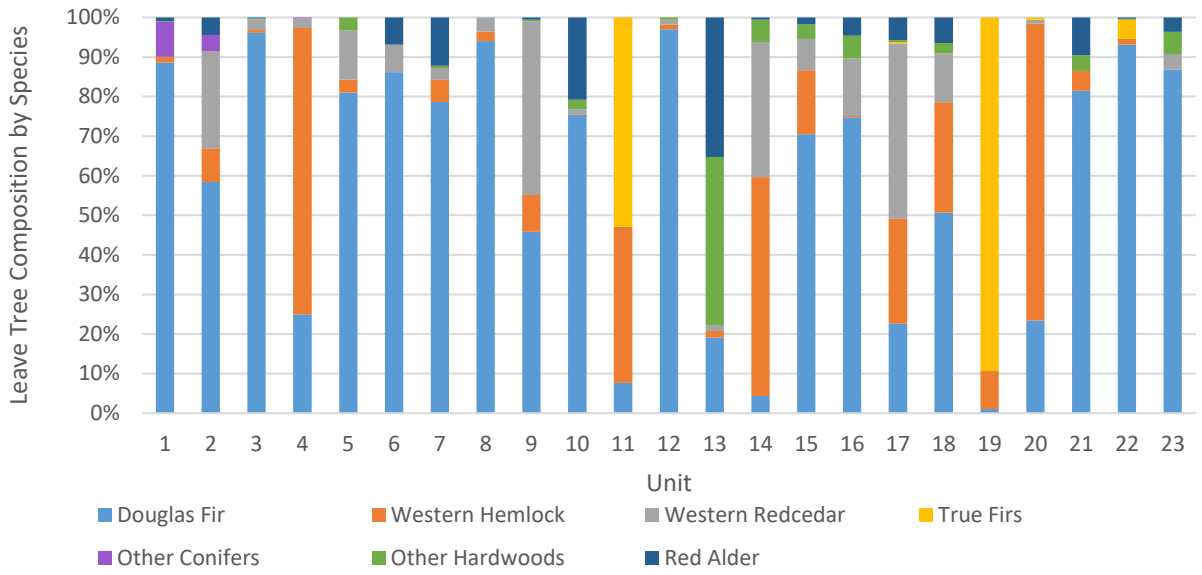


Figure 6: Leave Tree Species Composition as a Percentage of Total Leave Trees for Each Unit. Other hardwoods include bigleaf maple, black cottonwood, cherry, Pacific madrone, and willow. Other conifers include lodgepole pine, Sitka spruce, and western white pine. True firs include noble fir and Pacific silver fir. Chart courtesy of Justin Schmal.

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 following 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 described in the HCP. This section includes annual updates on DNR's effectiveness monitoring programs for spotted owl habitat, aquatic and riparian habitat in the OESF, and riparian silviculture.

Northern Spotted Owl Effectiveness Monitoring Program

The NSO Effectiveness Monitoring Program evaluates changes in habitat, including forest structure and specific habitat features, that result from timber harvest and other management activities carried out under the HCP. The status of the two primary components of this program through FY 2019 is noted below:

1. Long-term tracking of the effects of variable density thinnings (VDTs) on improving habitat structure in stands designated as NSO habitat.

   The first component of this program 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) HCP planning units. 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 and immediately after treatment.

Between 2013 and 2015, the 5- to 7-year re-measurement of all five permanent plots was conducted. Data analysis is currently underway to compare various metrics, such as tree density, canopy closure and cover, snags, and down wood, to measurements taken before and immediately after treatment. The final stage of this analysis involves processing historic aerial images to produce PhoDAR-based metrics of canopy cover for the pre- and post-treatment measurements. This will allow for consistent comparison of canopy cover and closure between the pre- and post-treatment measurements, and the 5- to 7-year re-measurement.

In future years, DNR intends to identify a second set of effectiveness monitoring sites in stands classified as "next-best" NSO stands using Remote-Sensing Forest Resource Inventory System (RS-FRIS) data, with the objective of identifying VDT treatments that accelerate stand trajectory from next-best to habitat. DNR scientists have begun working with the timber sales program to identify planned harvests that may be appropriate for site establishment.

2. Landscape-scale monitoring of basic habitat indicators across the entire westside HCP land base.

   The objective of this project 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 USFS that covers all forestland in Pacific Coast states. Results for this project will soon be updated with the release of additional GNN data that can provide a more current assessment.

In addition to the monitoring activities described above, DNR is also conducting two research projects related to NSO effectiveness monitoring (Mind the Gap, and Westside Individuals, Clumps, and Openings). More information about both projects can be found in the Research section.

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. 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.

In FY 2019, DNR and collaborators from the USFS Pacific Northwest Research Station continued field sampling and data management for nine habitat indicators such as riparian vegetation, stream temperature, and in-stream wood. DNR added six unmanaged or minimally managed watersheds on the western Olympic National Forest to the existing network of four reference watersheds in Olympic National Park and two reference watersheds in the OESF. An adequate sample of reference sites is needed to distinguish between the effects of DNR management and natural disturbances and to assess the natural range of variability in habitat conditions. This mutually beneficial collaboration was made possible through the Good Neighbor Authority, an agreement between DNR and the USFS that allows the agencies to work together to manage public forests and watersheds across jurisdictions.

Researchers used monitoring data from this project to evaluate the outcome of 18 years of passive restoration under the HCP by comparing managed watersheds in the OESF and unmanaged (reference) watersheds using four common indicators (stream temperature, shade, in-stream wood,

and salmonid densities). Over the analysis period, summer stream temperatures decreased and shade levels increased in the managed watersheds compared to the reference watersheds. In-stream wood and age-1 or older salmonids in the managed watersheds appeared to be either stable at reduced levels or declining. Overall, second-growth riparian forests need more time to develop allowing more light into streams (increasing primary productivity), while also allowing for the continuous recruitment of larger pieces of instream wood (improving habitat for salmonids). Active restoration techniques such as addition of instream wood and creation of openings in the riparian forest canopy may help to accelerate salmonid recovery. The results were published in the journal *Environmental Management* and the sixth issue of the newsletter *The Learning Forest*.

The project team also collaborated with the University of Washington (UW) and DNR's Forest Practices Cooperative Monitoring Evaluation and Research Committee to test the use of remotely sensed data for monitoring the status and trends of riparian vegetation. A LiDAR-based model estimating basal area, stand density, and tree diameters from the Cascades was evaluated to determine whether it could be applied in the OESF. Though results indicate that applying inventory models from the Cascades to the OESF, or vice versa, was not accurate, this project created two datasets that the Status and Trends Monitoring team will use in the future: a LiDAR-based model for monitoring riparian vegetation in the OESF, and GPS-delineated locations of riparian monitoring plots.

Riparian Silviculture Effectiveness Monitoring Program

The objective of DNR's effectiveness monitoring program 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. Thinning treatments are consistent with the RFRS and are applied in riparian management zones in cooperation with DNR's timber sales program.

The monitoring program uses an active monitoring approach in which habitat metrics are measured before and after treatment. Treatments consist of thinning to Curtis relative density 40 (RD40) or 50 (RD50), thinning to RD50 with intentional canopy gaps (RD50 gap), or no thinning (REF).

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 2.

Table 2: Treatment Summary and Sampling History of Riparian Silviculture Effectiveness Monitoring Sites.

			Year Measured[1]		
Site/Timber Sale Name	**Planning Unit**	**Treatments**	**Pre-treatment**	**Post-treatment**	**Last 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
Sumas Pass	North Puget	RD40, RD50, REF	2008	2013	2017
Pink Flamingo	North Puget	RD40, RD50, REF	2008	2010	2017

[1]Some dates have been updated to reflect the most complete dataset reviewed as of FY 2019.

In FY 2019, the Riparian Silviculture Effectiveness Monitoring Program prepared several datasets for analysis. These datasets include measurements of various habitat metrics such as downed wood and overstory and understory structure and composition. The program plans to develop a report and present findings following the analysis.

Validation Monitoring

Appendix: Background on Validation Monitoring

The Riparian Validation Monitoring Program (RVMP) is designed to test the hypothesis that forest management practices implemented under the HCP will restore and maintain habitat capable of supporting viable salmonid populations within the OESF. If negative trends are detected in salmonid conditions (abundance, biomass, species composition, age structure, and number of spawning redds), monitoring will then seek to evaluate cause-and-effect relationships between DNR management activities, riparian habitat, and salmonids. Once underlying mechanisms are understood, DNR may use this information to adapt its management practices.

The RVMP uses an observational study approach to monitor 50 Type-3 watersheds within the OESF and 10 reference watersheds in the OESF, Olympic National Park, and Olympic National Forest. These 60 watersheds are the same watersheds used in DNR's Status and Trends Monitoring of Riparian and Aquatic Habitat Program. As not all of the 60 watersheds can be sampled within a summer, 20 watersheds are sampled annually (annual panel), while an additional 20 watersheds per year are sampled on a two-year rotation (even and odd years). In addition, a section of the Clearwater River, a Type-1 stream, is snorkel-surveyed to assess DNR management on some of the larger streams of the OESF.

In FY 2019, the lead of the RVMP, Fish Biologist Kyle Martens, continued to work the Technical Review Group of the Quinault Indian Nation Lead Entity, a group that coordinates salmon habitat restoration on the western Olympic Peninsula. As part of the Technical Review Group, the RVMP provides scientific expertise to inform and prioritize potential restoration projects.

The RVMP also completed its third year of fieldwork which included three primary efforts:

- Multiple-pass removal of resident and juvenile salmonid abundance sampling in the annual and even-year panel of watersheds (Figure 7);
- Adult coho redd surveys in the annual panel as a measure of adult abundance;
- Snorkeling and habitat surveys over a 12-kilometer stretch of the Clearwater River.

Figure 7: Juvenile Cutthroat Trout Collected From a Stream in the OESF. Photo courtesy of Kyle Martens.

Salmonid abundance sampling conducted in FY 2019 resulted in the first complete sample of all 60 watersheds and the program's first status report. The status report focused on age-1 cutthroat trout, the most common salmonids species on the OESF, and included a series of analyses focused on habitat indicators where previous studies, outside of the OESF, have identified impacts from second-growth forests (the predominant forest type on the OESF) on salmonids.

Results indicate that cutthroat trout populations tended to increase with increasing stream depths, likely because deeper streams typically have more usable area for fish. There were also higher abundances in streams with higher gradients and more boulders, potentially because boulders can function as fish cover or habitat in a manner similar to instream wood. Instream wood and canopy-coverage levels were found to have a less significant impact on fish populations compared to the scientific literature, potentially because there were few streams sampled with lower canopy coverage and higher amounts of instream wood. These conditions are more likely to be present in the old growth stage of forest development which typically occurs in stands older than 200 years. Because of the limited range of current forest conditions in the OESF and the lengthy timeline for natural recovery, the RVMP recommends future experiments that evaluate the impacts of active restoration projects that increase instream wood and slightly decrease canopy cover.

Also in FY 2019, the RVMP collaborated with the Status and Trends Monitoring Program to assess the effects of 18 years of passive restoration on riparian forests under implementation of the HCP. The study was published in the journal *Environmental Management*, and more information can be found in the Status and Trends Monitoring section.

More information on the RVMP can be found in the 2018 ArcGIS story map, 2016–2018 RVMP Status Report, and the feature article in the sixth edition of *The Learning Forest*.

Research

DNR continually conducts research on its forestlands to better understand how forest management practices affect habitat conditions and forest productivity. 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 3 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 the table.

Table 3: DNR's Research and Monitoring Projects on HCP-Covered Lands.

Project	Priority			Monitoring
	1	2	3	
A Rare Opportunity: Gaining Insights into Current and Future Forest Resilience to Wildfire in the Western Cascade Mountains			x	
Cable-Assisted Logging System Experiment		x		
Eastside NSO Habitat and Fire Risk Evaluation	x	x		
eDNA Research in OESF			x	x
Experiment in Long-Term Ecosystem Productivity		x	x	

Project	Priority			Monitoring
	1	2	3	
Influence of Repeated Alternative Biodiversity Thinning on Young Stand Development Pathways		x		
Landscape-Scale Effectiveness Monitoring of Western Washington HCP Lands		x		x
Large-Scale Integrated Management Experiment on the OESF	x	x	x	x
Mind the Gap		x		
NSO Effectiveness Monitoring	x	x		x
Riparian Silviculture Effectiveness Monitoring	x	x		x
Riparian Validation Monitoring	x	x	x	x
Status and Trends Monitoring of Riparian and Aquatic Habitat on the OESF	x	x	x	x
Tracking Natural Tree Regeneration in Eastern Washington Forests Following Large Wildfires			x	
Using Passive Acoustic Monitoring to Evaluate Sustainability of Forest Management			x	x
Westside Individuals, Clumps, and Openings		x	x	

A Rare Opportunity: Gaining Insights into Current and Future Forest Resilience to Wildfire in the Western Cascade Mountains: The Norse Peak Fire burned more than 50,000 acres near Mount Rainier National Park in 2017 — one of the largest fires affecting the West Cascades since the early 1900s. This event provides a unique opportunity to enhance knowledge of fire ecology in forest types commonly found on DNR-managed land on the westside, and track how these systems are affected by increasing disturbance and a warming climate. The objectives of the study are two-fold:

1. Examine landscape patterns of burn severity in the Norse Peak Fire and compare them to regional historical fire regimes.
2. Test how post-fire vegetation responds to the interaction of burn severity and past disturbance history (including forest management) under a warming climate.

In 2019, researchers developed an initial map of remotely sensed burn severity and established more than 30 2.5-acre permanent plots where data was collected on fire effects and the tree overstory. In conjunction with understory information to be collected in 2020, results will provide critical early post-disturbance insights. Findings will uncover key components of forest resilience and provide important pilot data for future studies. This research is being conducted in collaboration with the University of Washington. For more information, contact Joshua Halofsky: Joshua.Halofsky@dnr.wa.gov.

Cable-Assisted Logging System Experiment: Cable-assisted, or "tethered," mechanized harvesting has recently been introduced to the Pacific Northwest and is rapidly being adopted by the forest industry, but many uncertainties exist about its impact on environmental conditions, operational productivity, and worker safety. In a study conducted in the OESF, researchers from Oregon State University (OSU) will compare cable-assisted logging systems to conventional, manual tree-felling with cable yarding. The study will quantify environmental impacts such as soil disturbance and sedimentation, changes in yarding productivity, and the likelihood of worker exposure to hazards in

each system. Results from this study will enable practitioners to evaluate the costs and benefits of each system and make informed choices about timber harvesting techniques. The experiment will be implemented on a timber sale sold in July 2019 in the OESF. OSU research staff will conduct pre-treatment sampling in January 2020 and will work with the purchaser (Interfor Inc.) to synchronize further data collection with logging operations. For more information, contact Teodora Minkova: Teodora.Minkova@dnr.wa.gov.

Eastside NSO Habitat and Fire Risk Evaluation: 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 forestland planning efforts. Researchers have analyzed nearly 300,000 acres of DNR's original mapped inventory (circa 1960) to estimate potential NSO habitat in the near past. In addition to this snapshot in time, DNR has also conducted extensive modeling to estimate likely ranges in historical NSO abundance prior to Euroamerican settlement. Other efforts are also examining over 200 known NSO nest site locations using LiDAR to better understand how the amount and configuration of habitat used by nesting owls differ from locations where owls are not known to nest. This project is a collaboration between DNR, UW, and USFS. For more information, contact Joshua Halofsky: Joshua.Halofsky@dnr.wa.gov.

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 and 2017, 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 recently occupied 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 are currently being analyzed by the USFS with the hope of developing a manuscript in the near future. For more information, contact Kyle Martens: Kyle.Martens@dnr.wa.gov.

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, UW, 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 experimental sites in the Pacific Northwest: three national forests in Oregon (Willamette, Siskiyou, and Siuslaw) and one site in the OESF. The OESF permanent plot installation in Sappho, Washington was established in 1995 and was re-measured in 2000 and 2016. A summary of this project is available on the OESF webpage. For more information, contact Teodora Minkova: Teodora.Minkova@dnr.wa.gov.

Influence of Repeated Alternative Biodiversity Thinning on Young Stand Development Pathways: This project was initiated in the late 1990s and stemmed from DNR's interest in testing pre-commercial thinning (PCT) as a way to set young stands on development pathways to increase forest structural complexity and habitat diversity. In 1998, five treatments were replicated at five sites on the OESF. Treatments included one control plus two different densities of PCT with or without the addition of gaps (Figure 8). In 2017, the sites were thinned again and additional gaps installed to explore the influence of gap timing on structural complexity. 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. Findings were presented at the 2019 OESF Science Conference and a summary of this project is available on the OESF webpage. For more information, contact Warren Devine: Warren.Devine@dnr.wa.gov.

Figure 8: Understory Vegetation Community in a Young Stand in the OESF. This stand was pre-commercially thinned in 1998 and gaps were created to foster development of structural complexity and habitat diversity. Photo courtesy of Richard Bigley.

Landscape-Scale Effectiveness Monitoring of Western Washington HCP Lands: The goal of this project is to determine how landscape-scale habitat conditions have changed since the implementation of the HCP. More information can be found in the NSO Effectiveness Monitoring section. For more information, contact Daniel Donato: Daniel.Donato@dnr.wa.gov.

Large-Scale Integrated Management Experiment on the OESF: This project compares three different integrated management strategies to identify which increases the well-being of the OESF's human communities and environment above current levels. One strategy includes the level of integrated management as described in the OESF Forest Land Plan. The other two strategies include more and less integration of revenue production and ecological values than described in the plan. A non-management control is also planned. The study is currently in the planning stage and is co-led by DNR and UW's Olympic Natural Resource Center (ONRC).

In FY 2019, DNR and the ONRC identified operable areas in the 16 experimental watersheds selected for the study, completed field reconnaissance of the uplands and parts of the riparian areas, and continued developing the study plan. Researchers also started to analyze the natural and anthropogenic disturbance history of the watersheds which will be used to identify experimental units and in future data analysis. Also in FY 2019, a UW graduate student analyzed dissolved organic carbon and water quality data along stream networks in four of the experimental watersheds. Results suggest that slope-related variables and precipitation were the primary drivers of carbon export, although the strengths and magnitudes of these relationships were different for the summer and fall. These results will be used to inform future monitoring protocols and the analysis of carbon export and trophic chains.

Legislative funding for partial implementation of the project was secured for FY 2020 and FY 2021. Fully funding the monitoring, analyses, stakeholder participation, and other project costs continued to be a challenge in 2019, and DNR and UW are exploring multiple grants and collaborative opportunities. For more information, contact Teodora Minkova: Teodora.Minkova@dnr.wa.gov.

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. This study has three phases:

- Phase I: A retrospective study of 10-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. Thinning treatments and pre- and post-treatment measurements have been conducted for Phase III. This study is now in a waiting period under the next set of measurements are taken, which are planned for 5–10 year intervals. A summary of this project is available on the OESF webpage. For more information, contact Daniel Donato: Daniel.Donato@dnr.wa.gov.

NSO Effectiveness Monitoring: The NSO Effectiveness Monitoring Program evaluates whether the HCP strategies and associated silvicultural treatments maintain or enhance NRF and dispersal habitat. More details can be found in the NSO Effectiveness Monitoring section. For more information, contact Daniel Donato: Daniel.Donato@dnr.wa.gov.

Riparian Silviculture Effectiveness Monitoring: Since 2006, DNR has documented 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 Silviculture Effectiveness Monitoring section. For more information, contact Daniel Donato: Daniel.Donato@dnr.wa.gov.

Riparian Validation Monitoring: The RVMP determines whether DNR's current forest management practices restore and maintain habitat capable of supporting viable salmonid populations. A summary of this work can be found in the Validation Monitoring section. For more information, contact Kyle Martens: Kyle.Martens@dnr.wa.gov.

Status and Trends Monitoring of Riparian and Aquatic Habitat on the OESF: 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. For more information, contact Teodora Minkova: Teodora.Minkova@dnr.wa.gov.

Tracking Natural Tree Regeneration in Eastern Washington Forests Following Large Wildfires: Between 2012 and 2015, more than 2.1 million acres burned in Washington, primarily east of the Cascade crest. 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 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 2012–2017. 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. Fifty additional plots were established in 2017, and another 80 plots were established in 2018. Plot establishment will resume in spring 2020 and continue through 2022, with a plan to monitor plots at 5–10 year intervals. For more information, contact Daniel Donato: Daniel.Donato@dnr.wa.gov.

Using Passive Acoustic Monitoring to Evaluate Sustainability of Forest Management: DNR received a grant from the Earthwatch Institute in FY 2019 for this project, which will be conducted in the OESF starting in spring 2020. The primary research objective is to determine how habitat quality, diversity, and function, indicated by the occupancy rate of key bird species, change in response to different forest management practices. Results will help DNR compare the effectiveness of current upland habitat conservation strategies to alternative approaches. The study will be implemented across the 16 watersheds designated for the Large-Scale Integrated Management Experiment described above. Researchers from DNR and UW will work with volunteers to collect and analyze sound recordings of 10 indicator bird species and conduct forest habitat surveys (Figure 9). Sites in a variety of forest developmental stages ranging from early seral to old-growth will be sampled in each watershed before and after treatment, and occupancy models will be developed for the indicator bird species. The Earthwatch Institute has developed a project webpage and started recruiting volunteers. For more information, contact Teodora Minkova at teodora.minkova@dnr.wa.gov.

Figure 9: Detection Ranges of Different Models of Acoustic Recording Units are Compared as Part of the Passive Acoustic Monitoring Study. Photo courtesy of Teodora Minkova.

Westside Individuals, Clumps, and Openings: 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. Stems in three pilot early old-growth stands and three thinned second-growth stands in westside planning units have been mapped; other qualified stands are being sought. DNR is conducting this project in partial collaboration with UW. For more information, contact Daniel Donato: Daniel.Donato@dnr.wa.gov.

OESF Research and Monitoring Program

Appendix: Background on the Research and Monitoring Program

In FY 2019, the OESF Research and Monitoring Program continued implementing two HCP monitoring projects (*Status and Trends Monitoring of Aquatic and Riparian Habitat* and *Riparian Validation Monitoring*), continued planning the large-scale integrated management experiment in cooperation with UW's Olympic Natural Resources Center (ONRC), and started the implementation of two new projects: Passive Acoustic Monitoring to Evaluate Sustainability of Forest Management and Cable-Assisted Logging System Experiment. Information about these projects can be found in the Research section of this report and on the OESF webpage.

The OESF Research and Monitoring Program and the ONRC continued to publish the joint biannual electronic newsletter *The Learning Forest* in the spring and fall. All issues are available on the OESF website. The publication is distributed to the internal networks of DNR and UW, and an additional 180 email subscribers.

The third annual OESF science conference took place in Forks in April 2019. It was attended by more than 100 people from local tribes, land management organizations, educational institutions, nonprofit organizations, DNR, and the general public (Figure 10). DNR researchers and collaborators presented on the effects of alternative pre-commercial thinning treatments, stand development after creation of canopy gaps, effectiveness of the HCP in fostering complex forest structure, assessment of the linkages between forests and fish, spatial and temporal variability of riparian microclimate, and spatial and temporal trends in dissolved organic carbon in streams. DNR experts from the Forest Resources Division described the use of data from drones and LiDAR for forest inventory, stream and wetland mapping, and silviculture compliance monitoring. Videos of the presentations are available on DNR's YouTube channel.

Figure 10: The Third Annual OESF Science Conference Took Place in Forks in April 2019. Photo courtesy of Cathy Chauvin.

In FY 2019, the program assisted several graduate students with research:

- A Ph.D. student from UW used hydrologic models calibrated to flow observations from the OESF to examine basin response to timber harvests.
- A graduate student from the UW School of Environmental and Forest Sciences successfully defended her master's thesis on the export of carbon through streams.
- A graduate student from Oregon State University's College of Forestry successfully defended his master's thesis on the impacts of forest management on coastal cutthroat trout.
- A graduate student from The Evergreen State College successfully defended her master's thesis on spatial and temporal variability of microclimates in riparian areas.

Also in FY 2019, the program secured three external sources of funding to support several research projects on the Olympic Peninsula: a three-year grant from the Earthwatch Institute to conduct passive acoustic monitoring by engaging volunteers to collect field data; legislative funding for FY 2020 and FY 2021 to coordinate with ONRC on four research projects; and one year of funding through the Good Neighbor Authority agreement between DNR and USFS to conduct stream monitoring.

The number of requests from external researchers to conduct studies in the OESF continued to grow which prompted the development of a master agreement with UW. The agreement will streamline the process for issuing research licenses to students and is planned to be finalized in FY 2020.

Publications and Presentations

In addition to conducting research on DNR-managed forestlands, DNR researchers also write and contribute to publications and presentations relevant to forest management in the Pacific Northwest. DNR authors denoted in bold text contributed to the articles and presentations listed below published in 2019.

Donato, Daniel C., **Halofsky, Joshua S.**, and Matthew J. Reilly. "Corralling a black swan: natural range of variation in a forest landscape driven by rare, extreme events" *Ecological Applications* 30(1): e02013. 2019. Available online.

- This paper addressed an HCP Priority 1 research question of how much habitat is needed to support spotted owl populations in the West Cascades. Simulation modeling of historical fire regimes suggests the West Cascades landscape typically fluctuated from approximately 45-90 percent late-seral habitat at any given time, suggesting that DNR's target of 50 percent habitat by watershed would be within the range of conditions owl populations experienced historically.

Hudec, Jessica L., Halofsky, Jessica E., Halsey, Shiloh M., **Halofsky, Joshua S**., and **Daniel C. Donato**. "Effects of climate change on special habitats in Southwest Washington." *Climate change vulnerability and adaptation in southwest Washington*. Ed. Jessica L. Hudec, Jessica E. Halofsky, David L. Peterson, Joanne J. Ho. Portland, OR: US Department of Agriculture, Forest Service, Pacific Northwest Research Station. 2019. Available online.

- In southwest Washington, climate change is expected to affect wildlife through altered habitat characteristics (food availability, nesting and resting structures, water sources), competition, and predator-prey dynamics. Despite the flexibility and adaptive capacity of many wildlife and botanical species, shifts in species ranges and local extirpation of some species may result from climate change in combination with other stressors.

Hudec, Jessica L., **Halofsky, Joshua S**., Halofsky, Jessica E., Gates, Joseph A., DeMeo, Thomas E., and Douglas A. Glavich. 2019. "Effects of climate variability and change on forest vegetation in Southwest Washington." *Climate change vulnerability and adaptation in southwest Washington*. Ed. Jessica L. Hudec, Jessica E. Halofsky, David L. Peterson, Joanne J. Ho. Portland, OR: US Department of Agriculture, Forest Service, Pacific Northwest Research Station. 2019. Available online

- In southwest Washington, ecological disturbance, mostly through increased occurrence of wildfire, insect outbreaks, and pathogens, will be the primary facilitator of vegetation change, and future forest landscapes may be dominated by younger age classes of trees. Projections generally show vegetation zones shifting from their current positions to higher elevations.

Keck, Jeff W., Minkova, Teodora V., Devine, Warren D., and Erkan Istanbulluoglu. "Preliminary flow records from small, mountainous channels in the Olympic Experimental State Forest." Invited presentation. American Geophysical Union. 2018.

- This research described the challenges of recording flow in small streams in the OESF and the novel application of modern rating curve methods to overcome those challenges. The unstable nature of the streams in the OESF and the steps used to create a series of rating curves from a minimal number of flow observations was discussed.

Khadduri, Nabil. "A wild winter at Webster: the impact of weather extremes of 2018–2019 at the state reforestation nursery." Invited presentation. Northwest Weather Workshop. 2019.

- This talk focused on two events: a severe lightning strike in December 2018 at DNR's Webster Nursery greenhouse and seed plant complex, and a cold snap in February 2019 follow by a rapid warm-up in March that impacted bareroot nursery operations.

Khadduri, Nabil. "Woods evaluation of container red alder grown with Bonzi® plant growth regulator." Invited presentation. Western Forest and Conservation Nursery Association Annual Meeting. 2018.

- This presentation described nursery production and woods evaluation of red alder stocktypes, including the use of a plant growth regulator in plug containers to improve nursery packout and outplant survival.

Martens, Kyle D., Devine, Warren D., Minkova, Teodora V., and Alex D. Foster. "Stream Conditions after 18 Years of Passive Riparian Restoration in Small Fish-Bearing Watersheds." *Environmental Management* 63(5): 673-690. 2019. Available online.

- This paper evaluated the outcome of 18 years of passive restoration under the HCP by comparing managed watersheds in the OESF and unmanaged (reference) watersheds using four common indicators (stream temperature, shade, in-stream wood, and salmonid densities). More information can be found in the Status and Trends Monitoring section.

Martens, Kyle D., Devine, Warren D., Minkova, Teodora V., and Alex D. Foster. "Stream Conditions after 18 Years of Passive Riparian Restoration in Small Fish-Bearing Watersheds" Invited poster. Headwater Streams and Forest Management in the Pacific Northwest Symposium. 2019.

- This poster provided information on the paper of the same name.

Martens, Kyle D. "Stream Conditions after 18 Years of Passive Riparian Restoration in Small Fish-Bearing Watersheds" Invited presentation. Oregon Chapter of the American Fisheries Society Annual Meeting. 2019.

- This presentation provided information on the paper of the same name.

Martens, Kyle D. "Assessment of the causal linkages between forests and fish: implications for management and monitoring on the Olympic Experimental State Forest – The 2016–2018 Riparian Validation Monitoring Program Status Report." Washington State Department of Natural Resources, Forest Resources Division. 2019. Available online.

- This status report focused on age-1 cutthroat trout, the most common salmonids species on the OESF, and included a series of analyses focused on habitat indicators where previous studies, outside of the OESF, have identified impacts from second-growth forests (the dominate forest type on the OESF) on salmonids. More information is available in the section on the Riparian Validation Monitoring Program.

Martens, Kyle D. "Assessment of the causal linkages between forest and fish: implications for management and monitoring." Invited presentation. OESF Science Conference. 2019.

- This presentation provided information on the paper of the same name.

Martens, Kyle D. "Fish and Riparian Habitat Monitoring in the Olympic Experimental State Forest." Invited presentation. Quinault Division of Natural Resources' Salmon Day. 2019.

- This presentation provided an overview of the RVMP, as well as recent findings that could provide guidance for fish enhancement projects on the Clearwater River.

Minkova, Teodora V. and Jennifer S. Arnold. "A Structured Framework for Adaptive Management: Bridging Theory and Practice in the Olympic Experimental State Forest." *Forest Science*. 2019. Available online.

- This paper compared regional experiences from private, state, and federal land managers in the Pacific Northwest (United States and Canada) and presented a structured adaptive management framework developed for the OESF. The framework, which can be customized by forest managers and policy makers according to their mandate and management objectives, describes an implementation process and organizational structure, links learning to management planning and implementation, and integrates the technical and social aspects of adaptive management.

Morris, Brian C. "Red Alder Site Selection." Invited Presentation. Washington Hardwood Commission Annual Symposium. 2019.

- This presentation investigated the history of planted red alder forest management on DNR-managed land to better understand how site conditions and planting stock affect survival and growth. Red alder silvics, past site selection tools, and new advancements in site selection tools were discussed.

Trobaugh, John. "Contracting, Communication, and Pricing Trends for Forest Seedlings." *Tree Planters' Notes* 61, no. 2: 126-134. 2018. Available online.

- This article discussed the challenges that many nurseries and reforestation programs have with shortages of farm labor and increasing labor costs, which are often passed on to the customer by increasing seedling prices. Labor shortages can also result in interruptions and delays in the lifting and delivery of seedlings. Given these challenges, the article emphasized the importance of open communication between the nursery and purchaser, and the use of a legal contract between the parties to document expectations.

Trobaugh, John. "Grow-to-throw: The dilemma of a forest seeding nursery." *Northwest Woodlands* 35, no. 2: 19-21. 2019.

- This article discussed the results of a survey of nurseries in the Pacific Northwest asking whether they grew seedlings for speculation sales, and how many total and speculation seedlings they grew. The article advised landowners to order seedlings early — one to two years before planting — to help nursery managers provide a reliable supply without unreasonable waste.

Conservation Strategy Updates

The HCP established numerous conservation strategies designed to minimize and mitigate the adverse effects of land management activities on the habitats of federally listed species and unlisted species of concern, as well as riparian habitats 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 2019. In FY 2020, the Board of Natural Resources adopted a long-term conservation strategy for the marbled murrelet which replaced the interim conservation strategy. More information can be found in the section on Marbled Murrelet Conservation Strategy Development.

Additional Habitat Restoration and Enhancement

Under the HCP, DNR conserves, restores, and enhances habitat for the northern spotted owl, marbled murrelet, and several federally listed salmonids, primarily through timber harvests and other forest management activities. These activities benefit species covered under the HCP and also generate revenue for trust beneficiaries.

DNR also works on a variety of additional habitat restoration and enhancement projects not required under the HCP. These projects, which are primarily funded through federal or state government grants, include in-stream restoration, riparian and upland habitat enhancement, and invasive species eradication. Additionally, DNR facilitates research and monitoring projects that go beyond the requirements in the HCP.

Much of this additional work is conducted in partnership with local, state, or federal agencies; tribes; non-profit organizations; educational institutions; or members of the public. These projects are typically executed under a land use license, special use lease, interagency agreement, memorandum of understanding, or research permit that allows external parties to conduct activities on state lands. In some cases, DNR completes projects in-house.

These additional projects can be separated into two types: habitat restoration and enhancement (Table 4), and research and monitoring (Table 5). These tables summarize projects initiated in FY 2019 within the HCP boundary.

Table 4: Summary of Habitat Restoration and Enhancement Projects Initiated in FY 2019 on DNR-Managed Land within the HCP Boundary.

Primary species or habitat	Project type	Approximate project area on DNR land	Partner	Natural area (if applicable)
Columbia Planning Unit				
Salmon	Stream restoration, engineered log jams	6.6 acres	Lower Columbia Fish Enhancement Group	N/A
Salmon	Stream restoration	3.3 acres	Cowlitz Indian Tribe	N/A
Salmon	Stream restoration	2.7 acres	Cowlitz Indian Tribe	N/A
North Puget Planning Unit				
Coho salmon	Culvert replacement, reforestation	2.6 acres	City of Everett	N/A
Coho salmon	Habitat enhancement, culvert replacement	1 acre	Whatcom County	N/A
South Puget Planning Unit				
Pheasant	Upland habitat enhancement	640 acres	WDFW	N/A
Chum salmon	Removal of noxious weeds in riparian areas	5,760 acres	Hood Canal Salmon Enhancement Group	N/A
Straits and South Puget Planning Units				

Primary species or habitat	Project type	Approximate project area on DNR land	Partner	Natural area (if applicable)
Removal of noxious weeds	Removal of knotweed and other invasive species	59,157 acres	Mason County Noxious Weed Control Board	N/A

Table 5: Summary of Research and Monitoring Projects Initiated in FY 2019 on DNR-Managed Land within the HCP Boundary.

Primary species or habitat	Project type	Approximate project area on DNR land	Partner	Natural area (if applicable)
Chelan Planning Unit				
Wenatchee Mts. checker-mallow	Evaluation of hydrologic restoration opportunities and monitoring hydrologic impact to species	2,018 acres	Chelan County	Camas Meadows NAP
Klickitat Planning Unit				
Cascades frog	Research to identify genetic diversity of population	2,014 acres	WDFW	Trout Lake NAP
OESF Planning Unit				
Wetlands	Visual assessment to validate wetland maps	35,200 acres	UW	N/A
South Coast and South Puget Planning Units				
Rough-skinned newt	Assessment of the impacts of a pathogenic fungus (*Batrachochytrium salamandrivorans*) on amphibians	95,613 acres	WSU	N/A
South Puget Planning Unit				
Instream and riparian habitat conditions on the Tahuya River	Habitat monitoring and assessment	4,800 acres	Hood Canal Salmon Enhancement Group	N/A
Fish, amphibians, macroinvertebrates	Watershed health monitoring	9.3 acres	Department of Ecology	N/A
Black bear	Monitoring impacts of management actions on black bear populations	71,000 acres	WDFW	N/A

Forest Inventory

Comprehensive Review

Appendix: Background on Comprehensive Reviews

Introduction

DNR's forest inventory program provides current information about the characteristics of forest resources across approximately 2.1 million acres of DNR-managed forest land. Forest inventory is an

important tool in forest management and is fundamental to agency decision-making and revenue generation. It provides key data for a variety of DNR's core business functions including timber sale planning, habitat classification, and monitoring and research.

DNR's forest inventory system consists of a suite of geospatial and tabular data at a variety of scales including measurements of individual trees collected on field plots, plot- and stand-level summaries of field data, and high-resolution predictive statistical models across DNR's forested land base. Measured, predicted, and derived attributes include a suite of approximately 40 forest characteristics for both live and dead trees including species, diameter, height, volume (total and merchantable), basal area, relative density, canopy cover and closure, biomass, carbon, and down and dead woody material.

History

DNR's forest inventory program began in 1990 when the agency initiated a program known as the Forest Resource Inventory System (FRIS). FRIS was a large-scale field sampling effort intended to sample DNR's entire forested land base with one plot every five acres, and report conditions at the stand level.

FRIS was designed to sample site-specific forest conditions within designated inventory units. Through a process of aerial photo interpretation, DNR analysts divided the forested land based into areas of homogeneous forest conditions. Approximately 40,000 forest inventory units were manually delineated, each considered a contiguous forest community sufficiently uniform in topography and vegetative characteristics to be distinguishable from adjacent communities. Inventory units were generally limited to areas between 5 and 100 acres.

A systematic grid of sample plots was located within each inventory unit. Using a combination of fixed-area and variable-radius plots and transects, field crews measured site and vegetative characteristics including live and dead trees, plant associations, ground vegetation, and down dead woody material. Plot data were summarized and a suite of over 100 forest inventory attributes were reported for each inventory unit. Both geospatial and tabular data were distributed agency-wide through DNR's corporate GIS and database systems.

FRIS was designed with the expectation that each stand would be revisited and re-measured every 10 years. In the intervening decade, DNR released periodic updates at approximately 2–4 year intervals by using the Forest Vegetation Simulator (FVS), a growth and yield model developed by the U.S. Forest Service, to "grow" each stand forward in time.

Field sampling under FRIS continued for more than two decades and provided a wealth of detailed information to its end users. To date, FRIS remains one of the largest-scale forest inventories ever implemented worldwide, representing a considerable investment in both time and resources. The intended 10-year re-measurement cycle required sampling over 200,000 acres each year, but in the late 2010s, the recession led to budget shortfalls and field sampling efforts were reduced.

With limited staff capacity, DNR was unable meet its sampling targets and only about 60 percent of the total forested land base was measured. To compensate, DNR relied on a statistical method known as imputation to fill the gaps for un-sampled areas. Imputation is a technique by which attributes are transferred from known sites to unknown sites based on available, though often limited, information. In addition, DNR relied on FVS to grow sampled data forward in time beyond the 10-year measurement cycle. For some areas, more than two decades passed since field plots were installed.

The combination of extensive imputation and repeated use of models to grow data forward began to introduce more error, yielding a data set that gradually became less of a measured inventory and more a modeled one. Coupled with the high costs of labor-intensive sampling, DNR sought a more accurate and economically sustainable solution.

Transition to RS-FRIS

In 2013, DNR began developing a new inventory system known as the Remotely Sensed Forest Resource Inventory System (RS-FRIS). RS-FRIS relies largely on remotely sensed data instead of field plots. Although implemented primarily as a cost-saving measure, the use of remotely sensed data has additional benefits: It allows the agency to leverage and stay abreast of cutting-edge and emerging technologies, DNR's inventory coverage has expanded considerably, and a new inventory is produced every two years using newly acquired remotely sensed data rather than relying on growth and yield models to grow data forward in time.

RS-FRIS combines plot measurements taken in the field with data from remote sensing. The field plots are similar in nature to the legacy FRIS plots and consist of a series of nested fixed-area plots and transects. They are installed on a statewide, systematic grid but at much greater spacing than FRIS plots. The sampling framework is known as a panel design in which a series of repeated sampling passes, or "panels," are conducted each year. As each panel is completed, the plot grid becomes more dense. Each panel includes approximately 600 field plots and requires about 18 months to complete. DNR field crews are expected to complete the fourth panel in calendar year 2020, with a resulting plot density of approximately one plot every 1,000 acres. A total of 2,086 plots have been installed as of January 2020 (Figure 11).

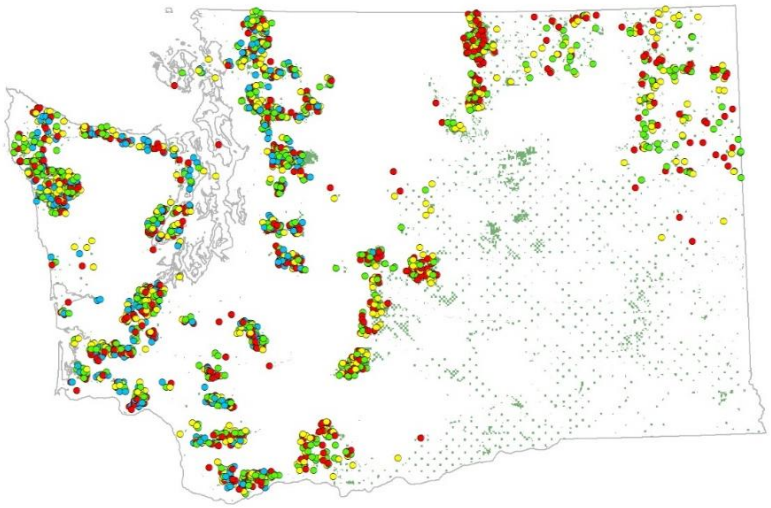


Figure 11: Location of RS-FRIS Inventory Plots Completed on DNR-Managed Forest Land. Each plot is color-coded by panel. Map courtesy of Jeff Ricklefs.

In contrast with FRIS, which summarized stand-level conditions directly from a dense network of plot data, RS-FRIS uses field data primarily to train statistical computer models. The models predict a suite of forest attributes at a fine scale across DNR's forested land base where remotely sensed data is available. DNR analysts used what is known as the "area-based approach" to fit a series of regression models that relate measurements from field plots to characteristics of remotely sensed data. The model output is a high-resolution GIS raster file for each inventory attribute with a pixel size of 1/10 acre.

RS-FRIS leverages two types of remotely sensed data: LiDAR and DAP. LiDAR (Light detection and ranging) is a type of remote sensing that uses aircraft-mounted, aerial scanning lasers to measure the three-dimensional configuration of the forest in great detail. DAP (digital aerial photogrammetry) produces a similar three-dimensional product of the forest canopy but relies on stereo imagery instead of laser measurements (Figure 12).

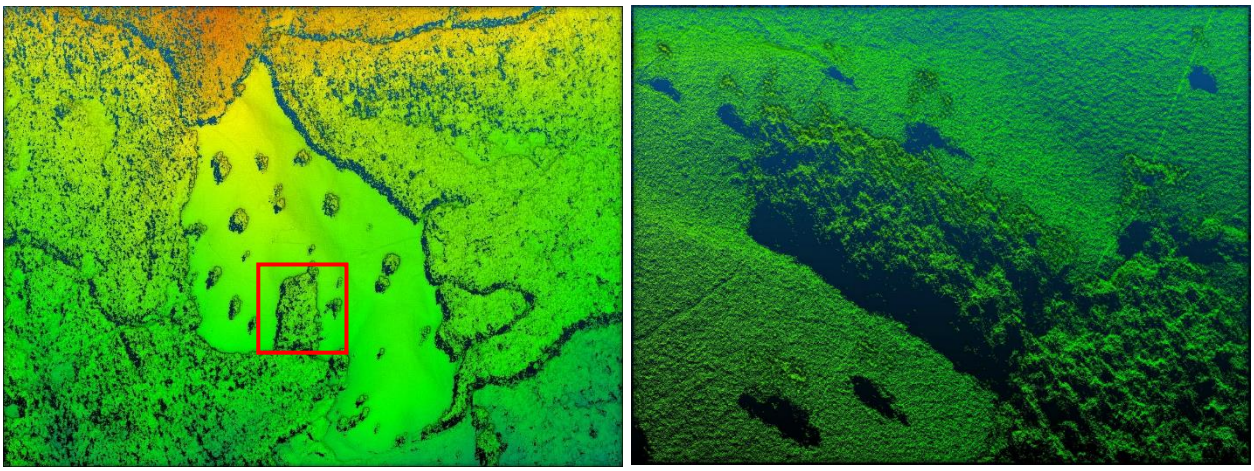


Figure 12: Example of Remotely Sensed Digital Aerial Photogrammetry Data Products. A three-dimensional surface model constructed from stereo imagery using photogrammetric software is pictured at left. An oblique view of the area in red is shown at the right. This image depicts a riparian buffer and leave trees, illustrating the detail revealed in a DAP data set. Figures courtesy of Jeff Ricklefs.

In 2019, DNR released the third iteration of its inventory, RS-FRIS 3.0, which reports forest conditions as of mid-2017 based on a combination of LiDAR ground models and DAP imagery. Earlier versions of RS-FRIS reported conditions as of 2013 (RS-FRIS 1.0) and 2015 (RS-FRIS 2.0). Stereo imagery flown in 2019 is currently being processed for use in RS-FRIS 4.0. With each subsequent release coverage has expanded, and RS-FRIS 3.0 covers approximately 99 percent and 97 percent of DNR-managed forest lands in western and eastern Washington, respectively.

Data Accuracy and Validation

RS-FRIS relies on the relationship between characteristics of the remotely sensed data and plot-level attributes measured on the ground. Remotely sensed data such as LiDAR and DAP measure height and canopy cover very accurately, and derivatives of these metrics serve as the primary predictors in the RS-FRIS models. In general, RS-FRIS model performance can be characterized as good to excellent. Models for forest attributes that are well-correlated with height or canopy cover perform especially well. For example, models for merchantable and total volume, quadratic mean diameter, and basal area have an excellent fit to measured field conditions.

Attributes such as down woody debris and snags are the most difficult to predict with great precision. By nature, these phenomena are somewhat stochastic, patchy in distribution, highly variable, and not well-correlated with overstory conditions. Moreover, they present a very small to non-existent signature in the remotely sensed data. Developing models for these attributes is challenging and model performance can be characterized as moderate.

In addition to the field plots used to train the models, RS-FRIS includes a separate set of validation plots installed across the state used to test the accuracy of RS-FRIS predictions. Validation plots were installed in “blocks” representing areas of contiguous forest conditions and were used to test the performance of RS-FRIS 2.0 and 3.0 models at the stand scale (Figure 13). Overall, RS-FRIS model performance was found to be excellent. The forest inventory program plans to install additional validation blocks in 2020 to evaluate RS-FRIS 4.0.

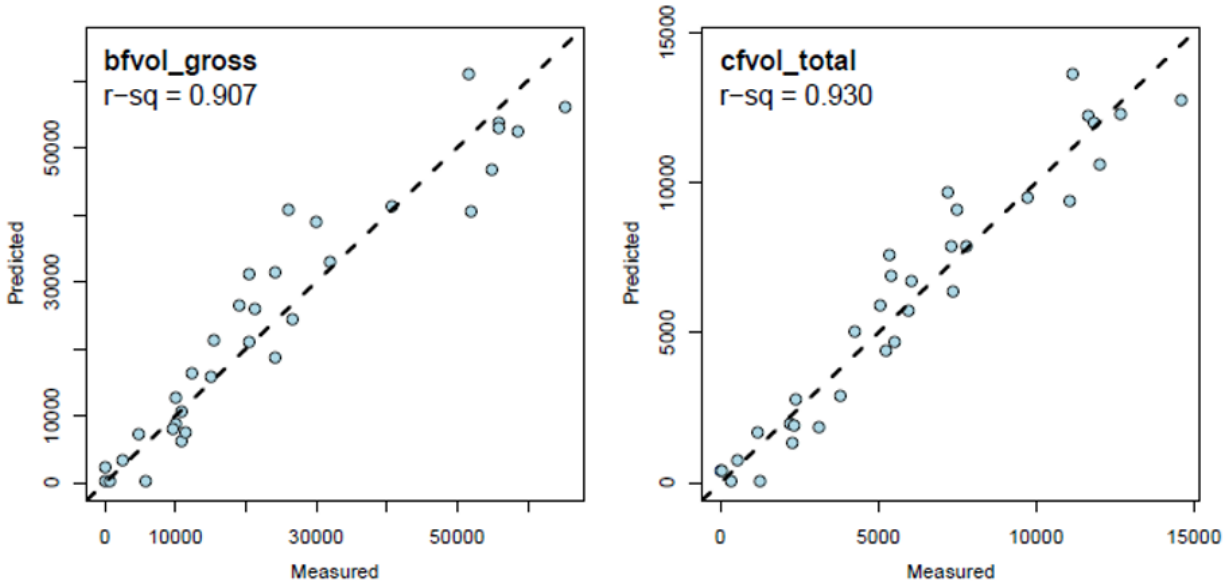


Figure 13: Results of RS-FRIS Validation for Merchantable Volume (Left) and Total Volume (Right). Each point shows stand-level summaries from a single validation block. Results from field measurements (x-axis) are compared to RS-FRIS model predictions (y-axis). The r-squared value indicates the correlation between the data sets, on a scale of 0 to 1. An r-squared value over 0.9 indicates excellent performance by these models. Charts courtesy of Jeff Ricklefs.

Additional validation efforts include a comparison of cruise data from DNR's timber sales program with RS-FRIS projections. Data from more than 1,000 timber cruises was analyzed and was found to correlate well with RS-FRIS. A third-party, independent validation effort was also completed which involved installation of 1,800 plots in western Washington by a contractor. Field data was found to be well-correlated to projections from RS-FRIS 3.0.

Benefits and Applications

RS-FRIS provides multiple benefits to the agency, including expanded coverage, more frequent updates, and considerable cost savings compared to a traditional ground-based inventory such as FRIS. Large-scale acquisitions of remotely-sensed data offer economies of scale, and the transition to an inventory based largely on remotely sensed data has greatly reduced the amount of field work required. By adopting RS-FRIS, DNR estimates inventory costs have been reduced by at least 80 percent compared to FRIS.

DNR's inventory program serves a variety of end users, including, but not limited to:

- foresters, who select areas for forest management activities;
- habitat biologists, who identify and classify habitat in accordance with the HCP;
- forest modelers, who make predictions of future forest conditions and calculate long-term decadal harvest volume targets; and
- environmental planners, who develop long-term management plans.

DNR's inventory and photogrammetry programs have pioneered the creation and application of DAP for resource management on large scales. Potential future applications of DAP include quantifying biomass and carbon, prioritizing areas for forest health treatments, identifying stands that have

experienced disturbance (such as wildfire or disease outbreaks), and developing an algorithm for automated stand delineation.

RS-FRIS and NSO Habitat Delineation

When the HCP was developed, DNR identified areas on state-managed lands that were most important to northern spotted owl conservation. These designated northern spotted owl management areas are managed for certain habitat classes and types that are defined in the HCP (p. IV11–12) and WAC 222-16-085. More information about habitat classifications and types for each westside northern spotted owl management area can be found in the Appendix.

In order to identify habitat types across state-managed forestland, DNR developed multiple queries that were applied to FRIS data (Table A-3). In 2017, during the transition to RS-FRIS, DNR made minor updates to the queries to reflect the attributes measured in RS-FRIS and better match the habitat definitions in the HCP. A list of updated queries used with RS-FRIS will be included in the FY 2020 HCP Annual Report.

Although the process of identifying NSO habitat based on definitions in the HCP is conceptually very similar between FRIS and RS-FRIS, the higher spatial precision of RS-FRIS data presented a unique challenge. A direct application of the habitat definitions to RS-FRIS data would result in a pixelated scattering of habitat in units as small as 1/10 acre. To identify habitat patches of ecologically meaningful sizes and configurations, RS-FRIS data were smoothed, and habitat patches were delineated using a derivation of the PatchMorph algorithm.

In this year's HCP Annual Report, the section on NSO Habitat Data contains habitat percentages for FY 2019 determined using FRIS data. Next year, the FY 2020 HCP Annual Report will contain habitat percentages based on RS-FRIS data for the North Puget, South Puget, and Columbia HCP planning units, and in the FY 2021 report, habitat percentages reported in OESF will also be based on RS-FRIS data. The timeline for reporting habitat percentages based on RS-FRIS in the Annual Report mirrors the timeline for implementing RS-FRIS in DNR's timber sales program; starting in FY 2020, sales sold in the westside planning units (excluding OESF) were planned using RS-FRIS data, and sales sold in OESF will use RS-FRIS data starting in FY 2021.

Silvicultural Activity

Appendix: Background on Silvicultural Activity

Information and analysis provided in this section are based on activities designated as "complete" in DNR's forest management activity tracking database, LRM, as of December 10, 2019. LRM is a tabular database that integrates GIS to spatially track individual forest management activities on the landscape.

Figure 14: A Mixed-Species Plantation Establishing in a Variable Retention Harvest Unit in the Klickitat HCP Planning Unit. Photo courtesy of Daniel Donato.

Five major silviculture activity types are discussed in this report: timber harvest, site preparation, forest regeneration, vegetation management, and PCT. These activities typically occur in this order following final harvest of standing timber (Figure 14). Table 6 shows completed

acres of silvicultural activities for FY 2019 as well as the mean annual acres of each activity for the last five fiscal years by HCP planning unit.

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 number of timber sales sold may stay relatively stable from year to year while timber removals or levels of completed activities may vary based on when purchasers choose to harvest (and thus complete) the sale.

Across all HCP planning units, acres of variable retention harvest (VRH) completed in FY 2019 were about eight percent above the five-year mean, acres of variable density thinning (VDT) were 12 percent below the five-year mean, and acres of commercial thinning were 40 percent below the five-year mean. In the eastside planning units, there was no uneven-aged management completed in FY 2019, but acreage of VRH was more than double the five-year mean.

Site Preparation

Total acreage of forest site preparation completed in FY 2019 was 51 percent higher than the five-year mean. In westside planning units not including the OESF, ground herbicide treatment acres were 61 percent above the mean. In the OESF, site preparation was 98 percent higher than the five-year mean. In eastside planning units, mechanical site preparation was more than double the mean. Sustained high costs for contract labor have resulted in prioritization of site preparation over stand-tending activities (PCT and vegetation management), as site preparation often provides a greater return on investment.

Forest Regeneration

Total acreage of forest regeneration completed in FY 2019 was similar to the five-year mean. Hand planting was the technique used on more than 96 percent of the regenerated acres across all planning units. However, there was a nearly five-fold increase in the amount of natural regeneration completed in eastside planning units in FY 2019 (445 acres) compared to the mean of 91 acres. Where site conditions are appropriate, DNR has begun to implement harvest and retention methods on the eastside that facilitate natural regeneration.

Vegetation Management

Acres of completed vegetation management in FY 2019 were 34 percent below the five-year mean. Ground herbicide, hand cutting, and hand pulling treatments were 41 percent, 34 percent, and 19 percent below the five-year mean, respectively.

Pre-Commercial Thinning

The total acreage of PCT completed in FY 2019 was 28 percent below the five-year mean. While the acreage of PCT in westside planning units not including the OESF was 48 percent below the mean, there was a 68 percent increase in the amount of PCT in eastside planning units. The increase in PCT on the eastside is driven primarily by the creation of a forest health revolving account through House Bill 1711 to help DNR fund forest health treatments on state lands, in addition to ongoing legislative funding.

Table 6: Acres of Silviculture Activities Completed in FY 2015–FY 2019 on State Trust Lands Managed under the HCP.

	FY 2019[1]							FY 2019 Totals (Five-year Mean: FY15–19)			
	EAST[2]		WEST					East	West	OESF	Total
	Klickitat	Yakima	Columbia	North Puget	South Coast	South Puget	Straits				
Timber Harvest											
Commercial thinning	0	0	932	0	26	0	0	0 (0)	957 (1,892)	502 (550)	1,459 (2,442)
Uneven-aged management	0	0	0	0	0	0	41	0 (404)	40 (53)	0 (0)	40 (457)
Variable density thinning	0	601	55	513	35	9	10	600 (714)	622 (784)	1,316 (1,378)	2,538 (2,876)
Variable retention harvest	0	282	2,186	2,804	4,234	907	1,220	282 (124)	11,351 (10,431)	776 (980)	12,410 (11,536)
Total timber harvest	**0**	**883**	**3,172**	**3,317**	**4,295**	**916**	**1,271**	**882 (1,243)**	**12,972 (13,161)**	**2,594 (2,908)**	**16,449 (17,313)**
Site Preparation											
Aerial herbicide	0	0	2,121	0	636	0	0	0 (0)	2,757 (2,477)	0 (0)	2,757 (2,477)
Ground herbicide	0	0	463	2,189	2,842	1,381	1,866	0 (0)	8,741 (5,440)	1,069 (539)	9,810 (5,979)
Ground mechanical	0	518	0	0	0	0	0	518 (203)	0 (0)	0 (0)	518 (203)
Total forest site preparation	**0**	**518**	**2,585**	**2,189**	**3,478**	**1,381**	**1,866**	**518 (203)**	**11,498 (7,917)**	**1,069 (539)**	**13,086 (8,660)**
Forest Regeneration											
Hand planting	116	285	2,877	2,856	2,412	738	1,068	400 (608)	9,951 (10,228)	971 (801)	11,324 (11,638)
Natural regeneration	0	445	0	0	0	0	0	445 (91)	0 (0)	0 (2)	445 (93)
Total forest regeneration	**116**	**730**	**2,877**	**2,856**	**2,412**	**738**	**1,068**	**845 (699)**	**9,951 (10,228)**	**971 (804)**	**11,769 (11,732)**
Vegetation Management											
Ground herbicide	0	0	48	170	395	52	712	0 (0)	1,377 (2,224)	0 (110)	1,377 (2,335)
Hand cutting	0	0	1,950	474	1,838	494	542	0 (0)	5,298 (8,235)	378 (368)	5,676 (8,603)
Hand pulling	0	0	0	0	532	253	57	0 (0)	842 (1,036)	0 (0)	842 (1,036)
Total vegetation management	**0**	**0**	**1,998**	**644**	**2,765**	**800**	**1,311**	**0 (0)**	**7,518 (11,496)**	**378 (478)**	**7,896 (11,975)**
Pre-Commercial Thinning											
Total pre-commercial thinning	**202**	**1,541**	**1,093**	**372**	**1,203**	**46**	**454**	**1,742 (1,034)**	**3,168 (6,105)**	**543 (435)**	**5,454 (7,574)**
Grand Total	**318**	**3,671**	**11,724**	**9,379**	**14,154**	**3,881**	**5,971**	**3,989 (3,180)**	**45,109 (48,909)**	**5,557 (5,166)**	**54,656 (57,256)**

[1]This table does not include any silviculture activities for which both the completed acreage in FY 2019 and the five-year mean were below 50 acres.
[2]There were no completed activities in the Chelan planning unit in FY 19.

Salvage

Table 7 compares acres of salvage harvest completed in FY 2019 to the five-year mean by harvest type. Overall, the total acreage of salvage harvest was 40 percent below the five-year mean. In westside HCP planning units including the OESF, only three acres were salvaged in FY 2019, compared to the five-year mean of 33 acres. In eastside planning units there were 282 acres of salvage which was 36 percent lower than the mean. All salvage acres completed in FY 2019 were in areas that experienced wildfires. Acres of post-wildfire salvage harvest tend to fluctuate with the severity of the wildfire season.

Table 7: Acres Salvaged by Harvest Type in FY 2019 Compared to the Five-year Mean (FY15–19).

		FY 2019 (Five-year Mean: FY15–19)			
		East	West	OESF	Total
Harvest type	Commercial thinning	0 (0)	0 (0.2)	0 (0)	0 (0)
	Uneven-aged management	0 (174)	0 (0)	0 (0)	0 (175)
	Variable density thinning	0 (151)	0 (0)	0 (0)	0 (151)
	Variable retention harvest	282 (113)	3 (19)	0 (13)	286 (146)
	Total	**282 (439)**	**3 (20)**	**0 (13)**	**286 (473)**

Road Management Activity

Forest Roads Program

Appendix: Background on Road Management Activity

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 2018.

In 2018, 26 barriers were removed from the fish-barrier worklist on DNR-managed lands, representing an investment of $1.3 million. DNR removed or replaced 23 of the barriers, opening an estimated 9.1 miles of fish habitat on DNR-managed lands (Figure 15). The three remaining fish-passage barriers were removed from the work list for one of the following reasons:

Figure 15: Fish-Barrier Removal on an Unnamed Tributary to Kalaloch Creek. This project replaced a 60-inch corrugated metal pipe (left) with a 16-foot diameter multi-plate culvert (right). A total of 0.7 miles of salmon and trout habitat were opened up as a result of this project. Photos courtesy of Jeremy Tryall.

- The stream designation was downgraded from "fish" to "non-fish" following protocol survey requirements.
- The fish-passage barrier removal would result in very limited habitat gain (usually less than 200 meters). With consensus from WDFW and DNR Forest Practices, these culverts were reprioritized for replacement at the end of their useful life.

Through land transactions and inventory activities in 2018, DNR acquired eight new fish passage barriers that need to be corrected. The Forest Roads Program is committed to remediating new barriers within six years of their identification. At the end of 2018, 64 fish barriers remained on DNR-managed lands.

On lands managed under the HCP, 77.4 miles of road were abandoned or decommissioned and 93.3 miles were constructed in 2018. There was a net increase of total road miles on HCP-managed lands from 10,493 to 10,607 due to land transactions, construction, and updates to the road inventory. Table 8 summarizes DNR's road management activity on both HCP- and non-HCP-covered lands in 2018.

Table 8: Road Management Activity Summary for Calendar Year 2018. All mileage data has been rounded to the nearest tenth of a mile.

	Miles					Barriers
	New Road Constructed	Road Reconstructed	Road Abandoned	Road Decommissioned	Inventoried Road[1]	Fish Barriers Removed
Chelan	0	0	0	0	45.9	0
Columbia	16.4	8.4	11.5	1.5	1,257.3	3
Klickitat	0	0	0.5	0	583.1	0
North Puget	35.3	32.2	32.9	3	1,482.1	3
OESF	4.2	8.2	0	4.2	1,918	12
South Coast	31.5	4.2	1.1	1.3	1,606.1	0
South Puget	1.7	0.4	1.3	9.1	1,355.9	1
Straits	2.8	0.1	0.1	1.7	981.1	1
Yakima[2]	1.4	4.5	2.1	7.1	1,377.6	1
TOTAL, HCP Covered Lands	**93.3**	**57.9**	**49.5**	**27.9**	**10,607.1**	**21**
Non-HCP Covered Lands	18.6	2.7	2.8	2.1	3,453.2	2

[1] Inventoried road includes forest roads (according to WAC 222-160-010) and decommissioned roads. It does not include abandoned or orphaned roads.

[2] Data for the Yakima HCP Planning Unit does not include roads on land co-managed by DNR and WDFW in the Teanaway Community Forest as this land is not covered by the HCP.

Easements

Appendix: Background on Easements

DNR grants easements across state trust lands to individuals, private organizations, and other public agencies for a variety of purposes including road and utilities access. DNR also acquires easements across private or public lands to gain access to DNR-managed 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 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 FY 2019, DNR continued to make progress on the Spatial Nature project that maps encumbrances on state lands that are not connected to DNR's road system such as utility corridors, communication sites, weather monitoring systems, irrigation infrastructure, agriculture and grazing leases, railroads, and land use restrictions.

Road Easements, Road Use Permits, and Utility Easements

Table 9 reports easements granted in FY 2019 that created a new footprint (i.e. timber was cut to create open space). Easements granted during the reporting period that created no new footprint because they overlap with existing easements or agricultural leases are not reported. DNR did not grant any utility easements that created a new footprint in FY 2019.

Table 9: Road Easements and Road Use Permits (New Footprint) Granted in FY 2019.

		Columbia	North Puget	OESF	South Coast	Straits	Total
Road easements and road use permits	Miles	0.18	1.28	0.23	0.07	0.17	**1.93**
	Acres	1.3	9.14	1.7	0.51	0.71	**13.36**

Land Transaction Activity

Appendix: Background on Land Transaction Activity

Below is a summary of land acquisitions, dispositions, and transfers completed in FY 2019 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 10 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

Columbia

Acquired: DNR purchased 13 acres for Washougal Oaks NAP/NRCA in Clark County, and 318 acres for the State Forest Transfer and Charitable, Educational, Penal, and Reformatory Institutions (CEP&RI) trusts in Skamania County.

Trust Land Transfer (TLT)/State Forest Transfer (SFT): In Skamania County, 163 acres of State Forest Trust land was transferred to Stevenson Ridge NRCA, and in Wahkiakum County, 87 acres of State Forest Trust land was transferred to Skamokawa Creek NRCA.

North Puget

Acquired: DNR purchased a total of 1,175 acres in the North Puget Planning Unit. Purchases for the trusts included 822 acres of forestland in Skagit County and 40 acres in King County for addition to the Raging River State Forest. Conservation purchases included 24 acres for the Rattlesnake Mountain Scenic Area and 289 acres for Mount Si NRCA, both in King County.

Disposed: DNR transferred 400 acres of Common School Trust land to San Juan County for a park.

OESF

Disposed: DNR sold one acre of administrative site land in Clallam County that was better suited for a home site.

South Coast

Acquired: DNR acquired 80 acres in Pacific County for addition to the Bone River NAP.

Disposed: In Grays Harbor County, DNR transferred 44 acres of partially forested CEP&RI trust land to Grays Harbor Community College.

TLT/SFT: In Pacific County, 81 acres of State Forest Trust land was transferred to Naselle Highlands NRCA.

South Puget

Acquired: DNR acquired a total of 422 acres in the South Puget Planning Unit. Four natural areas acquired a total of 154 acres: 16 acres in Thurston County for Woodard Bay NRCA, nine acres in Kitsap County for Stavis NRCA, six acres in King County for West Tiger Mountain NRCA, and 123 acres in Mason County for Kennedy Creek NAP/NRCA. An additional 534 acres was acquired for Kennedy Creek in early FY 2020 which will be reported in next year's HCP Annual Report. DNR also purchased 268 acres in Mason County for the Common School Trust.

Disposed: DNR sold 0.2 acres of Common School Trust land in Mason County to resolve a trespass, and 87 acres in King County to convey leased land to Green River Community College.

Straits

Acquired: DNR acquired 40 acres for Dabob Bay NRCA in Jefferson County.

Disposed: DNR sold an isolated 7-acre lot of Common School Trust land in Clallam County.

Table 10: Acquisitions and Disposals Completed in FY 2019 within the HCP Boundary.

		HCP Planning Unit						
		Columbia	North Puget	OESF	South Coast	South Puget	Straits	Totals
Acquired Lands[1]								
Stream miles by stream type	Type 1	-	-	-	0.3	0.7	-	**1.1**
	Type 2	-	-	-	-	-	-	**-**
	Type 3	-	1.8	-	-	0.2	-	**2.0**
	Type 4	0.9	1.1	-	-	0.4	-	**2.4**
	Type 5	0.4	5.0	-	0.7	0.3	0.2	**6.6**
	Type 9	0.3	2.0	-	0.4	1.1	-	**3.8**

		HCP Planning Unit						
		Columbia	North Puget	OESF	South Coast	South Puget	Straits	Totals
	Total miles acquired	**1.6**	**9.8**	**-**	**1.5**	**2.7**	**0.2**	**15.8**
Acres acquired in rain-on-snow zones		1	469	-	-	-	-	**469**
Acres per asset class[2]	Forested	317	856	-	-	268	-	**1,441**
	Conservation	13	317	-	80	153	40	**602**
Total acres acquired		**330**	**1,172**	**-**	**80**	**421**	**40**	**2,043**
Disposed Lands								
Stream miles by stream type	Type 1	-	-	-	-	-	-	**-**
	Type 2	-	-	-	-	-	-	**-**
	Type 3	-	-	-	0.2	-	-	**0.2**
	Type 4	-	-	-	-	-	-	**-**
	Type 5	-	-	-	-	-	-	**-**
	Type 9	-	-	-	-	0.1	-	**0.1**
	Total miles disposed	**-**	**-**	**-**	**0.3**	**0.1**	**-**	**0.3**
Acres disposed in rain-on-snow zones[3]		**-**	**-**	**-**	**-**	**-**	**-**	**-**
Acres per age class	Open (0–10 years)	-	-	-	-	-	-	**-**
	Regeneration (11–20 years)	-	-	-	-	-	-	**-**
	Pole (21–40 years)	-	-	-	-	-	-	**-**
	Closed (41–70 years)	-	-	-	-	-	-	**-**
	Complex (71–100 years)	-	384	-	32	27	2	**444**
	Complex (101–150 years)	-	-	-	-	-	-	**-**
	Functional (150+ years)	-	-	-	2	-	-	**2**
	Non-forested	-	9	1	11	60	6	**86**
	Unknown	-	6	-	-	-	-	**6**
Total acres disposed		**-**	**398**	**1**	**44**	**87**	**7**	**538**

[1] Data for acquired lands are estimates that have not yet been field-verified.
[2] 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.
[3] Rain-on-Snow (ROS) data is derived from DNR's corporate GIS layer.

Natural Areas Program

Appendix: Background on the Natural Areas Program

In FY 2019, the Natural Areas Program protected an additional 931 acres in Natural Area Preserves (NAPs) and Natural Resource Conservation Areas (NRCAs), all within the area covered by the HCP. These protection efforts added to 12 existing natural areas. The most significant of these were:

- **Bone River NAP:** DNR added nearly 80 acres to the Bone River NAP, the first addition to this site in 15 years. This acquisition included the last remaining inholding at the site, situated on the main stem of the river, and protects a key remaining area of salt marsh as well as adjacent forest habitat. This site provides benefits to marbled murrelet, northern spotted owl, bald eagle, and a variety of waterfowl and shorebirds.

- **Kennedy Creek NAP/NRCA:** DNR added 123 acres in FY 2019 and 534 acres in early FY 2020 to the Kennedy Creek Natural Area to provide additional protection for riparian habitats supporting the Kennedy Creek estuary and salt marsh. Kennedy Creek also supports a major chum salmon run and provides seasonal foraging for numerous shorebirds, waterfowl, and bald eagles. The lands acquired include more than five miles of the Kennedy Creek channel and riparian habitat (Figure 16), as well as adjacent upland forest.

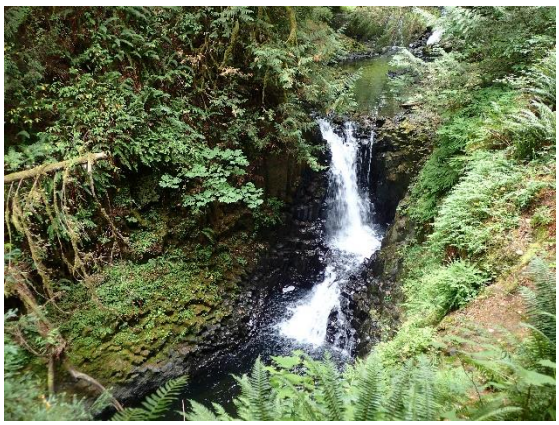


Figure 16: Kennedy Creek Falls in the Newly-Acquired Portion of Kennedy Creek NAP/NRCA. Photo courtesy of Regina Johnson.

- **Mount Si NRCA:** DNR added 289 acres to the Mount Si NRCA, protecting late-successional forests important to marbled murrelets and northern spotted owls, and enhancing residential buffer and recreational opportunities.
- **Stevenson Ridge NRCA:** A 163-acre parcel was added to the Stevenson Ridge NRCA to enhance protection of mature and late-successional forest that provides northern spotted owl nesting habitat.

In addition to land acquisitions, the Natural Areas Program continued to actively manage and enhance habitat on natural areas in FY 2019 to benefit federally listed species such as Bradshaw's lomatium (Lacamas Prairie NAP/NRCA), Wenatchee Mountains checker-mallow (Camas Meadows NAP, Figure 17), island marble butterfly (Cattle Point NRCA), Oregon spotted frog (Trout Lake NAP), and Puget Sound/Hood Canal salmon runs (Dabob Bay NAP/NRCA).

Figure 17: Wenatchee Mountains Checker-mallow at Camas Meadows NAP. Photo courtesy of David Wilderman.

Table 11 lists the natural areas located within the HCP boundary. Natural areas in bold text are composed primarily of mature forests and/or late-seral forests.

Table 11: Acres Added to Natural Areas within HCP-Covered Lands in FY 2019.

Natural Area	County	Acres Added in FY 2019[1]	Total Current Acres
Admiralty Inlet NAP	Island	-	79.5
Ashford NRCA	Pierce	-	78.4
Bald Hill NAP	Thurston	-	313.7
Bone River NAP	Pacific	79.7	2,799.7
Camas Meadows NAP	Chelan	-	2,017.8
Carlisle Bog NAP	Grays Harbor	-	310.0
Cattle Point NRCA	San Juan	-	112.1
Charley Creek NAP	King	-	1,966.0

Natural Area	County	Acres Added in FY 2019[1]	Total Current Acres
Chehalis River Surge Plain NAP	Grays Harbor	-	4,493.6
Clearwater Bogs NAP	Jefferson	-	504.1
Clearwater Corridor NRCA	Jefferson	-	2,323.0
Columbia Falls NAP	Skamania	-	1,233.8
Cypress Highlands NAP	Skagit	-	1,072.4
Cypress Island NRCA	Skagit	-	4,135.1
Dabob Bay NAP/NRCA	Jefferson	40.2	3,209.8
Dailey Prairie NAP	Whatcom	-	228.8
Devils Lake NRCA	Jefferson	-	80.0
Elk River NRCA	Grays Harbor	-	5,560.0
Ellsworth Creek NRCA	Pacific	-	557.0
Goose Island NAP	Grays Harbor	-	12.0
Granite Lakes NRCA	Skagit	-	603.2
Gunpowder Island NAP	Pacific	-	152.0
Hamma Hamma Balds NAP	Mason	-	957.0
Hat Island NRCA	Skagit	-	91.2
Hendrickson Canyon NRCA	Wahkiakum	-	159.0
Ink Blot NAP	Mason	-	183.6
Kennedy Creek NAP/NRCA[2]	Mason	122.7	340.3
Kings Lake Bog NAP	King	-	309.2
Kitsap Forest NAP	Kitsap	-	571.9
Klickitat Canyon NRCA	Yakima	-	2,335.2
Lacamas Prairie NAP/NRCA	Clallam	-	201.1
Lake Louise NRCA	Whatcom	-	137.7
Lummi Island NRCA	Whatcom	-	671.5
Merrill Lake NRCA	Cowlitz	-	114.2
Middle Fork Snoqualmie NRCA	King	-	9,198.4
Mima Mounds NAP	Thurston	-	640.5
Monte Cristo NAP	Klickitat	-	1,151.0
Morning Star NRCA	Snohomish	-	37,841.9
Mount Si NRCA	King	288.9	13,734.9
Naselle Highlands NRCA	Pacific	80.9	188.9
Niawiakum River NAP	Pacific	-	1,097.8
North Bay NAP	Grays Harbor	-	1,214.9
Oak Patch NAP	Mason	-	17.3
Olivine Bridge NAP	Skagit	-	148.0
Point Doughty NAP	San Juan	-	56.5
Queets River NRCA	Jefferson	-	601.0
Rattlesnake Mtn Scenic Area	King	24.3	1,875.7
Rocky Prairie NAP	Thurston	-	35.0
Sand Island NAP	Grays Harbor	-	8.0
Shipwreck Point NRCA	Clallam	-	471.8
Schumacher Creek NAP	Mason	-	498.8
Skagit Bald Eagle NAP	Skagit	-	1,546.0
Skamokawa Creek NRCA	Wahkiakum	87.5	381.1

Natural Area	County	Acres Added in FY 2019[1]	Total Current Acres
Skookum Inlet NAP	Mason	-	142.6
Snoqualmie Bog NAP	King	-	110.5
South Nemah NRCA	Pacific	-	2,439.5
South Nolan NRCA	Jefferson	-	213.0
Stavis NRCA	Kitsap	9.3	2,996.2
Stevenson Ridge NRCA	Skamania	162.6	583.9
Table Mountain NRCA	Skamania	-	2,836.5
Tahoma Forest NRCA	Lewis	-	230.0
Teal Slough NRCA	Pacific	-	8.4
Trout Lake NAP	Klickitat	-	2,014.0
Washougal Oaks NAP/NRCA	Clark	12.6	276.8
West Tiger Mountain NRCA	King	6.4	3,914.3
Whitcomb Flats NAP	Grays Harbor	-	5.0
White Salmon Oak NRCA	Klickitat	-	551.2
Willapa Divide NAP	Pacific	-	587.0
Woodard Bay NRCA	Thurston	15.7	917.5
	Total Acres	**930.8**	**126,447.8**

[1]Acreage data 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.
[2]An additional 533.7 acres was added to the Kennedy Creek NAP/NRCA in early FY 2020 which will be reported in this table in next year's HCP Annual Report.

Table 12 lists the federally threatened and endangered species found in natural areas covered by the HCP, and Table 13 lists other species of concern in these areas.

Table 12: 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, Queets River NRCA, 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, Clearwater Corridor 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

Species	Federal Status	Natural Area
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 13: Special Status Species Located in Natural Areas Covered by the HCP.

Species	Natural Area[1]
Federal Candidate	
Island Marble Butterfly	Cattle Point NRCA
Federal Species of Concern	
Bald Eagle	Numerous sites
Beller's Ground Beetle	Snoqualmie Bog NAP, Kings Lake Bog NAP
Cascades Frog	Morning Star NRCA
Columbia Torrent Salamander	Ellsworth Creek NRCA
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 Mountain NRCA
Larch Mountain Salamander	Table Mt. NRCA, Columbia Falls NAP
June's 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 Highlands NAP, Mt. Si NRCA, Elk River NRCA, Hat Island NRCA, Lummi Island NRCA, North Bay NAP
Puget Sound Coho Salmon	Dabob Bay NAP/NRCA
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

Species	Natural Area[1]
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	
Olympic Mudminnow (State Sensitive)	Carlisle Bog NAP, Chehalis River Surge Plain NAP, West Tiger Mountain NRCA
Sandhill Crane (State Endangered)	Trout Lake NAP, Klickitat Canyon NRCA
State Candidate – No Federal Status	
Cascade Torrent Salamander	Table Mountain NRCA
Dunn's Salamander	Teal Slough NRCA, South Nemah NRCA
Lewis's Woodpecker	Camas Meadows NAP
Bog Idol Leaf Beetle (Formerly Long-horned Leaf Beetle)	King's Lake Bog NAP
Olympia Oyster	Dabob Bay NAP/NRCA, Woodard Bay NRCA
Pacific Herring	Dabob Bay NAP/NRCA, Stavis NRCA, Elk River NRCA
Pileated Woodpecker	Table Mountain NRCA, Morning Star NRCA, Kitsap Forest NAP, and others
Puget Blue	Rocky Prairie NAP
Purple Martin	Woodard Bay NRCA, Kennedy Creek NAP
Sand Verbena Moth	Cattle Point NRCA
Western Toad	Dabob Bay NAP/NRCA, Morning Star NRCA, Oak Patch NAP, Stavis NRCA
White-headed Woodpecker	Camas Meadows NAP
Vaux's Swift	Numerous sites

[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 region offices may also offer 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. Table 14 summarizes DNR's sales of special forest products on HCP-covered forestlands in FY 2019.

Table 14: Sales of Special Forest Products on HCP-Covered Areas in FY 2019.

Region	Permits		Leases		Direct Sales	
	Occurrences	Acres	Occurrences	Acres	Occurrences	Acres
South Puget	167	84,469	23	70,104	2	822
Olympic	73	204,556	-	-	-	-
Pacific Cascade	75	220,570	-	-	1	50
Total	**318**	**516,849**	**23**	**69,469**	**4**	**922**

Leases

Appendix: Background on Leases

Grazing Permits and Leases

In FY 2019, there were approximately 270 acres of grazing leases on the westside. Most of this land is not forested and is therefore not managed under the HCP. There were no grazing permits active on the westside in FY 2019.

In Northeast Region as of December 18, 2019, there were approximately 2,125 acres of grazing leases and no grazing permits on forested land covered by the HCP in FY 2019. In Southeast Region as of December 13, 2019, there were 70,476 acres of grazing leases and 74,548 acres of grazing permits of forestlands covered by the HCP.

Communication Sites Leases

In FY 2019, there were 71 communication sites leased within the HCP boundary totaling approximately 77 acres.

Valuable Material Sales

Appendix: Background on Valuable Material Sales

In FY 2019, DNR had six active sand, gravel, and rock contracts within the HCP boundary, totaling approximately 665 acres. Table 15 summarizes those contracts. These contracts were approved by the Board of Natural Resources and awarded through a public auction process.

Table 15: Sand, Gravel, and Rock Contracts Active in FY 2019.

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 has been mined out and is in the process of being reclaimed.

In addition to the contracts listed above, DNR occasionally sells valuable material through a direct sale, a one-time agreement for the removal of a small amount of a resource (a maximum of $25,000 in value) that does not require Board of Natural Resources approval.

Recreation Program

Appendix: Background on Recreation Program

In calendar year 2019, DNR's recreation program worked with Washington Conservation Corps (WCC) crews and many volunteer groups to complete numerous projects across the DNR landscape. These projects included building more than 55 miles of new trail; performing maintenance on more than 325 miles of trail; installing new bridges, picnic tables, and fire rings; closing unauthorized trails and access points; and removing garbage. This work helped enhance the recreational experience, keep users safe and informed, and protect resources from erosion and overuse. Projects are summarized below.

Development

Northwest Region

Blanchard State Forest, Skagit County: DNR built crib stairs to reduce erosion and improve public safety at the Samish Overlook west launch and worked with volunteers to complete maintenance on approximately five miles of trail, maintain culverts, clear ditches and drain dips, and clean bridges to reduce soil erosion and minimize the impact of recreational use. WCC crews replaced failing boardwalks and wood puncheon with dirt turnpike trail structures. One-half mile of trail tread was reconstructed by widening the trail and improving drainage structures to reduce erosion, and unauthorized trails were decommissioned.

Harry Osborne State Forest, Skagit County: Recreation staff worked with volunteers to complete maintenance on five miles of trail (Figure 18). This work included maintaining culverts, clearing ditches and drain dips, and filling trail tread with gravel to reduce soil erosion and minimize the impact of recreational use. WCC crews worked on ten miles of trail maintaining culverts, brushing, clearing ditches and drain dips, and filling trail tread with gravel.

Figure 18: Volunteers Complete Trail Maintenance in the Harry Osborne State Forest. Photo courtesy of Rick Foster.

Morning Star Natural Resources Conservation Area, Snohomish County: DNR staff completed numerous projects to enhance public safety, improve user experience, and protect water quality. Staff conducted trail improvement work on the first two miles of the Boulder-Greider mainline trail, installed a sustainable backcountry toilet at Gothic Basin, and improved and defined trail tread on 300 feet of challenging trail on the Walt Bailey/Cutthroat Lakes trail system. Staff also acquired three bridges for installation on the Cutthroat Lakes trail system and completed cultural resources review for campground and trail improvements. One bridge was also acquired for Boulder Creek.

North Mountain Bike Trail System, Skagit County: The North Mountain Bike Trail System officially opened in October 2019. DNR worked with the Town of Darrington and the Evergreen

Mountain Bike Alliance to complete construction of 10.5 miles of trail within the upper-elevation area of the planned non-motorized trail system.

Point Doughty Natural Area Preserve, San Juan County: DNR acquired two sets of pre-fabricated stairs for installation as part of renovation work at the campground. DNR also rerouted approximately 100 feet of shoreline trail where the existing trail was at risk of erosion.

Reiter Foothills Forest, Snohomish County: In July 2019 DNR held the third annual Reiter Rock Crawl, hosting approximately 500 spectators and competitors from as far away as Colorado, New Mexico, Utah, and Canada (Figure 19). DNR also installed trail signage on all 25 miles of off-road vehicle (ORV) trails and three miles of non-motorized trail, and conducted inspections to identify needed repairs. DNR and WCC crews built one-half mile of new all-terrain vehicle (ATV) trail, hardened 1.2 miles of 4x4 trail, improved non-motorized access to Wallace Lake, repaired and re-graded two parking lots, inspected bridges, and removed trail hazards throughout the forest.

Figure 19: Third Annual Reiter Rock Crawl Event. Photo courtesy of Jacob Gilbert.

Walker Valley ORV Area, Skagit County: DNR sponsored 12 volunteer events that included garbage removal, installing and repairing signage, planting trees, maintaining trail, and restoring areas damaged by ORVs. Recreation staff replaced two bridges on the Tooler Trail and installed one culvert, 67 water bars, and 61 drain dips to protect resources from erosion and prevent sediment runoff into streams. Staff also inspected and maintained bridges, trails, culverts, and ditches throughout the forest, removed unauthorized trails, and cleaned up the Peter Burns Trailhead.

Olympic Region

Coast Campgrounds, Clallam and Jefferson Counties: DNR built steps and a tent pad at Yahoo Lake and performed weekly site maintenance.

Colville Trails, Clallam County: Donating more than 600 hours of time, volunteers built two miles of mountain bike trails and a pump track intended to develop mountain bike skills for less-advanced riders.

Foothills ORV and Sadie Multi-Use Trails, Clallam County: Working with WCC crews and volunteer groups, DNR completed a variety of projects that provide a safer experience for the user while promoting environmental stewardship including the installation of seven culverts and maintenance of 15 existing culverts. Staff hardened 585 linear feet of trail with weed-free surface rock to reduce sediment delivery to water, installed 26 new water dips and bars and maintained 120 more to improve drainage and reduce soil erosion, and installed signs and barriers to limit unauthorized spur trails.

Little River Trail, Clallam County: DNR improved a bridge by replacing railings, tread, and sill (Figure 20). The

Figure 20: Bridge Improvement Project on the Little River Trail in Clallam County. Photo courtesy of Justin Zarzeczny.

bridge was also lifted and the trail was re-routed for 0.10 miles to a more suitable grade.

Lyre River Campground, Clallam County: In consultation with WDFW, DNR installed a cedar crib log with round river cobble as backfill to stabilize an Americans with Disabilities Act (ADA) accessible fishing platform (Figure 21). DNR also performed routine maintenance to maintain roads, campsites, and facilities, including installation of new water lines for potable water spigots and metered electrical service to the camp host site, and development of one mile of new trail to connect the campground to adjacent property owned by the North Olympic Land Trust.

Figure 21: A Cedar Crib Log Was Used to Stabilize a Fishing Platform at the Lyre River Campground. Photo courtesy of Justin Zarzeczny.

Reade Hill Trail, Clallam County: DNR installed a new retaining wall at the picnic area parking lot, and five interpretive signs along the trail to educate the public about sustainable forest management.

Sadie Creek 4x4 Trails, Clallam County: Volunteers installed spall rock, silt fencing, and sterile straw to reduce sediment delivery to a Type-5 stream adjacent to a bog.

Striped Peak Trail, Clallam County: DNR began building a new ridge trail in partnership with volunteers from the Washington Trails Association (WTA) and WCC crews.

Pacific Cascade Region

Yacolt Burn State Forest, Clark County: DNR hosted the annual "Pick Up the Burn" event that removed 30 tires and 20 cubic yards of garbage from the forest. DNR also cleaned up target shooting areas, removed graffiti, and closed numerous unauthorized trails around gates. Several other projects were also completed in different areas of the Yacolt Burn State Forest:

- **Tarbell Trail System, Clark County:** DNR installed two new fiberglass bridges over Coyote Creek, completed drainage and culvert work on approximately 3.4 miles of trail to reduce erosion, and brushed 15 miles of trail. DNR maintained facilities at the Yacolt Burn, Tarbell, Grouse Vista, and Larch Mountain trailheads. Staff completed eight miles of new non-motorized multi-use trail and replaced damaged signs, fences, and kiosks. DNR also hosted volunteer work parties sponsored by the WTA, Back Country Horsemen of Washington, Washington Trail Riders Association, Evergreen Mountain Bike Alliance, and Chinook Trail Association.
- **Jones Creek and Hagen Creek Trail Systems, Clark County:** Recreation staff completed construction of one mile of new ATV trail, 1.5 miles of 4x4 trail, 0.3 miles of trail in the challenge area, one mile of single-track motorized trail, and a new practice circle for kids. Staff repaired and maintained motorized trail filters to prevent resource damage, added new signs to motorized trails, repaired vandalized sections, and decommissioned unauthorized 4x4 trails. Staff also completed reroutes and grade adjustments to reduce erosion and performed routine maintenance.
- **Cold Creek Campground and Day-Use Area, Clark County:** DNR replaced a damaged culvert to reduce erosion; completed improvements to 0.25 miles of ADA-accessible trail; upgraded multiple day-use sites and campsites with gravel, new picnic tables, a shelter, and fire rings; installed gates and gate keepers; removed hazard trees; and hosted volunteer work

parties sponsored by the Boy Scouts of America and the Washington and Chinook Trails Associations.

- **Dougan Creek Campground and Day-Use Area, Skamania County:** DNR staff added two tent sites and upgraded campsites with new gravel, picnic tables, and fire rings. Roads, parking, and day-use sites were improved with grading and gravel, and access to an ADA-accessible trail was improved.
- **Rock Creek Horse Camp and Day-Use Area, Clark County:** DNR created four new campsites and upgraded existing campsites with gravel, new picnic tables, and fire rings. Staff removed hazard trees, installed a high line for hitching horses, and hosted multiple volunteer work parties.

Butte Creek Day-Use Area, Pacific County: With local community support, DNR reopened this site after a 12-year closure and completed several upgrades including installation of a new entrance sign and kiosk, two wooden bridges, and five picnic tables; replacement of wooden stairs with concrete blocks, and the reopening of nearly one mile of hiking trail.

Merrill Lake, Cowlitz County: DNR staff installed a new entrance sign; improved trails; upgraded campsites with gravel, new picnic tables, and fire rings; and hosted volunteer work parties

Radar Ridge Block, Pacific County: Staff added two new campsites at Snag Lake.

Salmon Creek Block, Tunerville Campground, Pacific County: The recreation program conducted road maintenance, repaired damage to campsites from ATVs, and hosted volunteer work parties sponsored by Friends of Tunerville and Back Country Horsemen Willapa Hills Chapter.

Siouxon Block, Skamania County: Staff established the new Sugarloaf trailhead.

Winston Creek Campground, Lewis County: DNR staff installed a new entrance sign; upgraded the kiosk; and upgraded campsites with gravel, new picnic tables, and fire rings.

South Puget Sound Region

Capitol State Forest, Thurston and Grays Harbor Counties: DNR hosted the 14th annual Great Gravel Pack-In where volunteers from equestrian, mountain bike, ORV, and trail running organizations used horses and ATVs to spread more than 15 tons of rock to harden both motorized and non-motorized trails. Staff also replaced decaying decking on several bridges to maintain user safety and prevent debris and sediment from falling into the creek below. Staff from DNR's Recreation and Timber Sales programs met with trail recreationists in the field to discuss the location of leave trees on the planned Delineation timber sale. Several other projects were also completed within Capitol State Forest:

- **Level Up Trail:** Volunteers built two miles of new trail to increase safety and keep recreational users off a busy forest road.
- **Fall Creek Trailhead:** DNR staff began work on a half-acre expansion to better accommodate equestrian users. Staff and volunteers also built a day-use shelter and a ramp for disabled equestrians.
- **McLane Creek Nature Trail:** DNR replaced 120 feet of decomposing treated boardwalk with fiberglass stringers and decks and replaced 120 feet of structurally insufficient pressure-treated wood bridges with fiberglass structures and fir planking.

- **Wedekind Trail**: Volunteers installed 100 feet of rock and geosynthetic material to protect wet soils and encourage riders to stay in the center of trail. DNR also worked with volunteers to complete drainage maintenance and brushing on approximately 40 miles of trail.
- **Elbe Hills State Forest, Pierce County:** In 2019, volunteers donated nearly 5,000 hours of time to maintain and improve recreation facilities, including removal of 7,500 pounds of garbage. Recreation staff also completed routine maintenance on seven bridges and 40 miles of non-motorized trail at the Sahara Creek Campground and Nicholson Horse Trails and replaced a 50-foot puncheon to protect wet soils. In the Elbe ORV Campground and Trail system, approximately 500 feet of trail were fully reinforced with rock for tread and erosion prevention.

Mount Si NRCA, King County: DNR's Recreation and Natural Areas programs, in partnership with the Mountains to Sound Greenway Trust, completed construction on the new 1.7-mile Oxbow Loop hiking trail including an 80-foot trail bridge, installation of a self-contained outhouse, and a trailhead parking area. The Oxbow Loop Trail officially opened in May 2019.

Raging River State Forest, King County: Recreation staff began construction on 6.5 miles of trail.

Tahoma State Forest, Lewis County: Recreation staff conducted routine maintenance on 50 miles of winter-use trail and three ski huts, including waterproofing the restrooms to prevent infiltration of snowmelt. Maintenance included brushing, tread and drainage maintenance, and signage.

Tiger Mountain State Forest, King County: Recreation staff built a 1.5-mile connector trail, relocated one mile of the South Tiger Traverse Trail and built another 0.5 miles of optional trail on the Northwest Timber Trail to reduce trail congestion.

West Tiger Mountain NRCA, King County: DNR's Recreation and Natural Areas programs, in partnership with the WTA, completed a 1.5-mile reroute of the popular Tiger Mountain Trail. A segment of the trail was relocated to a more sustainable location, improving the user experience.

Southeast Region

Ahtanum State Forest, Yakima County: Recreation staff installed a new bridge at Ahtanum Camp to improve fish passage and water flow and removed access to several dispersed campsites along the Green Dot Road System to protect sensitive meadows and riparian areas.

Kittitas County: WTA volunteers completed trail maintenance on the Westberg Trail and rerouted 1,100 feet of the trail to a more sustainable location. Local residents near Elk Heights held work parties to remove garbage along Green Dot Roads and clean up campsites, logging a total of 841 hours.

Klickitat County: DNR conducted routine campground maintenance at Bird Creek and Island Camp including cleaning out fire rings, removing hazard trees, and maintaining vault toilets. Several truckloads of garbage were removed. A new toilet was installed at Buck Creek Trailhead #1. Numerous homeless camps and abandoned vehicles were removed.

Naneum Ridge State Forest, Kittitas County: With help from local volunteers, contract fire crews, and the WCC, DNR constructed approximately seven miles of new trail in the Cookie Cutter Trail System (Figure 22). Evergreen Mountain Bike Alliance held weekly work parties on the trail system, logging 380 volunteer hours. In addition, volunteers with motorized groups held two work parties to clean up the Green Dot Road System and dispersed campsites, and the Master Hunter volunteer group cleaned up hunting camps.

Teanaway Community Forest HCP Lands, Kittitas County: Recreation staff completed maintenance at Indian Camp, cleaning out fire rings, removing hazard trees, maintaining restrooms, and removing garbage. DNR also hosted two volunteer events that included cleanup of campgrounds and installation of cattle exclusion fencing.

Wenas Valley-Cascade Camp, Yakima County: Volunteers donated 145 hours to pick up garbage along the Green Dot Road System and at dispersed campsites. DNR maintained the Hog Ranch Road through the Cascade Camp to protect riparian areas and installed two new vault toilets.

Figure 22: A WCC Crew Work on the Cookie Cutter Trails in Naneum Ridge State Forest. Photo courtesy of Noel Cruse.

Planning and Design

Northwest Region

Blanchard State Forest, Skagit County: DNR began planning for new restroom construction at Lily Lake and Lizard Lake campgrounds and the relocation of a steep section of the Blanchard Mainline road to reduce erosion from vehicles and improve safety.

Cattle Point NRCA, San Juan County: DNR continued design work on new interpretive signage to educate users about the site and its conservation mission.

Cypress Island NRCA, San Juan County: DNR finished design work for mooring buoys which will protect eelgrass beds from impacts associated with anchoring.

Griffin Bay, San Juan County: DNR began planning to replace two existing vault toilets with sustainable composting toilets which will reduce cost and eliminate the need for septic pumping.

Lummi Island NRCA, Whatcom County: Staff began planning for new beach access steps, relocating a portion of steep and hazardous trail, and replacing two vault toilets with sustainable composting toilets.

Morning Star NRCA, Snohomish County: DNR began planning for renovations at Lower Ashland Lake, Upper Ashland Lake, and Beaver Plant campgrounds. Planned improvements include relocation of campsites, toilets, and trails to protect water quality and improve the user experience. DNR also began planning and design for bridge installation on two water crossings on the Boulder-Greider trail to improve public safety and protect water quality.

Reiter Foothills State Forest, Snohomish County: DNR contracted with an architecture and engineering firm to develop a site plan and design for a permanent trailhead for the ORV area. The

design includes 40 truck and trailer parking stalls, 34 standard vehicle stalls, five ADA stalls, a double-vault concrete toilet, and a storm-water detention pond. Staff also conducted fieldwork to plan for multi-use non-motorized trails.

Walker Valley State Forest, Skagit County: DNR began planning for the Criss Cross bridge replacement and preliminary design for an ORV play area.

Pacific Cascade Region

Yacolt Burn State Forest, Jones Creek and Hagen Creek Trail Systems, Clark County: DNR started the planning process for expanding the Jones Creek parking area.

South Puget Sound Region

Green Mountain State Forest, Kitsap County: DNR's recreation program completed community outreach for planning, design, and layout of new trail system connections. In addition, a design process was completed for renovating the Green Mountain Summit Vista and for developing a new access road trailhead. Portions of these projects will begin the development phase in 2020.

Marckworth State Forest, King and Snohomish Counties: DNR began pre-planning, land suitability analysis, and evaluation of existing recreational use across the forest, focusing primarily on the Cherry Valley area. Relocation of unsustainable portions of an existing hiking trail and providing sustainable parking access to Cherry Falls were explored, evaluated, and designed.

Raging River State Forest – Phase 3 Trails, King County: DNR recreation planners continued Phase 3 trail system layout and design for 10 additional miles of trail which will improve access for non-motorized users.

Tiger Mountain State Forest, King County: Recreation planners designed and permitted expansion of the east Tiger Mountain trail system, including new community connections and a link to the equestrian trail system. A day-use shelter near the east Tiger Mountain Summit was designed and progress was made on the Tiger Mountain Summit trailhead expansion

West Tiger Mountain NRCA, King County: DNR recreation planners began stakeholder outreach and concepts for renovating and expanding a gateway community facility and parking area and explored appropriate amenities and functions to be included at the High Point Trailhead and surrounding area on the south side of Exit 20, Interstate 90.

Southeast Region

Eagle's Nest Vista, Ahtanum State Forest, Yakima County: DNR recreation and engineering staff began developing a plan to improve access to the vista. Once completed, the unauthorized braided trail system will be decommissioned and the area will be restored with native plants and soils. Other improvements will include a new vista wall, ADA parking, new kiosks, and educational signage.

Cookie Cutter Trail System, Naneum Ridge State Forest, Kittitas County: In partnership with members of the Evergreen Mountain Bike Alliance, DNR continued planning for the Cookie Cutter Trail system. The system will be approximately 34 miles in length and will have two trailheads.

Teanaway Community Forest HCP Lands, Kittitas County: DNR continued the planning and design process to add one group site to Indian Camp and relocate some existing sites to restore riparian vegetation. Staff also started planning for a new groomed snowmobile route to replace one abandoned due to close proximity to a stream, leaving users without a connection from Indian Camp to 29 Pines. DNR staff are working with the local snowmobile club, Washington State Parks, and local trail groomers to identify a location to restore the connection.

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 2019.

Appendix A: Background

This appendix contains background information about DNR-managed forestlands 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.

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.

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 needed 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

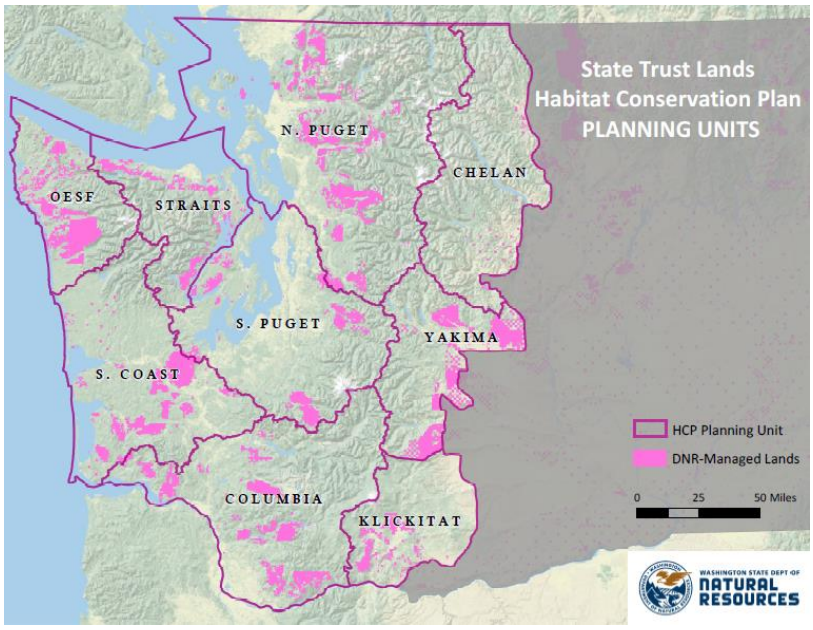
complex, healthy, resilient forest ecosystem capable of supporting native species. The HCP was signed in January 1997.

Lands Covered by the HCP

DNR manages approximately 2.4 million acres of forestland statewide. Of this amount, the HCP guides management of approximately 1.9 million acres of forestland within the range of the northern spotted owl (*Strix occidentalis caurina*). In general, these 1.9 million acres are located between the western coast 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).

Implementation of the HCP conservation objectives for the nine planning units is grouped into the three areas: 1) the five westside planning units except the OESF (HCP, p. IV.3), 2) the OESF (HCP, p. IV.86), and 3) the three eastside planning units (HCP, p. IV.19). The five westside planning units are Straits, North Puget, South Puget, South Coast, and Columbia. The three eastside planning units are Yakima, Chelan, and Klickitat.

DNR provides GIS data for lands covered by the HCP to allow for public analysis and to facilitate comparisons with relevant GIS layers maintained by the Services.



Map A-1: HCP Planning Units

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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 annual comprehensive review by subject 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]	Subject
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
FY 2017 Annual Report	Recreation
FY 2018 Annual Report	Riparian Forest Habitat Restoration
FY 2019 Annual Report	Forest Inventory

[1]A comprehensive review was not completed for the FY 2015 report due to limited staff capacity.

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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). NRF management areas on the westside were identified in the North Puget, South Puget, and Columbia planning units.
- **Dispersal management areas:** Areas important for facilitating northern spotted owl dispersal (movement of young owls from nesting sites to new breeding sites). Dispersal management areas on the westside were identified in the North Puget, South Puget, and Columbia planning units.
- **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.

Northern Spotted Owl. Photo courtesy of USFWS.

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. 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.

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: 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
			Sub-mature habitat	Sub-mature
			Dispersal habitat	Young forest marginal
				Dispersal
	South Puget HCP Planning Unit only	Dispersal habitat	Movement, roosting, and foraging (MoRF) plus habitat	High-quality nesting
				Type A
				Type B
				MoRF
			Movement plus habitat	Sub-mature
				Young forest marginal
				Movement
OESF		Old Forest Habitat		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.11-12 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**
	A minimum of 5% ground cover of large woody debris	(Down wood ≥ 4" diameter class) ≥ 2,400 $ft.^3$ per acre
	At least three of the 31 trees ≥ 21" dbh have broken tops	Not in query
Type A	A multi-layered, multispecies canopy dominated by large (≥ 30" dbh) overstory trees (typically 15–75 trees per acre)	(FVS-derived number of canopy layers) ≥ 2 **and**
		(Primary species ≥ 4 diameter class) >10% and (Primary species ≥ 4 dbh) ≤ 80% (mulitspec = yes) **and**
		(Live trees ≥ 30" diameter class) ≥ 15 trees per acre and ≤ 75 trees per acre **and**
	Greater than 70% canopy closure	(Relative density of live trees ≥ 4" diameter class) ≥ 48 **and**
	More than two large snags per acre, 30" dbh or larger	(Snags ≥ 30" diameter class and ≥ 16' tall) ≥ 2.5 trees per acre **and**
	Large accumulations of fallen trees and other woody debris on the ground	(Down wood ≥ 4" diameter class) ≥ 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) ≥ 2 **and**
		Primary species >10% and primary species ≤ 80% (mulitspec = yes) **and**
		(Live trees ≥ 20" diameter class) ≥ 75 trees per acre and ≤100 trees per acre **and**
	Greater than 70% canopy closure	(Relative density of live trees ≥ 4" diameter class) ≥ 48 **and**
	Large (greater than 20" dbh) snags present	(Snags ≥ 20" diameter class and ≥ 16 ft. tall) ≥ 1 tree per acre **and**
	Accumulations of fallen trees and other woody debris on the ground	(Down wood ≥ 4" diameter class) ≥ 2,400 $ft.^3$ per acre

Habitat Type	Habitat Definitions (HCP p. IV.11-12 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 ≥ 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' tall	(Largest 40 live trees per acre) ≥ 85' tall **and**
	Minimum of 5% ground cover of large down woody debris	(Down wood ≥ 4" diameter class) ≥ 2,400 ft.^{3} per acre **and**
	At least three snags or cavity trees per acre that are at least 15" dbh	(Snags ≥ 15" diameter class and ≥ 16 ft. tall) ≥ 3 trees/acre **and**
	At least two canopy layers	(FVS-derived number of canopy layers) ≥ 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 ≥ 4" diameter class) ≥ 30% of all live tree/acres **and**
	At least 70% canopy closure	(Relative density of live trees ≥ 4" diameter class) ≥ 48 **and**
	Tree density of 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' tall	(Largest 40 live trees/acre) ≥ 85' tall **and**
	At least three snags or cavity trees per acre that are at least 20"	(Snags ≥ 20" diameter class and ≥ 16 ft. tall) ≥ 3 trees per acre **and**
	Minimum of 5% ground cover of large down woody debris	(Down wood ≥ 4" diameter class) ≥ 2,400 ft.^{3} per acre
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	(Snags ≥ 20" diameter class and ≥ 16 ft. tall) ≥ 2 trees per acre **or**

Habitat Type	Habitat Definitions (HCP p. IV.11-12 and WAC 222-16-085)	Data Query Used to Interpret Habitat Definitions
	the ground covered with 4" diameter or larger wood, with 25–60% shrub cover	(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
Dispersal	Canopy cover at least 70%	(Relative density of live trees ≥ 4" diameter class) ≥ 48 **and**
	Quadratic mean diameter of 11" dbh for 100 largest trees per acre in a stand	(Largest 100 live trees per acre) ≥ 11" QMD **and**
	Top height of at least 85'	(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
Old Forest	Stands classified as the old forest habitat type were identified through implementation of the interim marbled murrelet conservation strategy. As part of the strategy, DNR conducted map and field reviews to delineate remnant patches of older forest to estimate how much potential murrelet habitat was present in the OESF. While over 40,000 acres were initially delineated for the purposes of eventually conducting murrelet surveys, the stands also coincided with unknown and suitable NSO habitat. In 2005 and 2006, during the Settlement Agreement negotiations, the Settlement Agreement Partners agreed to include those 40,000+ acres of older forest stands as the old forest habitat type, a fourth habitat type in the old forest habitat class.	

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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 which were defined through an amendment to the HCP. Sub-landscapes are used only in this unit.

The NSO conservation strategy in the HCP involves maintaining thresholds of habitat in each SOMU. Most designated NRF and dispersal SOMUs have a 50 percent overall habitat threshold.

For the OESF and South Puget HCP Planning Units, habitat thresholds have two objectives. For example, the OESF has a 40 percent overall habitat threshold objective which is further defined as restoring and maintaining at least 20 percent of each SOMU as old forest habitat with the rest composed of structural or better habitat. In the South Puget HCP Planning Unit, dispersal management areas have a 50 percent overall threshold, 35 percent of which is MoRF plus habitat, and 15 percent of which is movement plus habitat.

Table A-4 describes habitat thresholds for selected HCP planning units.

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
				MoRF
		15%	Movement plus habitat	Sub-mature
				Young forest marginal
				Movement
All Other Westside 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 special zones are not 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.

In October 2016, DNR adopted the OESF Forest Land Plan that will guide management of over 270,000 acres of forestland on the Olympia Peninsula. DNR's approach to assessing and mapping the current extent of NSO habitat for the OESF Forest Land Plan involved modeling numerous forest attributes from 2009–2109, including the presence of snags and down wood, which had been previously included as static features in NSO habitat models. Modeling snags and down wood allowed DNR to more accurately map NSO habitat across the OESF.

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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.

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Riparian Conservation Strategy

For the five westside HCP planning units, the HCP riparian conservation strategy was developed with two 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 using RMZs and WMZs to provide clean water, shade, and large logs for streams. 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, which applies to all westside HCP planning units except the OESF, 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 structure and species composition in areas where historic timber harvest created stands that were even-aged and overstocked. DNR uses canopy gaps and "skips"—areas that are left unmanaged—to help increase structural diversity and accelerate the development of habitat. Candidate stands for RFRS treatments are often missing long-lived conifer species like western red cedar, or are dominated by short-lived species like red alder. 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 to streams when they are alive and large woody debris 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, further restoration activities are low priority and site specific. During the initial RFRS implementation period, thinning in stands 70 years of age or older was conducted on a site-specific basis in consultation with the Services. This restriction was lifted in 2012 through a joint concurrence letter signed by DNR and the Services.

Headwaters Conservation Strategy

In 2007, DNR collaborated with the Services and the scientific community to develop a draft Headwaters Conservation Strategy 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 it would have introduced a prohibitive 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 objectives of the previous version. This alternative strategy incorporates emerging ideas about the

importance of non-fish-bearing stream habitat for ecosystem conservation and downstream fish habitat quality.

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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, public consultation, input from an independent science team, and several years of consultation with USFWS on the development of alternatives for a long-term conservation strategy, the Board of Natural Resources adopted a long-term strategy in December 2019. The long-term strategy replaces the interim strategy in the HCP.

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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.

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.

Adaptive Management and the Conservation Strategies

Adaptive management is a way to manage natural resources when knowledge of ecosystem functions or the effects of human actions is incomplete. New scientific developments and information obtained through research and monitoring can identify changes in DNR 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, science-based adaptive management process that allows for continual improvement of management strategies and practices. The adaptive management process includes the following tasks:

- Set research priorities
- Develop study plans

- Manage research projects
- Review results
- Make changes to DNR's forest management practices if necessary
- Monitor management activities to inform continuous improvement

Currently, adaptive management is implemented through two processes: the State Lands Adaptive Management Program and the OESF adaptive management process. These processes are closely linked, though they differ in scope and level of formalization. The State Lands Adaptive Management Program includes activities throughout DNR managed lands, while the OESF adaptive management process is focused on activities in the OESF. Unlike the state-wide program, the OESF process is guided by an administrative procedure, adopted in FY 2017, which describes the steps of the process and the responsible parties. Development of the OESF Forest Land Plan resulted in the separate OESF adaptive management process, as this process is an integral part of the management of the OESF.

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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 its 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 northern spotted owl conservation strategy, and monitoring of management activities in WMZs and RMZs.

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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 two primary components:

- Long-term tracking of the effects of VDTs on habitat structure in stands designated as habitat.
- Landscape-scale monitoring of basic habitat indicators across the entire westside HCP land base.

DNR is also conducting two research projects related to NSO effectiveness monitoring:

- Measurement of the response of habitat features to small-gap creation within thinned stands.
- 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.

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. 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. 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. In 2018, DNR added six unmanaged or minimally managed watersheds on the western Olympic National Forest to the network of reference sites.

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 fulfill its commitments for effectiveness monitoring and implementation of adaptive management under the HCP. The project is conducted and funded by DNR in collaboration with the USFS Pacific Northwest Research Station and the Olympic National Forest.

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 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 Olympic Experimental State Forest (OESF) is designated with the objective of learning how to integrate revenue production (primarily through timber harvesting) and ecological values (primarily habitat conservation). New scientific knowledge is applied by DNR to continually improve land management practices 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 OESF Research and Monitoring Program implements and coordinates research and monitoring projects on the OESF; facilitates the adaptive management process at DNR; fosters science communication and outreach; manages research and monitoring information; establishes and maintains research partnerships with universities, colleges, federal agencies and other organizations; collaborates with local land managers, tribes, environmental organizations and regulators on research and monitoring projects; and provides educational opportunities.

Current and Past Research and Monitoring in the OESF

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. The majority of the past research and monitoring activities are listed in the OESF Research and Monitoring Catalog, published by DNR in 2008.

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 shares the scientific knowledge developed in the OESF, builds public confidence in the sustainability of forest management practices and the effectiveness of the HCP conservation strategies.

The OESF Research and Monitoring Program publishes a biannual electronic newsletter ("The Learning Forest," a joint effort with the University of Washington ONRC, to share scientific knowledge on sustainable land management on the Olympic Peninsula. The newsletter is distributed in the spring and fall to about 180 subscribers and to DNR and University of Washington students and staff. Current and past issues are posted on the OESF and ONRC websites.

The purpose of the annual OESF science conference is to communicate results of research and monitoring activities taking place in the OESF and their relevance to land management uncertainties faced by DNR and other land managers. The conference takes place in Forks at the end of April and is attended by natural resource specialists, land managers, students, scientists, and the public.

Several pages on DNR's website contain information about the OESF, ongoing research and monitoring projects, news, and recent publications. The program's informal outreach and

communication activities include presentations at scientific and public forums, scientific publications, project reports, booths at college fairs, field trips, and other activities.

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.

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 statewide 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.

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 (ONRC), 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.

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Silvicultural Activities

Silviculture is the art and science of managing forests to meet objectives. Through silviculture, DNR manages the density and composition of trees in the forest to provide both quality timber for harvest and ecological values such as 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 plans to accomplish them (via silvicultural activities) in a forest management unit over an entire rotation. A forest management unit is a contiguous 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 applies specific "rotational objectives" to the unit in that context. For example, a unit that contributes to northern spotted owl habitat landscape objectives may have a rotational objective to "attain sub-mature NRF habitat." Rotational 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 rotational objectives.

Activities

Once DNR defines the rotational 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

DNR tracks planned and completed silvicultural activities using a database called Land Resource Manager (LRM). LRM is a tabular database that contains information about the activities that DNR implements on the landscape. For example, for a timber harvest, DNR uses LRM to track information such as harvest method and land class (riparian vs. upland area), or, the density and species composition planted during a regeneration activity. In addition to tracking tabular data, LRM integrates a Geographic Information System (GIS) that allows for the spatial tracking of individual forest management activities on the landscape. The previous system used by DNR (Planning and Tracking, P&T), which supplied data for previous HCP Annual Reports until FY 18, lacked the functionality to spatially track individual activities.

Year-to-year variation in the volume of timber harvest is common and is typically associated with variation in the 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 in LRM, 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 tracks each of the following types of harvests:

A Variable Density Thinning in the OESF

- **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), un-thinned 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.
- **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 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.

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. DNR typically only tracks natural regeneration as an activity in LRM when the associated timber harvest Forest Practices Application (FPA) has a natural regeneration plan; natural regeneration occurs following certain timber harvest methods, such as uneven-aged management, but these trees are tracked using stocking surveys over the life of the stand.

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 (PCT)

During a pre-commercial thinning, DNR removes the less-desirable trees to maintain the growth and stability of the retained trees. PCTs 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.

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

PCT 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.

Unmanned Aircraft Systems (UAS)

Throughout the life of a stand, DNR periodically conducts field surveys to assess stand conditions and evaluate the need for future treatment. DNR is beginning to use UAS to supplement or replace young stand surveys as UAS can provide a more cost-effective and safer way to collect data. Footage derived from UAS flights includes information on tree height and density, providing foresters with an additional decision-making tool to refine silviculture prescriptions.

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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, all of which can potentially harm salmon and other aquatic and riparian-obligate species. Current road-building and maintenance practices create better roads that minimize impacts 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. In 2015, RMAP rules were changed to allow forest landowners to apply for an extension of the completion date to October 2021. DNR received RMAP block extensions in the following HCP units: South Puget, OESF, Straits, South Coast, Columbia and Yakima. The RMAP work in the other three planning units was completed by the 2016 deadline.

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, upgrades, 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 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 Staff Reviewing a Proposed Easement

Photo courtesy of Kaerlek Janislampi.

DNR 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 currently 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. However, easement mapping under the Road Easement GIS and Spatial Nature projects is helping to address this issue.

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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 acquires 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 assesses 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 (TLT), which applies only to Common School trust lands, or the State Forest Trust Land Replacement Program (SFT), which applies only to State Forest trust lands. Through the TLT 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. Through the SFT program, DNR transfers State Forest trust lands in low-population, timber-dependent counties to NRCAs managed by the Natural Areas Program. To be eligible for the SFT program, the property must be encumbered by harvest restrictions due to species listed under the Endangered Species Act. The value of the timber (which is not cut) from each transferred property goes to the county where the land is located, and the land value is held in a replacement account which is used to buy forestlands for the State Forest trust.

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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 features unique to this region. The high-quality condition of these

sites, and the broad diversity of ecosystems they represent, make them foundational to maintaining the resilience of Washington's natural heritage in the face of climate change.

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 Resource 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 over 164,000 acres in 56 NAPs and 38 NRCAs. Over 126,000 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 43 special status species. This total includes 81,051 acres that DNR has added to the program since the HCP was signed in 1997. An additional 18,100 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 whitebark pine (*Pinus albicaulis*) (a candidate species for federal listing), and several natural areas provide suitable habitat for grizzly bears (*Ursus arctos horribilis*).

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.

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 Mountains 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 Nemah NRCA, more than 30 marbled murrelet occupancies have been recorded, including a confirmed murrelet nest site.

Natural areas also provide habitat for other sensitive species (federal species of concern, state-listed, state candidate) identified in the HCP. Examples include: insects like the Makah copper butterfly (*Lycaena mariposa charlottensis*), Beller's ground beetle (*Agonum belleri*), and Hatch's click beetle (*Eanus hatchi*) that are found only in bog habitats; 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 Loomis 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. Thirty-five years later, DNR 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 June's copper butterfly (*Lycaena mariposa junia*), formerly known as the Makah copper (*Lycaena mariposa charlottensis*).

Oregon Spotted Frog

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

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 several sites (Washougal Oaks NAP/NRCA, Bald Hill NAP, Lacamas Prairie NAP, and Oak Patch 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, Cypress Island, and Woodard Bay NRCAs by removing bulkheads, fill, and creosote-treated structures.

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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 allows 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, leases, and direct sales are selectively granted to prevent habitat degradation.

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Oil and Gas Leases

Oil and gas leases allow a lessee to reserve the right to explore for underground deposits. They also give the lessee the sole and exclusive right to drill, extract, or remove oil and gas. Any proposed on-the-ground activities must undergo State Environmental Policy Act (SEPA) review, and the lessee must have a DNR-approved plan of operations and the proper drill permit. Regulations exist to protect water and air quality, and any exploration holes must be plugged following use. 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. There have not been any since.

Mineral Prospecting Leases and Mining Contracts

Like oil and gas leases, mineral prospecting leases are exploration agreements that allow a lessee to search for mineral deposits. They are allowed for a period of up to seven years and may encompass up to 640 acres. A mineral prospecting lease must be converted to a mining 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 and may be subject to SEPA review, depending on the type of exploration activity proposed. 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 the permit holder must meet, such as turnout and removal dates, riparian protections, and the number of animals allowed on the range. Leases cover smaller areas than permits, and they also include resource management plans. These leases can allow grazing at any time during the year, as long as lessees follow the management plans.

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

DNR sells rock, sand, and gravel (valuable materials) through public auctions and direct sales. Contracts awarded through the public auction process are subject to review and approval by the Board of Natural Resources. Occasionally, DNR will conduct a direct sale, a one-time agreement for the removal of a small amount of a resource (a maximum of $25,000 in value) that does not require Board of Natural Resources approval.

Early in the implementation of the HCP, DNR had a substantial number of rock, sand, and gravel sales. Since then, that number has decreased, primarily due to the lengthy contract-development process and limited staff capacity.

DNR maintains many small rock pits on state land that are primarily used to construct forest roads during timber sales. Companies that purchase DNR timber sales may be permitted to utilize existing rock pits or develop new ones according to the specifications in the contract.

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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.

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.

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.

B

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

C

Cadaster: An official register of the ownership, extent, and value of real property in a given area, i.e. property lines.

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

Curtis relative density: See relative density.

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.

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.

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.

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 seed tree, variable retention harvest, and shelterwood.

F

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

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.

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 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: For the State Trust Lands Habitat Conservation Plan, a form of monitoring that determines whether or not a management plan or its components are implemented as written.

Inholding: A parcel of land owned by one party that is entirely surrounded by another ownership.

L

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.

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

Multiple-pass removal: A field sampling method used to estimate fish populations in a stream that involves placing nets across a stream at the beginning and end of a reach (typically around 100 meters) to confine fish to that area. A backpack electrofisher is then used to temporarily disable fish which are then captured, measured, and released. Each reach is sampled multiple times within a day until the desired precision in the population estimate is achieved.

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 resource 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.

O

Oil and gas lease: An agreement that allows the leaseholder to reserve the right to explore for under-ground 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.

P

Planning unit: In the State Trust Lands Habitat Conservation Plan, a management unit based on large watersheds. The approximately 1.9 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 does not generate revenue and is performed before the trees are large enough to be marketable. 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

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.

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

1. 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.
2. 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 plan 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 through natural seeding or hand planting, typically on sites that were harvested or burned in a wildfire.

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.

Riparian desired future condition: In the Riparian Forest Restoration 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: 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.

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 delimbing.

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 (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 resource 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).

Suitable northern spotted owl habitat: Each northern spotted owl management area is managed for certain habitat classes that include specific habitat types. Habitat types include high-quality nesting, Type A or B, movement roosting and foraging, sub-mature, young forest marginal, movement, dispersal, and old forest. Forest stands that meet the definition of habitat types within the specific management area are considered suitable habitat.

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.

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).

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 form of monitoring 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 (at least 12” on small end by 20’ long).

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

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.