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Environmental Assessment for the Upper South Fork Skokomish Vegetation Management Project

Olympic National Forest

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UPPER SOUTH FORK SKOKOMISH VEGETATION MANAGEMENT PROJECT
Mason County, Washington
February 2012

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Abstract:
This Environmental Assessment (EA) documents the proposed action and the no action alternative considered for commercially thinning timber; conducting road construction, reconstruction, and maintenance; treating activity-generated slash (fuels); and implementing connected actions within the Late-Successional Reserve, Adaptive Management Area, and Riparian Reserves land allocations of the Upper South Fork Skokomish River subwatershed on the Olympic National Forest, Hood Canal Ranger District.

Cover photo: View of the Upper South Fork Skokomish River watershed, looking southeast from Forest System Road 2355.

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CHAPTER 1 – PURPOSE AND NEED

DOCUMENT STRUCTURE

This Environmental Assessment (EA) documents the analysis of the proposed action and a range of alternatives for commercial thinning and associated activities in the Upper South Fork Skokomish River subwatershed, located on the Hood Canal Ranger District of the Olympic National Forest.

Chapter 1 describes the purpose of and need for action, and the proposed action for the Upper South Fork Skokomish Vegetation Management Project. This chapter also identifies and describes the project area, outlines applicable management direction, addresses the scope of the decision to be made, and lists the issues identified during scoping.

Chapter 2 describes the proposed action and alternatives, the process by which the proposed action was designed, the alternative development process, and the project design criteria and mitigation measures that would apply to the project.

Chapter 3 describes the affected environment and the environmental consequences of the proposed action and the no action alternative. The chapter is broken into sections based on resource area.

Chapter 4 contains a list of preparers and agencies consulted during this environmental assessment process.

Chapter 5 contains all appendices to the EA, including maps.

RELATIONSHIP TO THE FOREST PLAN AND OTHER MANAGEMENT DIRECTION

Forest Plan

The Forest Service has prepared this Environmental Assessment (EA) in compliance with the National Environmental Policy Act (NEPA) and its implementing regulations (40 Code of Federal Regulations §1500-1508) as well as those requirements established by Federal environmental laws and regulations. It is tiered to the Final Environmental Impact Statement (FEIS) for the Olympic National Forest Land and Resource Management Plan (USDA Forest Service 1990), as amended. Major plan amendments include:

- Final Supplemental Environmental Impact Statement on Management of Habitat for Late Successional and Old-growth Forest Related Species Within the Range of the Northern Spotted Owl (USDA Forest Service and USDI Bureau of Land Management, 1994a) as adopted and modified by the April 1994 Record of Decision, which provides additional standards and guidelines (USDA Forest Service and USDI Bureau of Land

Management, 1994b). These two documents are commonly referred to as the 1994 ROD or the Northwest Forest Plan.

The 1994 ROD added seven land allocations to the allocations in the 1990 Land and Resource Management Plan. The standards and guidelines it established for these land allocations supersede management direction in the 1990 LRMP unless the 1990 LRMP is more restrictive or provides greater benefits to late-successional-forest-related species. The 1994 ROD also includes an Aquatic Conservation Strategy, designed to protect and improve the health of aquatic ecosystems.

For the Olympic National Forest, the land allocations established by the 1994 ROD are Late-Successional Reserves (LSR), Adaptive Management Areas (AMA), and Riparian Reserves (RR). The objective of the LSR allocation is to protect and enhance conditions of late-successional and old-growth forest ecosystems, which serve as habitat for late-successional and old-growth related species, including the northern spotted owl. The AMA allocation was designated to encourage the development and testing of technical and social approaches to achieving desired ecological, economic, and other social objectives. Riparian Reserves (RR) include land along streams, and unstable and potentially unstable areas. They are managed to maintain and restore riparian structures and functions, confer benefits to riparian-dependent and associated species other than fish, enhance habitat conservation for organisms that are dependent on the transition zone between upslope and riparian areas, improve travel and dispersal corridors for many terrestrial animals and plants, and provide for greater connectivity of the watershed. Riparian Reserves overlie all other management allocations.

In this EA, the term "Forest Plan" refers to the 1990 LRMP (USDA Forest Service 1990) as amended by the 1994 ROD and other amendments currently in force.

Survey & Manage

On December 17, 2009, the U.S. District Court for the Western District of Washington issued an order in *Conservation Northwest, et al. v. Sherman, et al.*, No. 08-1067-JCC (W.D. Wash.), granting Plaintiffs' motion for partial summary judgment and finding NEPA violations in the *Final Supplemental to the 2004 Supplemental Environmental Impact Statement to Remove or Modify the Survey and Manage Mitigation Measure Standards and Guidelines* (USDA and USDI, June 2007). In response, parties entered into settlement negotiations in April 2010, and the Court filed approval of the resulting Settlement Agreement on July 6, 2011. Projects that are within the range of the northern spotted owl are subject to the survey and management standards and guidelines in the 2001 ROD, as modified by the 2011 Settlement Agreement.

The Upper South Fork Skokomish Vegetation Management Project is consistent with the Olympic National Forest Land and Resource Management Plan as amended by the 2001 *Record of Decision and Standards and Guidelines for Amendments to the Survey and Manage, Protection Buffer, and other Mitigation Measures Standards and Guidelines* (2001 ROD), as modified by the 2011 Settlement Agreement.

The Upper South Fork Skokomish Vegetation Management Project applies a 2006 Exemption from a stipulation entered by the court in litigation regarding Survey and Manage species and the 2004 Record of Decision related to Survey and Manage Mitigation Measure in *Northwest Ecosystem Alliance v. Rey*, No. 04-844-MJP (W.D. Wash., Oct. 10, 2006). Previously, in 2006, the District Court (Judge Pechman) invalidated the agencies' 2004 RODs eliminating Survey and Manage due to NEPA violations. Following the District Court's 2006 ruling, parties to the litigation entered into a stipulation exempting certain categories of activities from the Survey and Manage standards and guidelines, including both pre-disturbance surveys and known site management. Also known as the Pechman Exemptions, the Court's Order from October 11, 2006 directs:

"Defendants shall not authorize, allow, or permit to continue any logging or other ground-disturbing activities on projects to which the 2004 ROD applied unless such activities are in compliance with the 2001 ROD (as the 2001 ROD was amended or modified as of March 21, 2004), except that this order will not apply to:

a. *Thinning projects in stands younger than 80 years old:*
b. *Replacing culverts on roads that are in use and part of the road system, and removing culverts if the road is temporary or to be decommissioned;*
c. *Riparian and stream improvement projects where the riparian work is riparian planting, obtaining material for placing in-stream, and road or trail decommissioning; and where the stream improvement work is the placement large wood, channel and floodplain reconstruction, or removal of channel diversions; and*
d. *The portions of project involving hazardous fuel treatments where prescribed fire is applied. Any portion of a hazardous fuel treatment project involving commercial logging will remain subject to the survey and management requirements except for thinning of stands younger than 80 years old under subparagraph a. of this paragraph."*

Per the 2011 Settlement Agreement, the 2006 Pechman Exemptions remain in force:

> *"The provisions stipulated to by the parties and ordered by the court in Northwest Ecosystem Alliance v. Rey, No. 04-844-MJP (W.D. Wash. Oct. 10, 2006), shall remain in force. None of the following terms or conditions in this Settlement Agreement modifies in any way the October 2006 provisions stipulated to by the parties and ordered by the court in Northwest Ecosystem Alliance v. Rey, No. 04844-MJP (W.D. Wash. Oct. 10, 2006)."*

The Upper South Fork Skokomish Vegetation Management Project meets Exemption A because it entails no regeneration harvest and entails thinning only in stands less than 80 years old (see table C.2 in Appendix C).

Other Documents

This EA tiers to and incorporates by reference the following documents:

- Olympic National Forest Land and Resource Management Plan (USDA Forest Service 1990a). The Land and Resource Management Plan (LRMP) guides all natural resource management activities and establishes standards and guidelines for the Olympic National Forest.
- Final Environmental Impact Statement (FEIS) for the Olympic National Forest Land and Resource Management Plan (USDA Forest Service 1990b). This FEIS discloses the environmental consequences of six alternatives for managing the land administered by the Olympic National Forest.
- Final Supplemental Environmental Impact Statement on Management of Habitat for Late Successional and Old-growth Forest Related Species Within the Range of the Northern Spotted Owl (USDA Forest Service and USDI Bureau of Land Management, 1994a) as adopted and modified by the April 1994 Record of Decision, which provides additional standards and guidelines (USDA Forest Service and USDI Bureau of Land Management, 1994b). These two documents are commonly referred to as the 1994 ROD or the Northwest Forest Plan.
- South Fork Skokomish Watershed Analysis (USDA 1995). The watershed analysis provides a scientifically-based understanding of the ecological structures, functions, processes, and interactions within the watershed, and identifies desired trends, conditions, and restoration opportunities. Watershed analysis is one of the four elements of the Aquatic Conservation Strategy in the Northwest Forest Plan.
- South Fork Skokomish Watershed Analysis (Simpson Timber Company and Washington Department of Natural Resources 1997). This watershed analysis provides information about mass wasting, surface erosion, hydrologic function, fish habitat, public works, stream channels, and riparian function in the watershed.
- South Fork Skokomish Restoration Summary (USDA Forest Service 2004a). This document summarizes restoration work conducted on National Forest lands in the watershed since the early 1990s, and restoration work remaining.
- The Olympic National Forest Strategic Plan (USDA Forest Service 2004b). The Strategic Plan used an interdisciplinary process to identify priority areas for aquatic and terrestrial ecosystems, restoration needs, and opportunities to integrate projects to achieve multiple benefits.
- The Olympic National Forest Access and Travel Management Plan (ATM) (USDA Forest Service 2004c). The ATM documents priorities for road management objectives on the Olympic National Forest.
- Hood Canal South Late Successional Reserve Assessment (LSRA) (USDA Forest Service 1996). The LSRA examines the historic and current uses of the Hood Canal South Late Successional Reserve (LSR), vegetative condition, and late-successional forest associated species known to exist within the LSR; presents criteria for developing treatments for achieving LSR objectives; and identifies areas for potential treatment.
- Olympic National Forest Final Environmental Impact Statement and Record of Decision – Beyond Prevention: Site-Specific Invasive Plant Treatment (USDA Forest Service 2008). This environmental impact statement (EIS) provides forest-level direction for the site-specific treatment of invasive plant infestations.

Additional documentation, including more detailed analyses of project-area resources, may be found in the project planning record located at the Olympic National Forest Headquarters in Olympia, Washington. The project record and all references cited are hereby incorporated by reference into this Environmental Assessment.

PROJECT LOCATION

The roughly 38,500-acre Upper South Fork Skokomish River subwatershed contains nine smaller catchments: Brown Creek, Cedar Creek, Church Creek, Lebar Creek, Middle South Fork Skokomish River, Pine Creek, Rule Creek, Steel Creek, and Upper South Fork Skokomish River. The 36,750-acre Upper South Fork Skokomish planning area includes all National Forest System lands within the Upper South Fork Skokomish subwatershed. The subwatershed and the planning area are located primarily in Mason County, northwest of Shelton, Washington. Approximately 725 acres along the western edge of the subwatershed are located within Grays Harbor County, and roughly 475 acres at the far northwest tip of the planning area lie within Jefferson County. The planning area contains portions of T22N, R06W; T22N, R05W; T23N, R07W; T23N, R06W; and T23N, R05W. Map 1 in Appendix E shows the planning area and vicinity.

The 36,750-acre Upper South Fork Skokomish Vegetation Management Project planning area encompasses about 95 percent of the subwatershed. The planning area contains about 33,050 acres in the LSR land allocation and 3,700 acres in the AMA land allocation, which are overlain with approximately 20,860 acres of Riparian Reserves. Roughly 1,130 acres of the northern tip of the subwatershed lie within the boundaries of the Olympic National Park, and about 650 acres at the eastern edge of the subwatershed are under State or private ownership. Table 1.1 displays Forest Service land management allocations in the planning area, and other land ownership in the subwatershed. Note that Riparian Reserves overlie other Forest Service land management allocations, and do not contribute to the total acreage in the planning area.

Table 1.1. Ownership and Forest Plan land management allocations in the Upper South Fork Skokomish River subwatershed

US Forest Service (USFS) land management allocation or other ownership	Acres	Percent of 38,500-acre subwatershed	Percent of 36,750-acre planning area
USFS Late-Successional Reserve (LSR)	33,050	86	90
USFS Adaptive Management Area (AMA)	3,700	9	10
USFS Riparian Reserve [1]	20,680	54	56
Olympic National Park	1,130	3	0
Non-Federal (State and Private)	650	2	0

In addition to the standards and guidelines that apply to LSR, AMA, and Riparian Reserve allocations, the following management area prescriptions from the 1990 LRMP are relevant to portions of the planning area: A1A-Undeveloped Recreation (Non-Motorized); A1B-Undeveloped Recreation (Motorized); A2-Scenic; A4BG-General Level River Corridor; A4BGA3-

Developed Recreation and Administrative Sites; A4BM-Minimum Level River Corridor; A4BN-Natural Level River Corridor; and E1-Timber Management.

The Upper South Fork Skokomish River subwatershed is part of the South Fork Skokomish River watershed, which is designated as a Key Watershed in the 1994 ROD. Key watersheds are the highest priority for watershed restoration. The ROD requires watershed analysis to be completed prior to timber harvest in Key Watersheds. The South Fork Skokomish Watershed Analysis was completed by the Olympic National Forest in June 1995. An additional watershed analysis was completed by the Washington State Department of Natural Resources and the Simpson Timber Company in 1997. Both of these watershed analyses were consulted for this Environmental Assessment.

PURPOSE OF AND NEED FOR ACTION

The purpose of the proposed thinning is to implement the Forest Plan by increasing forest structural diversity and accelerating the development of late-successional forest characteristics in selected forest stands in the Upper South Fork Skokomish River Watershed. The forest in the project planning area has been heavily influenced by past logging activities. Approximately 15,000 acres of National Forest System land in the planning area were clearcut between 1940 and 1992. Most of this acreage was replanted after harvest. As a result of this history, much of the vegetation in the watershed currently consists of relatively dense, single-aged, second growth plantations in a structurally simplified stage. Also due to historic management, composition of much of the riparian vegetation has changed: areas that once supported large conifers now have high percentages of small-diameter conifers and hardwoods, and the available supply of trees for recruitment of large wood, an important component of fish habitat, into streams has been reduced. This action is needed to help address these effects of past management.

The individual stands proposed for thinning in this project are single-storied, second-growth stands that are experiencing a slowing of growth due to overcrowding, and contain little understory or groundcover. Stand ages range from 37 to 66 years. These stands do not currently provide adequate habitat for old-growth-dependent species. This project is needed in order to reduce stand density and accelerate the development of late-successional forest habitat structure.

The purpose and need of the Upper South Fork Skokomish Vegetation Management Project is three-fold, varying slightly by Forest Plan land allocation.

1. *Increase structural and habitat diversity and accelerate the development of late-successional forest characteristics by decreasing stocking in dense, previously managed stands in Late-Successional Reserve.*

   The purpose of Late Successional Reserves (LSR) is to maintain and enhance late-successional forest as a network of existing old-growth forest ecosystems [(USDA and USDI 1994b)]. The following are characteristics of old-growth forest (Old-Growth Definition Task Group 1986; Carey and Johnson 1995; Carey and Curtis 1996; Rapp

2003) that describe the desired future condition of the stands proposed to be treated in this project:

- a patchy, multilayered forest canopy with high crown closure and trees of several age classes;
- a variety of herbs, shrubs, and coniferous tree seedlings and saplings on the forest floor;
- overstory trees exceeding 36 inches in diameter at breast height (dbh) with large crowns, large branches, broken tops and other indications of old and decaying wood in some of them;
- understory trees with a range of diameters and ages;
- large standing dead trees; and
- coarse woody debris on the forest floor.

2. *Increase structural and habitat diversity and accelerate the development of late-successional forest characteristics by decreasing stocking in dense, previously managed stands in the Adaptive Management Area. Test a variety of techniques intended to restore late-successional forest and riparian conditions.*

   The purpose of the Adaptive Management Area (AMA) land allocation is to provide opportunities for development, demonstration, and testing of techniques that emphasize restoration of late-successional forest conditions and riparian zones, and integrate commercial timber harvest with ecological objectives (USDA Forest Service and USDI Bureau of Land Management 1994b, p.C-21;D-1). The silvicultural objective within Adaptive Management Area (AMA) is to add structural and tree species diversity to the stands, which includes many of the desired conditions described above.

3. *Manage Riparian Reserves for desired vegetation characteristics needed to attain Aquatic Conservation Strategy objectives (USDA Forest Service and USDI Bureau of Land Management 1994b, p.B-11; C-32).*

   Riparian Reserves, which overlie all other land allocations, are a central component of the Aquatic Conservation Strategy (ACS), and include areas along streams, wetlands, ponds, lakes, and unstable or potentially unstable areas. Generally, standards and guidelines for riparian reserves prohibit or restrict activities that delay or prevent attainment of ACS objectives. Silvicultural practices "to control stocking, reestablish and manage stands, and acquire desired vegetation characteristics needed to attain Aquatic Conservation Strategy objectives" are allowed within Riparian Reserves. Desired conditions include:

   - late-successional characteristics (see purpose 1., above);
   - retention of stream shading;
   - accelerated growth of conifers to provide future large wood for recruitment into streams (instream large wood is an important structural component of aquatic habitat).

PROPOSED ACTION

The proposed action is to manage stand density and restore forest diversity by conducting variable density commercial thinning treatment on approximately 880 acres in the Upper South Fork Skokomish subwatershed in Mason County. The thinning treatments would be designed to accelerate the development of late-successional forest characteristics in the selected stands. Stands were selected on the basis of the need for treatment to improve wildlife habitat, accessibility by existing system and non-system roads, and economic feasibility.

On the majority of the treated acres, the thinning would utilize a "thinning from below" treatment that generally retains the larger trees, and would include skips (unthinned areas), gaps (small openings), and some more heavily thinned areas to provide increased structural and spatial heterogeneity within the stands proposed for treatment. Hardwoods and other minor tree species would generally not be cut.

Logging systems would include ground-based, cable, and helicopter logging, with the potential for some prebunching in some units designated for helicopter or cable yarding. Current forest system roads, unclassified or abandoned road grades, and new temporary roads would be used to access the stands, including some short stub roads to get logging equipment and operations off of main roads for the purpose of public safety. Approximately 3.6 miles of currently unclassified or abandoned roads would be reopened, and about 1.0 miles of new temporary roads would be constructed. All of these roads would be decommissioned after use. Opportunities may also exist to decommission or improve drainage on additional system roads, to decommission additional non-system roads, and to implement other restoration and habitat improvement work with funds generated from the project.

DECISION FRAMEWORK

The Responsible Official is the Forest Supervisor of the Olympic National Forest. The Forest Supervisor will review the proposed action and alternatives, the environmental effects associated with the alternatives, and comments received during the public comment periods. Based on that review, the Forest Supervisor will decide:

- How much thinning will be accomplished, and where;
- Which logging systems and associated road access are appropriate; and
- What management requirements, project design criteria, and mitigation measures to include in the project.

PROJECT IMPLEMENTATION

It is anticipated that implementation of this project would begin the first summer after a decision is signed. The earliest possible implementation date would be the summer of 2013.

SCOPING

This project was first listed in the Forest's quarterly Schedule of Proposed Actions (SOPA) on January 1, 2011. It will remain on the SOPA until a decision is made, and through the quarter following that decision. The project has appeared on the Olympic National Forest's www website (http://www.fs.fed.us/r6/olympic/projects-nu/index.shtml) since January 2, 2011. A letter initiating formal consultation was sent to the Skokomish Tribal Nation on January 13, 2011. A public scoping letter was sent to 173 interested individuals and organizations on January 28, 2011. The 30-day public scoping process ran from January 28 through February 28, 2011. In addition to this public outreach, the Skokomish Watershed Action Team (SWAT) has been kept actively informed of the project since the spring of 2010, when the proposal first began to be developed. SWAT is a collaborative group representing diverse interests, whose mission is to work towards common ecological and economic goals in the Skokomish River watershed through collaborative basin restoration projects.

Table 1.2 contains a summary of the eight responses received during public scoping.

Table 1.2. Summary of comments received during public scoping
• Thinning may be unnecessary in moist forests, and can cause damage. • Concerns about road construction, especially in Riparian Reserves. Advocates no new roads, especially in Riparian Reserves. Wants monitoring of these roads. • Concern about thinning in Riparian Reserves – loss of snags and down wood, and loss of stream shade leading to increased stream temperatures.
• Decommissioned roads should be forage-seeded and left in a condition that allows travel for wildlife and humans. • Would like forage seeding in thinned areas.
• Make sure pre-bunching is an option in NEPA analysis.
• Respondent provided some specific recommendations for thinning prescriptions, tree marking, and helicopter landing size.
• Create 1- to 3-acre gaps for elk forage; emphasize forage (early successional habitat) over thermal cover.
• Minimize seasonal operating restrictions wherever possible; allow harvest, helicopter use, and log haul in winter.
• Harvest adequate volumes, especially for helicopter logging, and allow for pre-bunching where possible on slopes up to 45 percent.
• Design flexibility into slash/fuel treatments – objective-based rather than prescriptive.
• Use small no-cut riparian buffers (25-50 feet) to maximize volume and to meet late-seral conditions objective faster.
• Consider use of stewardship contract to address other restoration opportunities.
• Look at alternatives that do not need new temporary roads as well as alternatives that minimize the need to reopen existing roads.
• Provide more discussion of rationale and methods for thinning within Riparian Reserves.
• Retain remnant large trees.

All of the concerns raised in the comments were considered by the Interdisciplinary Team (IDT). Several of the comments received during scoping concerned road decommissioning in general and were not directly pertinent to this project. None of the comments raised issues that were not already considered in the development of the proposed action.

ISSUES

Considerations outside of the project's purpose and need that drove the development of the original proposed action included minimizing the need for road construction and reconstruction, particularly in riparian reserves; minimizing potential impacts on northern spotted owl and marbled murrelet suitable habitat; minimizing road closures and other activities that might temporarily limit access to recreation facilities; ensuring public safety during project operations; and maintaining economic viability. Because of the recent emphasis on road decommissioning in the South Fork Skokomish watershed, a high emphasis was placed on minimizing new road construction.

Other issues that contributed to the development and design of the original proposed action were identified internally by the IDT. These issues include resource concerns such as the protection of soil productivity, water quality, slope stability, aquatic and riparian habitat, habitat for threatened and endangered wildlife species, sensitive plant species, and recreation trails and facilities. A set of management requirements was developed to address these concerns, and was agreed upon by the IDT members. These project design criteria are described in Chapter 2. The comprehensive set of project design criteria developed for the project resolve the environmental concerns raised by the scoping respondents and the interdisciplinary team members. There are no known unresolved issues that would lead to the development of alternatives to the proposed action.

CHAPTER 2 – THE PROPOSED ACTION AND ALTERNATIVES

This chapter describes the process by which the proposed action was developed. It includes a detailed description of the Proposed Action. It also includes a discussion of possible sale area improvement and restoration projects that might be implemented in association with the project. The chapter concludes with a description of the management requirements – project design criteria, mitigation measures, and best management practices – that would be part of project design and implementation

DEVELOPMENT OF THE PROPOSED ACTION

The process of developing the Proposed Action began with a landscape-level geographic information systems (GIS) and aerial photo assessment of late-successional habitat, and an identification of gaps in the network of remaining late-successional habitat patches. This process started with all previously harvested stands outside of known spotted owl habitat circles in the planning area, and identified their priority for treatment to accelerate the development of late-successional forest habitat conditions for old-growth associated wildlife species. Stand age in 2010 ranged from 35 to 65 years. Stands were ranked for wildlife habitat potential and associated treatment need, with priority based on the following factors: highest priority was associated with stands that could increase connectivity between or add to blocks of existing old-growth habitat, or that were in close proximity to the Upper South Fork Skokomish River or a major tributary; medium priority was associated with stands representing connectivity between headwater areas near subwatershed and catchment boundaries; and lowest priority was assigned to stands adjacent to hard edges (for instance, adjacent recently clearcut private timber land), stands isolated from old-growth patches, and stands dominated by hardwoods.

Next, based on current stand conditions, a potential treatment was identified for each stand: commercial thinning, non-commercial thinning of young dense stands with trees smaller than commercial size, or no treatment. This process resulted in roughly 2,850 acres with commercial thinning potential, and 2770 acres with non-commercial thinning potential.

The third level of analysis considered logistical considerations – primarily road access – to the stands. Recent management and restoration activities in the South Fork Skokomish watershed have emphasized road decommissioning to reduce risk to aquatic resources and reduce overall road densities. In keeping with this management focus, the interdisciplinary team was directed not to consider the use of previously decommissioned roads for this project, and to keep the construction of new temporary roads to a minimum, with an emphasis on public safety rather than logistical concerns. For these reasons, stands inaccessible using the current system of authorized forest roads were eliminated, regardless of their priority for wildlife habitat improvement.

Finally, the remaining stands were assessed for economic feasibility based on probable logging systems. The criterion of assessment here was that, while some stands within the project might be treated at a loss, the total group of treatment units as a whole needed to be economically

feasible. For economic reasons, most of the remaining accessible acres with only non-commercial thinning potential were eliminated at this point, although some accessible stands were included as additional restoration and improvement activities (table 2.5, below). This final assessment resulted in 1,037 acres for which commercial thinning was indicated as both needed to meet the purpose of accelerating the development of late-successional habitat characteristics, and as economically feasible overall.

Because of resource concerns raised during the environmental analysis, including soil conditions, slope stability, and aquatic habitat quality, 157 acres were designated as planned skips, and removed from consideration for active treatment, although they remained within the delineated units. The final proposed action includes 880 acres of potential commercial thinning treatments.

ALTERNATIVES CONSIDERED BUT ELIMINATED FROM FURTHER ANALYSIS

The interdisciplinary team reviewed the comments received during public scoping, and concluded that all of the pertinent suggestions and concerns could be addressed through the design of the proposed action. Two respondents suggested developing an alternative with no temporary road construction. That alternative was considered, but eliminated from full analysis (see below). Therefore this EA includes a single action alternative – Alternative B, the Proposed Action – and a No Action alternative (Alternative A) against which to compare the effects of the Proposed Action.

No temporary road development

During the scoping process, two respondents suggested that an alternative that included no temporary road developed should be considered. Such an alternative would greatly reduce the possibility for using ground-based logging systems. The resulting higher reliance on helicopter yarding systems would result in an economically unfeasible project. The low likelihood that such a project could be implemented means that this alternative would most likely not meet the purpose and need established for the project. The Proposed Action was intentionally developed to minimize temporary road development, while still providing for public safety by removing logging equipment from direct proximity to forest roads. It was determined that a no-temporary-road alternative was economically unfeasible, and that the Proposed Action minimized road construction to the greatest extent possible while still maintaining project feasibility.

ALTERNATIVES CONSIDERED IN DETAIL

Two alternatives are considered in detail in this Environmental Assessment:

- Alternative A – the No Action Alternative;
- Alternative B – the Proposed Action.

All acreage and mile values reported in this EA are estimates calculated using GIS data and GIS analysis. In general, acreage figures are rounded to the nearest acre or tenth of an acre, and road length values are rounded to the nearest one-hundredth of a mile (approximately 53 feet).

Alternative A – the No Action Alternative

Alternative A, the No Action alternative, is provided to serve as a baseline of the existing condition for comparison with the Proposed Action. Under the No Action alternative, no thinning treatments or associated project activities would take place. Forest stands in the project area would remain untreated. All existing roads – authorized system roads, decommissioned roads, and existing unclassified roads – would remain in their current condition. No timber harvest or related activities would take place. No funds would be available from timber sale revenues for additional restoration activities in the project area.

The No Action alternative does not represent a static condition. Forest stands would continue to develop along their current trajectories.

Alternative B – the Proposed Action

Treatment acres and logging systems

Alternative B includes approximately 880 acres of active commercial thinning treatments, and 157 additional acres in pre-designated skips – areas which would receive no thinning. These skips are located in portions of units in which other resource concerns preclude either access for or feasibility of available logging systems. These skips are within thinning unit boundaries (defined as the boundaries of the original clearcut harvest units) and would be treated as skips in the silvicultural prescription. The remaining 880 acres would receive thinning treatment. The riparian and other resource protection buffers described in the project design criteria section this chapter would decrease the number of actively thinned acres by approximately 25 percent.

Of the 880 acres that would potentially receive active thinning, 813 are in LSR, 68 are in AMA, and 224 are overlain by Riparian Reserves.

Management allocations from the 1990 Olympic National Forest Land and Resource Management Plan (LRMP) include E1-Timber Management (535 acres), A2-Scenic (448 acres), and A4BN-Natural Level River Corridor (54 acres). Proposed logging systems include ground-based, cable, helicopter, and helicopter with ground-based pre-bunching equipment. Table 2.1 displays a summary of treatment acres by logging system, 1994 ROD land allocation, and acres within Riparian Reserves.

Table 2.1. Summary of proposed treatment acres by logging system and land allocation				
Logging System	**Total unit Acres**	**LSR acres within units**	**AMA acres within units**	**RR Acres[1]**
Ground-based yarding	330	330	0	53
Cable yarding	188	138	49	83
Helicopter/prebunching	50	50	0	11
Helicopter yarding	312	294	18	78
Subtotal – potential thinning acres	**880**	**813**	**68**	**225**

1 *Riparian Reserve is an overlay on all land allocations, and does not contribute to the sum of total acres.*

Temporary road development

Temporary roads are existing or proposed roads that are not part of the authorized Forest Service road system. In order to access treatment units, the Proposed Action includes a total of approximately 3.52 miles of temporary road development, consisting of reconstruction of 2.24 miles of existing unclassified roads; reopening of 0.37 miles of previously decommissioned roads; and 0.91 miles of new temporary road construction. Of this total, 0.76 miles are within Riparian Reserves. All of these roads would be decommissioned after use as part of project activities. Table 2.2 displays a summary of proposed temporary road development by road type, and indicates how much of this road development would be within Riparian Reserves.

Table 2.2. Summary of proposed temporary road development by road type		
Type of temporary road construction	Miles	Miles in RR[1]
Reconstruction of existing unclassified road	2.24	0.55
Reopening of existing decommissioned road	0.37	0.02
New road construction	0.91	0.16
Total temporary road mileage	**3.52**	**0.76**

1 *Miles in Riparian Reserves (RR) is a subset of miles by type of temporary road construction.*

System road use – log haul

System roads are existing roads that are part of the authorized Forest road system. Within the Upper South Fork Skokomish River Watershed, log haul would occur on the 3.52 miles of proposed temporary roads (table 2.2), and on 27.4 miles of existing authorized Forest Service system roads. A total of one mile of closed system road would be reopened; the remaining 26.4 miles are currently open and are typically maintained for either high clearance vehicles (operational maintenance level ML2) or passenger vehicles (ML3 and ML4). An additional 26.3 miles of system roads outside of the planning area would also be used for log haul. Road maintenance and upgrading would need to occur on some of these roads to bring them up to a standard suitable for log haul. Table A.5 in Appendix A contains a summary of road work and maintenance needed to prepare these roads for log haul for the project. Table 2.3, below, displays operational maintenance level and miles of system roads that would be used for log haul.

Table 2.3 Summary of haul route by system road type		
Operational maintenance level	Miles inside planning area	Miles outside of planning area
ML 4 (passenger car)	8.4	9.4
ML 3 (passenger car)	11.3	9.1
ML 2 (high-clearance vehicles)	6.6	5.7
ML 1 (closed system road)	1.0	2.1
Total haul route mileage (system roads)	**27.4**	**26.3**

Desired Future Condition

The desired future conditions for LSR, AMA, and Riparian Reserves are described in the "purpose and need for action" section of chapter 1.

Summary of Proposed Vegetation Treatment

Given the age and current condition of stands included in this project, commercial thinning is supported by the 1994 Record of Decision (ROD) for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl (USDA and USDI 1994, p. B-6) and by the Hood Canal South Late Successional Reserve Assessment (USDA 1996, p. 39-40) as a beneficial activity which can be used to promote the development of late-successional characteristics and allow more rapid attainment of desired future conditions.

The thinning treatment would be a variable density thinning from below incorporating skips, gaps, and areas of heavy thinning. The objective of the proposed treatment would be to promote the development of late-successional habitat characteristics within the project stands. Thinning would reduce stand density, add structural and spatial complexity, maintain or increase crown and branch size and diameter growth of individual trees, introduce or continue to develop an understory of seedlings/saplings, shrubs, and herbs, increase the number of snag recruitment trees suitable for cavity nesters, and contribute to coarse woody debris recruitment. Within Riparian Reserves, an additional objective would be to enhance the long-term recruitment of large woody debris in streams adjacent to project stands.

ADDITIONAL RESTORATION AND IMPROVEMENT ACTIVITIES

These are restoration, habitat enhancement, and sale area improvement activities that may be implemented after commercial thinning activities in an area are complete, if sufficient revenue is generated by the timber sales to support them. This environmental assessment assumes that all the activities listed here would be implemented, and takes into account the environmental effects of implementing them. These treatments are presented here by resource area.

Vegetation

Non-commercial young stand thinning

Following the proposed commercial thinning, selective non-commercial thinning In adjacent stands that are younger or smaller in size would accelerate the development of desired tree and stand characteristics, and contribute to the future connectivity of late-successional habitat on the landscape. Of the stands less than 35 years of age within the planning area, there are currently 77 stands totaling 2,770 acres which may benefit from a non-commercial thinning treatment. Table 2.4 below displays the seven stands, totaling 249 acres, which would be the highest priority for treatment due to their proximity (within 0.25 miles) to stands proposed for a commercial thinning treatment in the Proposed Action.

Table 2.4. Priority Stands for non-commercial thinning treatment

Compartment	Cell	Stand Age in 2011	Acres
4203	182	27	17
4204	179	24	43
4204	185	34	21
4302	28	33	38
4302	40	31	18
4302	109	25	62
4303	71	30	50

Invasive plant treatment

After project activities are complete, thinning units, temporary roads, landings, and system roads within 0.25 miles of thinning units would be surveyed for invasive plants, and any infestations located would be treated. It is estimated that there would be approximately 40 infested acres that would need treatment.

Wildlife

Wildlife habitat enhancement

Limited mortality, windthrow or breakage of leave trees is expected following the commercial thinning treatment. However, given the generally low levels of snags and coarse woody debris (CWD) within project stands, the active creation of snags and CWD would enhance the habitat values provided by the project stands. Snag creation would use a variety of methods (girdling, topping and fungal inoculation) that would delay mortality of some trees and produce snags in multiple decay classes. The placement of flying squirrel nest boxes would provide short term habitat improvement while natural cavities develop. Coarse wood structures would be in the form of log pyramids and slash piles. In addition, forage planting of native shrubs is recommended for big game and other species. Table 2.5 describes these activities.

Table 2.5. Recommended wildlife habitat enhancement activities

Activity	Location	Description
Snag creation	All commercial thinning units	Estimated total snag creation need is 200 trees.

Table 2.5. Recommended wildlife habitat enhancement activities		
Activity	**Location**	**Description**
Coarse wood creation	All commercial thinning units	Approximately 100 log pyramids and 100 brush piles would be created. Any creation of brush piles would be coordinated with slash and fuels treatments.
Placement of flying squirrel boxes	All commercial thinning units	Estimated need for 200 nest boxes across all units.
Forage planting of native shrubs	Landings and temporary roads	Shrub species include elderberry, snowberry, red osier dogwood, and willow. Approximately 1000 plants total across all units.

Aquatic Habitat and Roads

Road decommissioning

Table 2.6 contains recommendations for road decommissioning. These roads are high priority for decommissioning due to their potential to deliver sediment to aquatic habitat were a landslide or culvert failure were to occur.

Table 2.6. Road segments recommended for decommissioning					
Road number and mileposts	**Miles**	**Op. ML [2]**	**Obj. ML [3]**	**No. stream crossings**	**Priority**
2355400, MP 0.0 to 1.2 [1]	1.2	2	2	3	High
2355400, MP 1.2 to 3.9 [1]	2.7	2	2	8	High
2360000, MP 0.0 to 0.6	0.6	2	2	2	High
2360200, MP 0.0 to 2.0 [1]	2.0	1	D	11	High
2361300, MP 0.0 to 0.3	0.3	1	1	2	Moderate

1 *The effects of decommissioning this road segment have already been analyzed in either the Skokomish Road and Trail Remediation Project EA and Decision Notice; or the Church, Brown and Steel Creeks Decommission and Closure Project EA and Decision Notice.*

2 *Op. ML means "operational maintenance level," and is the level at which the road is currently maintained.*

3 *Obj. ML means "objective maintenance level" and is the maintenance level recommended for the road in the Forest's current Access and Travel Management Plan (USDA Forest Service 2004c).*

Road stabilization and upgrading

Table 2.7 contains recommendations for stabilization and/or drainage upgrading of several system roads associated with project units.

Table 2.7. Road segments recommended for stabilization and/or drainage upgrading					
Road number and mileposts	**Miles**	**Op. ML**	**Obj. ML**	**No. stream crossings**	**Priority**
2300, MP 9.2 to 16.7	7.5	4	4	(many)	Moderate-High
2340-230, MP 0.0 to 2.1	2.1	2	2	6	Moderate
2340, MP 9.2 to 12.9	3.7	3	3	14	Moderate-High
2360, MP 0.0 to 4.4	4.4	2	2	10	High

Table 2.7. Road segments recommended for stabilization and/or drainage upgrading					
Road number and mileposts	**Miles**	**Op. ML**	**Obj. ML**	**No. stream crossings**	**Priority**
2356-400, MP 0.0 to 1.3	1.3	2	2	8	Moderate

Aquatic organism passage improvement

There are several culverts on existing system roads in the planning area that are barriers to passage for fish and other aquatic organisms. Replacing these culverts with structures designed to allow fish passage would improve habitat for these creatures. Table 2.8 lists these culverts, including the amount of upstream habitat they block and their priority for replacement.

Table 2.8. Recommendations for aquatic organism passage improvement					
Road number	**Milepost**	**Stream name**	**Fish stock**	**Miles blocked**	**Priority**
2340-100	0.2	Vincent Creek	Resident	0.7	Moderate
2350	5.5	Cabin Creek	Resident	0.7	Moderate
2300	3.8	Fir Creek	Resident	0.5	Moderate
2351	11.9	Rock Creek	Resident	0.5	Moderate
2350	1.9	Nickelson Creek	Resident	0.4	Low
2351	11.1	Rock Creek	Resident	0.4	Low
2361	0.8	Cedar Creek	Resident	0.3	Low
2353-210	0.2	Lebar Creek	Resident	0.3	Low
2350	7.7	Vance Creek	Resident	0.2	Low

PROJECT DESIGN CRITERIA, MITIGATION MEASURES, AND BEST MANAGEMENT PRACTICES

Project design criteria (PDCs), mitigation measures (MMs), and best management practices (BMPs) are management requirements that were developed to address the potential for negative effects associated with the activities in the Proposed Action. They are based on law, policy, and the professional judgement of the resource specialists on the IDT. They apply project-wide. They are embedded in the silvicultural prescription, the design and implementation of the treatments and associated activities, and in the physical layout of the project on the ground. All analyses of environmental effects in chapter 3 of this EA presume that these requirements are implemented wherever they are applicable.

While they are generally arranged here by resource area, some of these requirements and restrictions intentionally serve multiple purposes: for instance, riparian no-cut buffers protect water quality (fisheries) as well as habitat for amphibians (wildlife); leaving coarse woody debris in place protects lichens and mosses (botany), habitat for terrestrial mollusks and small rodents (wildlife), and site productivity (soils and silviculture). To avoid repetition, each requirement is described only once.

All logging activities will be approved by the Forest Service Timber Sale Administrator. Where there are site-specific uncertainties about the applicability of a restriction, an appropriate Forest Service specialist will be consulted. Any request for modification to a project design criterion is subject to approval by the District Ranger and Timber Sale Contracting Officer, in consultation with appropriate resource specialists.

Riparian no-cut buffers

The objective of the no-cut riparian buffers is to retain riparian vegetation to provide shade to maintain or improve stream temperatures, maintain slope stability (including headwalls), minimize soil erosion, protect riparian vegetation, and provide protection for aquatic and riparian-dependent wildlife species.

Buffer distances are measured along the slope. No thinning or equipment operations would occur within these buffers, and there would be no construction of new landings or reconstruction of existing landings within no-cut buffers. In all cases, buffers will be extended 25 feet upslope from the major slope break that defines a headwall, inner gorge, or potential unstable area. The appropriate Forest Service watershed specialist, botanist, or wildlife biologist will be consulted to determine riparian and wetland buffer location at layout stage.

Table 2.9. Riparian no-cut buffer widths

Landscape feature	Minimum no-cut buffer width or equipment/road location exclusion areas
South Fork Skokomish River mainstem	200 feet, measured from outer edge of the channel migration zone on either side of channel.
All other fish bearing streams (includes intermittent fish-bearing streams).	100 feet, measured from the outer edge of the streambank.

Table 2.9. Riparian no-cut buffer widths	
Landscape feature	**Minimum no-cut buffer width or equipment/road location exclusion areas**
Non-fish-bearing perennial streams	70 to 85 feet, based on existing tree heights and adjacent land slopes, measured from the outer edge of the streambank.
Non-fish-bearing intermittent and ephemeral streams	50 feet, measured from the outer edge of the streambank.
Lakes and natural ponds	300 feet, measured from the outer edge of the extent of riparian/wetland vegetation or the perennially saturated soil, whichever is greater.
Wetlands greater than one acre	150 feet, measured from the outer perimeter of riparian/wetland vegetation or the perennially saturated soil, whichever is greater.
Wetlands less than one acre	100 feet, measured from the outer perimeter of riparian/wetland vegetation or the perennially saturated soil, whichever is greater.
Wet areas – seeps and springs	50 feet, measured from outer perimeter of soil perennially saturated edge of wet area, seeps or springs.
Landform 663X7 (escarpments) with potential slope stability concerns	25 feet, measured from the edge of the landform.
Steep slopes in Riparian Reserves	No gap openings or heavily thinned areas will be created within Riparian Reserves on slopes greater than 70 percent.

Wildlife and wildlife habitat

The objectives of these criteria are to protect and benefit marbled murrelets, northern spotted owls, cavity nesters, amphibians, and other wildlife species. Some of the criteria protect specific habitat structures, and some are intended to minimize the potential for disturbance during nesting and breeding seasons.

Table 2.10. Measures to protect wildlife and wildlife habitat protection		
Landscape Feature	**Description**	**PDCs, MMs, BMPs**
Primary Constituent Element 1 of critical habitat (PCE1 or "potential nest trees")	PCE1 (individual trees with potential nesting platforms) are defined as having: a minimum of 28" diameter at breast height; one branch at least 4 inches in diameter and at a height of 33 feet or higher on the tree; a relatively flat surface on the branch at least 4 inches in diameter that can function as a platform and may or	• 100-foot, no-cut buffer; no yarding through and no skid trails through buffer. • Trees that qualify as "Potential Nest Trees" or "Legacy Trees" should not be used as anchor trees.

Table 2.10. Measures to protect wildlife and wildlife habitat protection		
Landscape Feature	**Description**	**PDCs, MMs, BMPs**
	may not have some amount of moss or lichen, mistletoe, witch's broom, and/or other deformities; some degree of cover to the potential nesting platforms that is provided by adjacent trees. (Generally left over from original harvest)	
Legacy Trees (LTs)	LTs are defined as having at least three of the following characteristics: 30" or greater diameter at breast height (dbh); deeply furrowed bark (applicable to Douglas-fir only); one or more branches 3-inches or greater in diameter; substantially (at least 25% or more) more crown cover than adjacent trees; one or more dead tops or multiple live tops; platforms of mistletoe (western hemlock); platforms from epicormic branching (Douglas-fir)	• 100-foot, no cut buffer; yarding and skid trails may go through buffer but should be avoided if possible • Trees that qualify as PCE1 or "Legacy Trees" should not be used as anchor trees.
Legacy Snags	Standing dead trees that are 30 inches or greater in diameter and 12 feet tall or taller	No-cut buffer of 1.5 times the snag height (i.e., a 40' snag gets a 60'-radius buffer)
All snags	Standing dead trees of all sizes	All snags would be retained unless they pose a hazard to human safety. Snags felled due to safety concerns would be left on site to contribute to CWD.
Coarse Woody Debris (CWD)	Existing dead and down wood on the forest floor exceeding 6 inches in diameter.	CWD may be moved for access, however disturbance would be minimized to conserve CWD. Big, old stumps would be kept intact and not uprooted wherever possible. Temporary roads and skid trails would be closed after operations are complete to conserve CWD that might otherwise be removed for firewood.
Suitable Habitat	Coniferous forest mapped as "suitable habitat" and/or forest stands that	Suitable habitat would not be removed for temporary road or

Table 2.10. Measures to protect wildlife and wildlife habitat protection		
Landscape Feature	**Description**	**PDCs, MMs, BMPs**
	meet late-successional characteristics (large trees and logs, multiple canopies, high amount of canopy cover, etc.)	helicopter landing construction; if individual large trees (>36" diameter) need to be removed, the wildlife biologist will be consulted.

Recreation and public safety

The following criteria are designed to minimize visual and physical impacts to developed and dispersed recreation sites and trails; to ensure public access to trails during project activities; and to protect public safety during project operations.

Table 2.11. Measures to protect recreation sites and public safety	
Recreation feature	**PDCs, MMs, BMPs**
Church Creek Shelter Trail #870	• Leave a no-cut buffer area 66 feet on either side of the trail. • Directionally fall trees away from the trail. • Notify public of trail closure and alternative route to access Church Creek Shelter through news releases and signage at all trail and road access points during logging operation. May require Forest Closure Order. • Notify public about alternative trail access points that avoid passing through the thinning units.
Pine Lake Trail # 887.1 2361-200 Road (Access road to Trail # 887.1)	• Leave a no-cut buffer area of 66 feet on either side of the trail corridor. • Directionally fall trees away from the trail. • Notify public of trail and road closures through news releases and signage. Identify alternative hikes in the area. May require Forest Closure Order. • Logging operations in units S36 and S36A are restricted to weekdays (Monday through 4:00 pm Friday) between May 1 and October 30. Trail closures will be in force during periods in which logging operations could put trail users at risk. May require Forest Closure Order.
2353 120 Access Trail to Lower SF Skokomish Trail #873.3	• Leave a no-cut buffer area of 66 feet on either side of the trail corridor. • Directionally fall trees away from the trail. • Notify public of trail and road closures through news releases and signage, include alternative trails to access the Lower SF Skokomish Trail. May require Forest Closure Order.
Brown Creek Campground	• No log haul through Brown Creek Campground (FSR 2340).

Botany and invasive plants

Sensitive plant occurrences

One sensitive flora site was located during botany surveys: an occurrence of the sensitive lichen *Usnea longissima* on a Douglas-fir tree in unit L01A. The criteria below are designed to protect the host tree and the lichen inhabiting it, and to increase the possibility of dispersal and establishment of *U. longissima* onto adjacent substrates and adjacent forest stands.

Table 2.12. Measures to protect sensitive plant species

Sensitive plant location	PDCs, MMs, BMPs
Usnea longissima site in unit L01A	• Leave the host tree intact and undamaged • Create a 0.1 to 0.25-acre gap beginning approximately 25 feet from the host tree, on the downwind side of the tree. Leave hardwoods, smaller conifers, and shrubs in this gap.

Invasive plant infestations

There are many known infestations of invasive plants and noxious weeds in the project area. The following design criteria and mitigation measures are designed to prevent the spread of existing infestations in the vicinity of project activities, and to prevent the introduction and spread of new infestations. They are drawn from the Olympic National Forest's 2008 Environmental Impact Statement and Record of Decision – Beyond Prevention: Site-Specific Invasive Plant Treatment (USDA Forest Service 2008)

Table 2.13. Measures to prevent introduction and spread of invasive plant infestations

Activity	PDCs, MMs, BMPs
Treat existing infestations	Treat existing invasive plant infestations with appropriate herbicide, mechanical, or manual methods before ground disturbing activities begin when practical. If timing or resources prevent treatment before the project begins, then treat infestations in the project area upon completion of the project in order to prevent invasive plants from colonizing the disturbed ground.
Equipment cleaning	Clean all off-road equipment of dirt/mud, seeds, and other plant parts before it is moved onto National Forest Service land. If operating in an area infested with invasive plants, clean all equipment before moving between sites or leaving the project area. For cleaning equipment on Forest Service land, the Contractor and Forest Service shall agree on methods of cleaning, locations of the cleaning, and control of off-site impacts, if any. 'Off-road equipment' includes all machinery other than log trucks, chip vans, pickup trucks or vehicles used to transport personnel on a daily basis.
Work/travel in infested areas	Forest Service shall flag locations of high priority invasive plant infestations prior to work commencing and provide the contractor with a map of these locations. These areas shall be avoided during work and travel associated with the project unless otherwise directed by the Contracting Officer. If directed to work in infested area, the contractor shall be required to prevent spreading the infestation into un-infested areas by cleaning vehicles and equipment. The contractor shall use wash stations approved by the Contracting Officer.

Table 2.13. Measures to prevent introduction and spread of invasive plant infestations	
Activity	**PDCs, MMs, BMPs**
Weed-free material, both Government - and Contractor-provided	All material (e.g. soil, gravel, sand borrow, aggregate, etc.) transported onto National Forest System land or incorporated into the work shall be weed-free. The Contracting Officer may request written documentation of methods used to determine the weed-free status of any and all materials furnished by the contractor. Contractor-provided expertise and methods to establish weed-free status must be appropriate for the weeds on the current Washington State noxious weed list (www.nwcb.wa.gov/weed_list/weed_list.htm). A Forest Service weed specialist shall inspect proposed sources to determine weed-free status. The contractor shall provide the Contracting Officer written notification of proposed material sources 14 days prior to use. If weed species are present in the proposed source, appropriate mitigation measures may allow conditional use of the source as required by the Contracting Officer.
Disposal of infested fill	Fill material generated from the project site, containing or suspected to contain invasive plants, shall be stockpiled within the project area and as close to the infested source area as possible. The material shall not be broadcast for disposal.
Weed-free mulch	Mulch used on the project shall be weed-free. The Contracting Officer may request written documentation of methods used to determine the weed-free status of any and all materials furnished by the contractor. Contractor-provided expertise and methods to establish weed-free status must be appropriate for the weeds on the current Washington State noxious weed list (www.nwcb.wa.gov/weed_list/weed_list.htm). *(Refer to the North American Weed Free Forage Program standards, Regional EIS, Appendix O)*
Weed-free seed	Seed used in the project shall be weed-free and meet state and local noxious weed laws.
Plant natives	Give priority to seed mixes and plantings with local native species.

Heritage and archaeological project design criteria

No eligible historic properties were found within the Area of Potential Effect for this project. These criteria are designed to protect previously undiscovered important archaeological, historical, and cultural sites from potential damage associated with project activities.

Table 2.14. Measures to protect heritage sites	
Heritage feature	**PDCs, MMs, BMPs**
Previously undetected archaeological, historical, or cultural resources	If subsurface archaeological evidence or previously unidentified cultural resources are located during implementation of the project, activities will cease pending an evaluation of cultural significance by a qualified Forest Service archaeologist, who will determine appropriate mitigation measures. The Forest will fulfill its consultation requirements in accordance with 36 CFR 800.11.

Table 2.14. Measures to protect heritage sites	
Heritage feature	**PDCs, MMs, BMPs**
Skeletal material or features of burial/interment	In the event that skeletal material or features of burial/interment are encountered, all work must be stopped immediately and contact must be established with the Forest Service archaeologist or representative, who will initiate contact with local law enforcement, SHPO, and the affected Indian Tribes.

Fire and fuels – project design criteria for activity-generated slash

These project design criteria will serve to reduce the risk of a potential ignition and allow adequate response times for local initial attack resources to contain fires while they are still small. Options for slash treatment include hauling activity fuels back into the units and scattering or piling for habitat structures; hand piling fuels within the buffer strip for burning at a later date; or piling slash on landings by machine for burning at a later date.

Table 2.15. Measures to treat project-generated fuels (slash)	
Fuels consideration	**PDCs, MMs, BMPs**
Open roadways	A 100-foot slope distance fuels pull-back buffer strip will be created along all affected roadways that are left open to the public after the project has been completed. This includes road-adjacent turnouts and landings used for the project. Surface fuel conditions within the buffer strip will resemble pre-thinning conditions.
No-cut resource protection buffers within units	No fuel treatments will occur in no-cut buffers within units.
Riparian areas	Fuel treatments will be designed to meet Aquatic Conservation Strategy objectives and to minimize disturbance to riparian vegetation.
Machine and helicopter landings	Piles of slash created on machine and helicopter landings should be placed as far as possible from surrounding forest vegetation so as to reduce the risk of causing any damage to the forest when they are burned.
Burning	All burning will be conducted in compliance with the current Washington State Smoke Management Plan.

Aquatics: Fisheries, Soils, Hydrology, and Water Quality

These measures are designed to provide protection of fish, soil, and water resources. They cover activities associated with constriction, use, and obliteration of roads, landings, and skid trails; and logging system equipment use. Many of these measures are standard practices or are contained in standard timber sale contract language.

Location and development of temporary roads and reconstruction of system roads

These measures are intended to maintain and restore aquatic organism passage, prevent erosion, stream diversion, debris flows, or mass wasting events; minimize impacts to riparian areas, habitats, and dependent species, including amphibians; and protect and restore natural hydrologic function. Temporary roads will be decommissioned after use. All road construction, reconstruction, and decommissioning will occur during the dry season (see seasonal restrictions table 2.26, and Appendix B).

Table 2.16. Measures to protect aquatic resources: road construction and reconstruction

Action or resource condition	**Is construction/reconstruction allowed?**			**Requirements if construction or reconstruction is allowed**
	Reconstruction of existing unclassified road	***Reconstruction of existing system road***	***Construction of new temporary road***	
Construction of stream crossing on fish-bearing stream (anadromous or resident)	Yes, if reconstruction results in crossing upgrade or improved aquatic organism passage	Yes, if reconstruction results in crossing upgrade or improved aquatic organism passage.	No	Design crossing to meet current aquatic organism passage standards.
Perennial stream crossing (sensitive): high gradient, 36 inch diameter or greater culvert; plugging and/or diversion potential	Yes	Yes. Reconstruct crossing to reduce diversion potential	No	Construct to current standards. Maintain to prevent diversion of streamflow.
Perennial stream crossing (non-sensitive): lower gradient, less than or equal to 24-inch diameter culvert; low plugging and/or diversion potential	Yes	Yes	Yes	Construct to current standards. Maintain to prevent diversion of streamflow.
Roads that intersect wetlands, natural ponds, ephemeral streams, seeps, springs, and wet areas	Yes	Yes	No	Reconstruct to restore hydrologic function.

Roaded access, landings, and log haul

Table 2.17. Measures to protect aquatic resources: temporary roads	
Activity or resource condition	**PDCs, MMs, BMPs**
Road location (new temporary roads)	New temporary roads will be located and designed to minimize disruption to hydrologic flows by: • following the contour of the terrain; • minimizing clearing limits (generally no more than 16 feet on level ground, 20 feet for curves, slightly more for steeper grades); • minimizing excavation of cutslopes and fillslopes; and • routing drainage away from potentially unstable hillslopes, sidecast, and channels.
Roads in unstable areas	Construction of new roads or landings in potentially unstable landforms (escarpment landform 663X7) will be assessed on the ground by a Forest Service geotechnical engineer or soils scientist prior to approval by the Timber Sale Administrator.
Existing roads in Riparian Reserves	Existing unclassified and previously decommissioned roads that are located in riparian reserves (including potentially unstable landforms) will be re-constructed in a way that adequately addresses road drainage, cutslope and fillslope instability, and potential water diversions. Sidecast of loose material is prohibited.
Roads on sideslopes	Temporary roads constructed on sideslopes greater than 30 percent shall have proper compaction of roadbed and fillslopes in order to maintain slope stability.
Road stabilization	Stabilization measures will be required if a temporary road is in place for more than one year.
Wet weather use	If roads are left open through extended wet weather, erosion and sedimentation control measures will be maintained. Spot rocking will be used as needed to reduce off-site erosion and sedimentation risk.

Table 2.18. Measures to protect aquatic resources: log and helicopter landings	
Activity or resource condition	**PDCs, MMs, BMPs**
Landing location	Existing landings will be reused where possible.
Landing location	Skyline and cable and helicopter landings will be placed in areas away from streamcourses, wet areas, and unstable soils. Short landing extensions may be used to reduce and control potential runoff.

Table 2.18. Measures to protect aquatic resources: log and helicopter landings	
Activity or resource condition	**PDCs, MMs, BMPs**
Riparian Reserves	If landings must be located within Riparian Reserves, they will be placed on existing roadways or on existing landings that require only minimum reconstruction (e.g., clearing vegetation, sloping for drainage, or surfacing for erosion control purposes) to be made suitable for use.
New helicopter landings	New helicopter landings will be limited to one acre in size. Some vegetation may need to be removed outside of this one-acre area to facilitate flight paths and safe operating procedures.
Helicopter landings	Helicopter landings will be scarified and mulched with certified weed-free straw or natural slash and coarse woody debris following use.

Table 2.19. Measures to protect aquatic resources: log haul	
Activity or resource condition	**PDCs, MMs, BMPs**
Surface and ditch maintenance	Aggregate and unsurfaced road surfaces used for log haul will be bladed and cross-drained. Ditches and culvert inlets will be kept free of debris.
Sediment filters – use, maintenance, and removal	To minimize the amount of sediment delivered to streams along the haul route, sediment filters (i.e., straw tubes, slash filter windrow, and/or sediment fence) will be placed as needed in ditchlines along the haul route or in areas where ground is disturbed and sediment has the potential for delivery to streams (i.e. stream crossing fills). Sediment filters will be maintained and adjusted as directed by the sale administrator. Removal of sediment filters will be done when site conditions are dry, and captured sediment will be relocated to a stable location away from streamcourses.
Wet weather and soil moisture – suspension of haul	Weather conditions will be monitored, and log haul temporarily suspended during prolonged periods of precipitation when soil moisture becomes elevated. If maintenance cannot be performed adequately due to weather, haul will be discontinued until conditions improve.
Winter haul	If the purchaser's plan of operations includes log haul between November 1 and May 31, the Sale Administrator, in consultation with a Forest Service watershed specialist, will review the purchaser's plan to prevent sediment from entering stream channels. This may include placing additional road surfacing, rock armoring ditches, constructing silt fencing, and straw mulching exposed soils along cutbanks and fillslopes.
Winter maintenance	For winter maintenance on surfaced and un-surfaced roads, ditches will not be bladed past the last cross-drain before a stream crossing.

Table 2.19. Measures to protect aquatic resources: log haul	
Activity or resource condition	**PDCs, MMs, BMPs**
Freezing conditions	Log haul on surfaced and un-surfaced roads will be allowed during freezing conditions, but will be suspended as roads begin to thaw. Purchaser will work with Forest Service Engineering Representative to develop standards for checking thaw.
Snow plowing	Plowing of snow will be permitted as needed, if the timber sale contract T-803 Snow Removal requirements are met.

Decommissioning of unclassified roads, temporary roads, skid roads, and landings

Table 2.20. Measures to protect aquatic resources: decommissioning	
Activity or resource condition	**PDCs, MMs, BMPs**
Ripping	All temporary roads (including existing unclassified roads) and landings will be ripped to a soil depth of at least 14 inches. Ripping should be done immediately following completion of logging activities. Available logging slash will be placed across the ripped surface. To prevent re-compacting of the treated roadways and landings, no ground-based equipment will be operated on ripped portions of roads and landings after ripping is completed.
Culvert removal	All culverts will be removed and stream bank profiles reestablished.
Cross-drains or waterbars	Prior to the wet season, cross-drains or waterbars will be installed every 150 feet, or more frequently where slopes exceed 5 percent.
Flat slopes	On roads across relatively flat slopes, any thru-cuts that generate berms will be back-bladed across the roadway.
Outsloping	Road surfaces in potentially unstable landforms will be ripped and fully outsloped. All sidecast material will be removed and placed in a stable location.
Revegetation	Road surfaces will be revegetated with appropriate native or specified non-native grass seed and/or native tree seedlings. Acceptable seed mixes, types of weed free mulch, and application rates will be specified by a Forest Service botanist.
Preventing motorized access	Post-harvest motorized access to all temporary roads and landings will be prevented by construction of an approved closure device (e.g., earth berm, large boulder placement and planting of native materials).

Fisheries

Table 2.21. Measures to protect fish and fish habitat (including culvert requirements)	
Activity or resource condition	**PDCs, MMs, BMPs**
Instream work	Project activities will follow all applicable provisions of the Memorandum of Understanding (MOU) between the Washington Department of Fish and Wildlife and USDA Forest Service, Pacific Northwest Region, Regarding Hydraulic Projects Conducted by USDA Forest Service, Pacific Northwest Region (2012). Follow all applicable provisions found in Appendices A and D of the MOU.
Instream work	A pre-approved dewatering plan is required before instream work can proceed. A Forest Service fish biologist should be contacted to review the plan as part of the approval process.
Existing instream wood	All existing wood in streams or wetlands will be left in place unless designated for removal by a Forest Service fish biologist.
Stream crossing restoration	Restoration of stream channel crossings will incorporate design features to prevent ATVs from using them as fording sites.
Stream crossings on gravel roads	For gravel-surface roads, stream crossings with fish presence shall be rocked with a 3-inch lift where needed as determined by a Forest Service watershed specialist or road engineer to control sediment production.
Temporary culverts	Temporary culverts are culverts installed for one summer season and removed before the end of the work period.
Aging culverts	Culverts nearing or past their lifespan will be replaced as necessary.
All culverts	All culverts (new or replacements) installed for more than one summer season are considered to be permanent culverts and need to meet the Q100 criteria.
Culvert removal	All culverts removed from stream crossings and ditches will be transported off-forest by the contractor.
Ditch relief culverts	Additional ditch relief culverts may be installed as needed to divert runoff away from stream channels.

Soils and water quality: logging systems and log yarding

These measures are designed for the protection of soils, site productivity, and water quality. They are applied to reduce the potential for erosion, compaction, deep rutting, soil displacement, alteration of surface and subsurface water flow, and offsite stream sedimentation. These management requirements are presented here by log yarding system.

Table 2.22. Measures to protect soils: all types of yarding operations	
Activity	**PDCs, MMs, BMPs**
Erosion control - general	Erosion control measures will be designed in coordination with a Forest Service watershed specialist prior to the close of the timber sale, and implemented by the purchaser by November 1.

Table 2.22. Measures to protect soils: all types of yarding operations	
Activity	**PDCs, MMs, BMPs**
Erosion control on landings, corridors, skid trails	Maintenance and erosion control on landings, disturbed cable corridors, skid trails, and temporary and permanent roads will be completed prior to the onset of extended periods of wet weather and following the completion of operations.
Cable and helicopter yarding: operations on steep slopes	Avoid harvest on areas that have average sideslopes of more than 80 percent. Some trees may be cut on slopes steeper than 80 percent for occasional cable corridors in order to access areas of stand less than 80 percent.
Erosion control and mitigation on steep slopes	Areas of gouging or soil displacement on steep slopes resulting from yarding systems will be treated to prevent rill and gully erosion and possible sediment delivery to stream courses. Erosion control treatment may include, but is not limited to, repositioning displaced soil to re-contour disturbed sites, creating small ditches or diversions to redirect surface water movement, and scattering slash material to create flow disruption and surface soil stability.
Erosion control off skid trails	If it is necessary for equipment to travel away from approved skid trails, corridors, or temporary roads, the machines will operate on a slash mat of limbs and tops that is deposited directly in front of the machine. This mat will be as thick and continuous as practicable. Activities will be planned to make as few trips as possible.
Directional falling of trees	Directionally fall trees away from buffers to protect riparian vegetation from damage. Trees accidentally felled into buffers may not be removed.
Thinning units near the South Fork Skokomish River mainstem	Due to the close proximity of the units to the river, design logging systems to limit the creation of corridors or skid trails that could encourage vehicle access to the river.
Detrimental soil conditions	Detrimental soil conditions will not exceed 20 percent of the project area, including roads and landings.

Table 2.23. Measures to protect soils: ground-based yarding	
Activity	**PDCs, MMs, BMPs**
Skid trail location	In preference to the construction of new skid trails, old skid trails will be used wherever possible, as long as they avoid wet areas and are located in such a way that will prevent sediment delivery to streams.
Skid trail use	Skid trails will have slash placed on them prior to use by equipment whenever possible.

Table 2.23. Measures to protect soils: ground-based yarding	
Activity	**PDCs, MMs, BMPs**
Erosion control on skid trails	Erosion control devices such as backblading and waterbars will be used as necessary on all skid trails. Erosion control work shall be kept current particularly preceding expected seasonal periods of precipitation or runoff. The type and intensity of erosion control will be based on ground and weather conditions and the need to control runoff.
Skid trail rehabilitation	Where skid trail rut depth exceeds 10 inches, the following actions will be required: 1) subsoiling the full width of the skid trail to the depth of the rut plus six inches; 2) returning all displaced soils on adjacent berms and any excavated material to the skid trail to approximate original soil contours; 3) replacing any disturbed large coarse woody debris as closely as possible to its original orientation (i.e., top side up); and 4) placing slash and stumps onto the skid trail so that it is contiguous with the surrounding area.
Ground-based skidding and yarding	Standard ground-based equipment is restricted to slopes that are no greater than 30 percent.
Tractor operation on sensitive soils: restricted operating season	On soil types with seasonal high water tables, ground-based operations are restricted to the period from June 1 through October 30. These soil types are (EUI or SMU): 501N8, 505N7, 506N7, 511N8, 516N7, 536M7, 537M7, 538M7, 900AZ, 901AZ, 902E8. (See seasonal restrictions section for affected units)
Pulling logs to skid trails (lining)	Lining-pulling operations may be accomplished by yarding material to lead, or at a 30-45 degree angle towards skid trails wherever possible. Suspension of logs is not required during lining operations.

Table 2.24. Measures to protect soils: skyline yarding	
Activity	**PDCs, MMs, BMPs**
Yarding direction	Design cable yarding systems to yard away from potentially unstable slopes, stream channels, wetlands and wet areas, and other riparian no-cut buffers.
Suspension of logs	One end suspension of logs is a minimum requirement (except during lining operations). Where yarding across a stream channel or wet area is necessary, full suspension is required.
Downhill yarding	Downhill cable yarding should be avoided. Where this method would result in less overall impacts to soil and watershed values, care shall be taken to maintain one end suspension and avoid soil gouging.

Table 2.25. Measures to protect soils: mechanical prebunching	
Activity	**PDCs, MMs, BMPs**
Equipment access	Excavation of the road prism for access of pre-bunching equipment will be kept to a minimum. Avoid potentially-unstable cutslopes and fillslopes for access. Rehabilitation and revegetation should occur as soon as possible.
Corridor width and spacing	Pre-bunching corridors will only as wide as necessary for the equipment to travel (less than 12 feet wide wherever possible) and no closer than 50 feet between trails.
Corridor routes and orientation to slope	The equipment will travel up and down (parallel to) the slope and be restricted to slopes less than 50 percent. Exceptions may be approved by the Timber Sale Administrator for short, steep pitches if erosion control and rehabilitation measures are in place and timely. Routes will be planned to minimize both travel across (perpendicular to) the slope and turning on steep slopes. Feller/buncher corridors will flagged by Purchaser and approved by Forest Service Timber Sale Administrator upon review by watershed specialist.
No-cut buffers	Feller/buncher equipment will not enter into riparian no cut buffers, including streams, persistent and ephemeral seeps, wetland areas and unstable slopes. If equipment cannot avoid these areas then, as needed, "corduroy" logs will be laid down parallel to the direction of water flow in order to minimize alteration of hillslope hydrology. If feasible, additional slash/tops will be placed in the equipment's path.
Equipment movement	Equipment travel will be limited to one round trip (two passes). Processor will pull line or buck logs if needed to reach logs outside of cable road, and will not take equipment off the approved corridor.
Equipment movement – slash mats	Soil rutting (ruts greater than 6 inches deep) caused by feller/buncher equipment will be minimized, especially on steeper slopes, by ensuring adequate slash placement.
Service trails	"Go-back" trails used for equipment fueling and servicing shall be approved by the Forest Service Timber Sale Administrator and shall be in locations with suitable grade and minimal impact to soils and streamcourses. These trails will be rehabilitated after use.
Rehabilitation of skid trails, corridors	Rehabilitation of pre-bunching skid trails with ruts deeper than 6 inches for 20 feet will occur as soon as practical. Ruts shall be removed and berms pulled in, the disturbed area will be decompacted, any concentrated water will be ditched out, and additional slash will be placed over the site.

Seasonal operating restrictions

Seasonal operating restrictions are imposed for resource protection. The general operating restrictions shown in tables 2.26 and 2.27 apply to this project. Not all restrictions apply to all units or all activities. See Appendix B for additional details and a graphic calendar representation of seasonal operating restrictions for individual thinning units and roads.

It is understood that, while restricted operating seasons are necessary to protect resources, they also reduce project feasibility, increase the cost of operations, and reduce timber sale proceeds that could be applied to additional restoration and improvement activities in the project area.

Table 2.26. General seasonal operating restrictions for thinning operations

ID	Reason for restriction	Restriction[1]	Operating Window
A	Seasonal high water table – prevent soil damage	No ground-based logging activities November 1 through May 31. Includes log haul on temporary roads.	June 1 - October 31
R	Recreation high use season – minimize trail closures	No project activities on weekends (4:00 pm Friday through Sunday) May 1 through September 30	October 1 - April 30
1	Owl and murrelet breeding season – prevent noise disturbance	Restriction on ground-based machine noise April 1 through August 5	August 6 - March 31
2	Owl and murrelet breeding season – prevent noise disturbance	Restriction on helicopter noise March 1 through August 5	August 6 - February 28
3	Wildlife gate closures (WDFW)	Wildlife gates closed October 1 through April 30	May 1 - September 30
4	Two-hour work window restriction to minimize disturbance to owls and murrelets	Noise-producing activities may not commence until two hours after sunrise, and must cease two hours before sunset. April 1 through August 5	August 6 - March 31

1 *Not all restrictions apply to all units or activities. See Appendix B for additional details and a graphic calendar representation of seasonal operating restrictions for individual thinning units and roads.*

Table 2.27. General seasonal operating restrictions for road construction and maintenance			
Restriction applies to	**Reason for restriction**	**Restriction[1]**	**Operating Window**
2361 Road and spurs	Bull trout habitat protection (specified in USDI 2003)	For 2361 road and spurs, no ditch blading, road blading, or other major road maintenance activities from October 1 through March 31. Minor maintenance to prevent washouts and sediment delivery is allowed year-round.	Major maintenance allowed April 1 through Sept 30. Log haul allowed year-round. To prevent need for major maintenance between October 1 and March 31, haul will cease if there is a risk of sediment delivery to streams or of road damage or rutting.
2300240, 2300260 roads	Minimize soil damage (road is located on sensitive soil type)	No haul November 1 through March 31	Haul window = April 1 through October 31
All instream work	Minimize sedimentation, protect aquatic habitat (per Hydraulic MOU with WDFW)[2]	All temporary and system road instream work will occur during instream work window (July 15-Sept 30).	July 15 through September 30
All temporary roads	Minimize erosion, sedimentation, protect aquatic habitat	Temporary road construction, reconstruction, and decommissioning will not occur between October 1 and May 30.	June 1 through September 30
All temporary roads	Prevent noise harassment to spotted owls and marbled murrelets	Restriction on ground-based machine noise April 1 through August 6. Restriction on helicopter noise March 1 through August 6	Temporary road construction, reconstruction, and decommissioning seasons will match unit-level operating seasons 1 and 2 in table B.1 for the associated unit(s).
All system roads	Prevent sedimentation, protect aquatic habitat	It is assumed that any system road construction needed for the project would occur between June 1 and September 30.	

1 *Not all restrictions apply to all units or activities. See Appendix B for additional details and a graphic calendar representation of seasonal operating restrictions for individual thinning units and roads.*

2 *USDA Forest Service, Washington Department of Fish and Wildlife. 2012.*

Implementation and Effectiveness Monitoring

During project implementation, no-cut buffers, noise levels, soil conditions, water quality, and other compliance monitoring would be conducted to ensure that the management requirements described above are being implemented. After elements of the project are completed, effectiveness monitoring would be conducted to assess the success of the project in meeting its objectives. The results of this monitoring would be used to inform future management activities.

CHAPTER 3 – AFFECTED ENVIRONMENT AND ENVIRONMENTAL EFFECTS

INTRODUCTION

This chapter describes the affected environment and potential effects of the Proposed Action (Alternative B) and the No Action alternative (Alternative A), and presents the scientific and analytical basis for comparing the alternatives. The chapter is divided into sections based on resource area, and the affected environment and potential effects are described in relation to the resource under consideration. The Silviculture and Forest Stand Development section contains a description of the treatment elements that would comprise the unit-level silvicultural prescriptions.

For each resource area, there is a discussion of direct, indirect, and cumulative effects associated with each alternative. These types of effects are defined in 40 CFR 1508, the Council on Environmental Quality (CEQ) implementing regulations for the National Environmental Policy Act (NEPA). Direct effects are caused by and occur at the same time and place as the action under consideration. Indirect effects are caused by the action, but occur later in time or are farther removed in distance. Cumulative effects are discussed in more detail below

Acreage and road mileage figures presented in this environmental assessment are estimated values generated through geographic information system (GIS) analysis using currently available data. Accuracy of these estimates varies, and is based on the varying scales and accuracies of the individual spatial datasets used in the analysis. Rounding errors may make totals differ slightly but do not affect the results of the analyses.

CUMULATIVE EFFECTS

Cumulative effects are the effects on the environment resulting from the incremental effects of the current action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes those actions. Cumulative effects can result from individually minor but collectively significant actions taking place over a period of time. To be relevant to the project under analysis, the effects of past, present, and foreseeable future actions need to have a cause-and-effect relationship (overlap in time and in space) with the affected environment and the direct and indirect effects of the proposed action and any alternatives.

Past Actions

In order to understand the contribution of this project's effects to the to the cumulative effects of past, present, and reasonably foreseeable actions, this analysis relies on current environmental conditions as a proxy for the impacts of past actions. This is because existing conditions reflect the aggregate impact of all prior human actions and natural events that have affected the environment and might contribute to cumulative effects. The Council on Environmental Quality issued an interpretive memorandum on June 24, 2005 regarding analysis of past actions, which states, "agencies can conduct an adequate cumulative effects analysis by

focusing on the current aggregate effects of past actions without delving into the historical details of individual past actions." By looking at current conditions, we are sure to capture all the residual effects of past human actions and natural events, regardless of which particular action or event contributed those effects. The cumulative effects analysis in this EA is consistent with Forest Service National Environmental Policy Act (NEPA) Regulations (36 CFR 220.4(f)).

Past actions that still have present effects that are relevant to the Upper South Fork Skokomish Vegetation Management Project and its affected environment are road construction and timber harvest, both of which have greatly influenced current conditions in the planning area. All of the stands proposed for thinning are stands that have been harvested in the past, and in which the effects of past timber harvest still linger. Historic road construction still has present effects on soil conditions and water quality in the project area.

More recent relevant past actions include commercial thinning; and road stabilization, drainage upgrades, closure, and decommissioning.

Present and Reasonably Foreseeable Future Actions

Present and reasonable foreseeable future activities relevant to this project are maintenance and repair of authorized Forest System roads; pre-commercial thinning; invasive plant treatments; and shrub planting for wildlife forage enhancement. The bulk of the planned road stabilization, closure, and decommissioning for the Upper South Fork Skokomish River watershed has been completed, but there are several miles remaining that are likely to be completed in 2012 and 2013. Timber harvest and associated activities may occur on the small portion of non-Federal land in the upper east end of the watershed.

SILVICULTURE AND FOREST STAND DEVELOPMENT

The 36,750 acres within the planning area have the following forest age distribution in 2011 (table StandDev-1).

Table Silviculture-1. Current stand age distribution		
Stand age in 2011	**Acres**	**Percent of planning area**
34 years old or younger	7,674	21%
Between 35 and 199 years	8,219	22%
Over 200 years	19,539	53%
Non-forested	1,323	4%

A total of 880 acres of dense, 37 to 66 year-old, single-storied conifer stands are proposed for active commercial thinning treatment, with about 157 additional acres of identified skips (no active treatment). Given the age and current condition of stands included in this project, commercial thinning is supported by the 1994 Record of Decision (ROD) for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl (USDA and USDI 1994, p. B-6) and by the Hood Canal South Late Successional Reserve Assessment (USDA 1996, p. 39-40) as a beneficial activity that can be used to promote the development of late-successional characteristics and allow more rapid attainment of desired future conditions. Table C-1 in Appendix C presents information about basic characteristics of the stands proposed for thinning in the Upper South Fork Skokomish Vegetation Management Project.

Historic Disturbance and Previous Management

Historically, large-scale disturbances on the landscape were dominated by fire. Fires were generally stand-replacing disturbances greater in extent than the planning area. Large fires in 1100, 1250, 1308, 1508 and 1701 burned all or part of the planning area (USDA 1995), creating large areas of even-aged forests, which moved through successional stages as large blocks. Prior to the onset of large scale human disturbances in the project area, forested stands in about half the planning area originated following a fire in 1308 (northern and eastern portions) and the remainder following fires in 1668 or 1701 (southern and western portions). In more recent history, timber harvest and related activities have been the dominant disturbance on the landscape.

Clearcut harvesting in the project area began in the 1940's, peaked in the 1980's, and ended in the early 1990's. Clearcut harvest units generally 60 to 100 acres in size and associated road building fragmented contiguous patches of old growth forest, and created landscape level vegetation patterns that differ from those created by the historic fire regime. Prior to 2002 the project area was included in the Shelton Multiple Use Sustained Yield unit, and as a result the project area was subjected to more intensive management than most other watersheds on the Olympic National Forest. Following clearcut harvesting (and broadcast burning in most cases), stands were regenerated by a combination of planted Douglas-fir seedlings and natural regeneration resulting from seedfall from adjacent stands. According to total resource inventory (TRI) records, the total acreage clearcut in the Upper South Fork Skokomish

Vegetation Management Project planning area was 15,089 acres (41% of the planning area), and the majority of the clearcut acreage (12,922 acres) was broadcast burned. A total of 15,041 acres were actively reforested, with the 48-acre difference likely due to the fact that some stands were left to regenerate naturally following early clearcut harvesting. Since the 1970's, a total of 7,578 acres were pre-commercially thinned to about a 10-foot spacing at age 15-20 in anticipation of a commercial thin at age 30-40. About 125 acres within the project area have received a commercial thinning treatment. Aerial application of fertilization to increase tree growth was done on 4,875 acres, primarily in the late 1980's. Pruning of lower tree limbs to improve wood quality took place on 107 acres in 1993. Table C.2 in Appendix C presents information about current stand age and past timber harvest activities that have taken place in the project stands.

Current Stand Conditions

Historic stand information was obtained from the South Fork Skokomish Watershed Analysis (USDA 1995) and TRI records, and current stand conditions were assessed in stands proposed for treatment utilizing walk-thru stand exams. The data gathered included overstory tree and stand level characteristics, snag abundance, understory plant and tree species and abundance, coarse woody debris cover and probable plant associations. Table C-3 in Appendix C presents information about current tree species composition and understory vegetation in the project stands.

The stands proposed for treatment were between 37 and 66 years of age in 2011 (see Table C.2 in Appendix C). A mix of Douglas-fir and western hemlock comprise the overstory of these stands, with variation in the relative abundance and dominance of these tree species from stand to stand. Occasional western redcedar, red alder and Pacific silver fir are also present in the overstory. Some stands contain scattered legacy trees and/or potential nest trees for marbled murrelet. These trees remained following the previous clearcut harvest, and are primarily located near edges with old growth stands.

Current canopy closure ranges from 75 percent to 95 percent, and is approximately 90 percent in most stands. There are between about 150 and 750 trees per acre in the overstory of these stands, with most stands in the range of 250 to 350 trees per acre. Overstory trees generally have a DBH ranging from 6 inches to 20 inches (with occasional larger trees in some stands). Variation in the diameter distribution between stands is attributable to site quality, tree density, species composition, management history and other factors. Similarly, the size and abundance of understory trees are variable both within and between stands. Understory trees are predominately western hemlock and western redcedar. Scattered vine maple clumps are present in some stands, in addition to sapling or pole-sized red alder, Douglas-fir and western hemlock associated with small canopy gaps. Stand quadratic mean diameter is generally 10 to -11 inches DBH (diameter at breast height – 4½ feet) , but ranges from about 7.5 to 15.3 inches DBH and is inversely related to trees per acre. In the 5 to 10 years previous to measurement for this project, most stands displayed considerable reductions in radial tree growth attributable to high stand density. Stand basal areas are in the range of about 100 to 260 square feet per acre, with an average stand condition of approximately 200 square feet per acre.

Plant associations that best characterize stands proposed for treatment are in the western hemlock series (Henderson et al. 1989). Major plant associations identified (in order of decreasing occurrence) include TSHE/GASH/POMU (western hemlock /salal/swordfern), TSHE/BENE (western hemlock/Oregon grape) and TSHE/BENE/POMU (western hemlock/Oregon grape/swordfern). Minor plant associations identified (in order of decreasing occurrence) include TSHE/POMU-TITR (western hemlock/swordfern/foamflower), TSHE/GASH (western hemlock /salal) and TSHE/GASH/BENE(western hemlock /salal/Oregon grape). These plant associations generally indicate moderate growth potential for trees, with most associations representing Site Class 3. Understory vegetation in the stands displays a wide range of conditions in species composition and percent cover (2 percent to 90 percent), depending on the plant association and stand treatment history.

Some stands contain numerous small snags less than 6 inches DBH, but there are generally few snags 10 inches DBH or larger in the project stands. Legacy snags are widely scattered and are generally located along the perimeter of adjacent old growth stands. The project stands have generally low levels of CWD, with an average stand condition of around 5 percent cover.

Stand Health and Vigor

Symptoms of infection with Armillaria root disease (*Armillaria ostoyae*) were noted on scattered individual live trees in most stands, as well as on some recently dead trees. In western Washington and Oregon, tree mortality caused by Armillaria has most often been associated with Douglas-fir plantations less than 30 years of age, and with trees exhibiting low vigor (Shaw et al. 2009). Observations of trees exhibiting symptoms of infection and recent mortality in these stands confirmed that most of the affected individuals were trees of low vigor (in the intermediate or suppressed crown classes) that were stressed by density-related competition for resources.

Hemlock dwarf mistletoe (*Arceuthobium tsugense*) is present on individual western hemlock trees in many of the stands included in this project. Dwarf mistletoe is typically associated with previously suppressed trees that were released following clearcut harvest or trees that are located near stand edges with adjacent old-growth stands. Individual trees display “witches’ brooms” (either alive or dead) on lower limbs, but in general the upper tree crowns appear to be unaffected. Dwarf mistletoe is likely causing some growth loss for infected individuals, but the witches’ brooms have the potential to contribute to structural diversity within the stand and provide valuable habitat for a variety of wildlife species.

Stand Density Index (SDI) is a relative density measure that was developed to quantify the level of site occupancy based on tree number and size (Reinecke, 1933). SDI can be used to assess the degree of inter-tree competition in a stand. Calculated SDI for Douglas-fir dominated stands proposed for thinning ranged from 240 to 464, which is 40 percent to 78 percent of the maximum SDI for Douglas-fir (Reinecke 1933). Calculated SDI for the one stand dominated by western hemlock (unit S099) was 306, which is 39 percent of the maximum SDI for western hemlock (Long 1985). The threshold that triggers a high level of density-dependent tree mortality occurs at 55 percent of maximum SDI (Drew and Flewelling 1979), and project stands with lower density are projected to reach this condition within about a decade. Relative densities of 40 percent to 55 percent maximize stand growth, and maximum tree sizes are

attained by managing near 15 percent relative density (Drew and Flewelling 1979). Flewelling, Wiley and Drew (1980) state that "most of a site's (growth) potential is captured if relative density is maintained at 40 percent or higher, and over 90 percent of the site's potential is captured if the relative density is maintained at 30 percent."

Stand Development

The current stand conditions indicate that these stands are in the competitive exclusion stage as defined in the Hood Canal South Late Successional Reserve Assessment (USDA 1996), or stem exclusion stage (Oliver and Larson 1990). This stage of stand development is characterized as having relative structural uniformity and simplicity, with only one canopy layer, little understory vegetation, and low plant species diversity. Dense overstory canopy shading limits the growth of shrubs and herbs – though they exist in the stands, they are mostly small plants with little biomass – and prevents development of a multi-storied canopy for many decades. Structural and species diversity are therefore relatively low. There are few late-successional habitat components such as large crowns and limbs, cavities, and other tree "defects," few large snags, and low levels of CWD. Competition-related tree mortality produces numerous small-diameter snags with relatively little wildlife habitat value. The overstory trees utilize the majority of the available growing space on the site, resulting in increasingly intense inter-tree competition as the trees increase in size. The stress of inter-tree competition (often combined with a reduction in live crown ratios as tree crowns recede) decreases tree vigor, reduces diameter growth and results in higher height-to diameter ratios. Height-to-diameter ratios exceeding 80 decrease tree stability and result in windthrow and stem breakage under moderate wind or snow loads as the tree becomes structurally unsound (Wonn and O'Hara 2001). As crown recession continues for individual trees or entire stands, the live crown ratio can fall below 30 percent, reducing the potential for a growth response to increased resource availability, and reduced height growth occurs below approximately 20 percent live crown ratio (Oliver and Larson 1990).

When compared to stand conditions that occur before or after this stage of stand development, the stem exclusion stage has lower plant species and structural diversity, and provides habitat for the fewest number of wildlife species of any developmental stage. Currently 22 percent of the planning area is in this stage of stand development, and within 20 years these conditions will be present on 43 percent of the acreage in the planning area as the younger stands enter the stem exclusion stage of stand development. Carey and Curtis (1996) recommend "minimizing area and time in the competitive exclusion stage" to promote biodiversity and accelerate development of late-successional characteristics. They conclude that, left untreated, managed stands may spend over 100 years in the competitive exclusion stage or fail to develop desired late-successional characteristics. Others have postulated that managed stands are on a different trajectory than the developmental pathway that produced current old-growth stands, and that managed stands are not likely to develop desired characteristics without treatment (Tappeiner et. al. 1997). Even in unmanaged stands following a stand replacing disturbance, the desired late-successional characteristics associated with single-storied stands (one tree layer) are generally not present until the stand reaches a minimum age of 175 years, and another 100 years or more is required to develop a multi-storied, late-successional stand (USDA 1996).

Most of the stands proposed for treatment are early in the stem exclusion stage of stand development, and as a result have not yet displayed a high degree of density-dependent tree mortality. They have relatively high live crown ratios, relatively low height-to-diameter ratios, and a relatively high cover of understory vegetation. These factors are beneficial for the acceleration of late-successional characteristics through thinning because current conditions allow for the enhancement and retention of some desirable stand and tree characteristics that could be lost if treatment were delayed for several decades. Current average live crown ratios of 35 percent to 55 percent, and average height-to-diameter ratios of 50 to 65 indicate that the overstory trees have the potential to utilize the increased resources made available by thinning, and still display a relatively low risk of windthrow and stem breakage.

Some of the stands proposed for treatment have not yet reached the threshold of 55 percent of maximum SDI, and as a result have larger numbers of relatively small diameter trees (5 inches to 8 inches DBH). In some stands a large number of the overstory trees are in this diameter range and still have relatively high live crown ratios (30 -40 percent), although they display reduced height and diameter growth compared to larger trees in the stand. Over the next several decades, trees in this diameter range will be subject to density-related tree mortality as competition for resources intensifies within the stands. Reduction of tree density by thinning would allow this class of trees to persist in the project stands for a longer period of time, either producing larger snags and CWD as a result of delayed mortality, or developing into midcanopy trees. The stands also exhibit potential for the development of two-storied stands in the form of light, scattered understories of western hemlock and western redcedar, which would likely be lost to mortality with increasing stand density. The proposed treatments would increase light to the forest floor, promoting the retention and development of understory trees and vegetation.

Thinning and Windthrow Risk

In some cases windthrow can become a problem in recently thinned stands by acting as a stand-replacing disturbance. Where the objective is the development of late-seral conditions, this level of windthrow is not desirable. Historically, however, stand-level windthrow was uncommon within the Upper South Fork Skokomish planning area (USDA 1995). Future wind events may result in the windthrow of individual trees or groups of trees and some snapped tree tops within the project stands, especially in the first few years following treatment. This level of windthrow would provide some gaps, contribute to CWD, and create new snags – all components of the desired future condition. Wind events would increase the spatial heterogeneity and structural complexity of the stands proposed for treatment by creating some of these elements, which are currently lacking in these stands.

In general, areas where wind throw has had a noteworthy impact have exhibited some or many of the following ten risk factors (no attempt is made here to order them or quantify the risk associated with each):

- Predominantly hemlock and Sitka spruce stands – shallow rooting (Harris, 1999);
- Stands adjacent to clearcuts that occur within a few years after thinning;
- Stands with height-to-diameter ratios exceeding 80 (Wonn and O'Hara 2001);
- Large flat areas;

- Exposure to storm winds (Harris, 1999);
- Shallow soils (Harris, 1999);
- Wet soils;
- Stands 50 years old and older that have not been thinned in the past;
- Narrow buffer strips of standing trees between clearcuts and roads;
- Stands heavily infected with root rots.

Based on records of historic wind disturbance and an absence of most risk factors within the project stands, there would be a low risk of stand-replacing windthrow following the proposed thinning treatments. After the thinning treatment, individual or small patches of dead standing or downed trees resulting from spotty windthrow or mortality from root disease would be left in the stand as snags and CWD, and would serve as valuable components of wildlife habitat.

Desired Future Condition

In the long term, the desired future condition for the project stands would be fully functional late-successional stands. To achieve this goal, the purpose of the Upper South Fork Skokomish Vegetation Management Project is to Increase structural and habitat diversity and accelerate the development of late-successional forest characteristics by decreasing stocking in dense, previously managed stands in Late-Successional Reserve and Adaptive Management Area land management allocations; and to manage Riparian Reserves for desired vegetation characteristics needed to attain Aquatic Conservation Strategy objectives(also see Chapter 2, Purpose of and Need for Action):

The following are characteristics of old-growth forest (Franklin et al. 1986; USDA 1993; Carey and Johnson 1995; Carey and Curtis 1996) and describe the desired future condition of the stands proposed to be treated in this project:

- a patchy, multilayered forest canopy with high crown closure and trees of several age classes;
- a variety of herbs, shrubs, and coniferous tree seedlings and saplings on the forest floor;
- overstory trees exceeding 36 inches in diameter at breast height (dbh) with large crowns, large branches, broken tops and other indications of old and decaying wood in some of them;
- understory trees with a range of diameters and ages;
- large standing dead trees;
- coarse woody debris on the forest floor;
- retention of stream shading in Riparian Reserve;
- accelerated growth of conifers in Riparian Reserve to provide future large wood for recruitment into streams.

Summary of Proposed Treatment

The proposed treatments are designed to reduce stand density; add structural and spatial complexity; maintain or increase crown and branch size and diameter growth of individual trees; introduce or encourage continued development of an understory of seedlings and

saplings, shrubs, and herbs; increase the number of snag recruitment trees suitable for cavity nesters; and contribute to coarse woody debris recruitment. While there are differences in proposed treatments for stands located in LSR and those in AMA, all the proposed treatments are variations of a variable density thinning treatment. The concept of variable density thinning developed from research that emphasized the inclusion of patches of differing tree density with an overall thinning treatment, including features such as "skips" (unthinned patches), "gaps" (small openings), and heavily thinned areas (Carey and Curtis 1996, Muir et al. 2002). One objective of variable density thinning is to increase structural heterogeneity (both vertical and horizontal) through the inclusion of patches receiving different treatment intensities in the overall stand treatment.

Long-term studies have demonstrated that lower stand density results in increased diameter growth (Curtis et al. 1997), and increased tree growth has been observed for overstory trees (Harrington et al. 2005; Roberts and Harrington 2008) and midstory trees (Comfort et al. 2010) following variable density thinning treatments on the Olympic Peninsula. Variation in the thinning intensity within the project stands would produce differences in the growth of individual trees (Roberts and Harrington 2008, Comfort et al. 2010), promoting both vertical and horizontal structural heterogeneity. Thinning would increase cover of herbs, shrubs and understory trees (Bailey and Tappeiner 1998; Carey and Wilson 2001; He and Barclay 2000; Tappeiner and Zasada 1993), and promote understory species diversity (Ares et al. 2010). Flower and fruit production of understory shrubs would also be enhanced by thinning (Wender et al. 2004). Compared to an unthinned condition, the stands would have greater density, survival, and growth of conifer seedlings (Bailey and Tappeiner 1998, Brandeis et al. 2001; DeBell et al. 1997), moving the project stands toward developing a multi-layered canopy.

Commercial thinning

Differences in proposed treatment components between stands located in LSR and those in AMA, including skips, heavy thinning, gaps and patches of "thinning from above" treatments, are described in separate sections below.

Regardless of designation as LSR or AMA, the majority of the area within all project stands would be given a thinning from below silvicultural treatment. The edge of the dense, plantation conifer stand type and the design criteria specified in Chapter 2 would be used to locate boundaries. The Designation by Description contract specification would be used to implement the prescription. Designation by Description results in variably spaced trees and a wider range of leave-tree diameters than a strict thinning from below prescription, but generally removes smaller trees and leaves larger trees. Thinning would generally remove trees of the most abundant conifer species, while leaving less abundant conifer species and hardwood species in the stand, however individual trees (less abundant conifer or hardwood species) would be cut if they pose a safety hazard or for operational reasons, such as for skid trails, yarding corridors, landings and road locations that would be used for the proposed treatment. Leave trees would be selected without regard to whether the tree has any damage, so that trees with defects, potential cavities, nesting platforms, or other similar features of structural diversity may be retained in the units (Knowles 1996a). In this case, the term "damage" refers to breakage, double tops, crooks, heart rots, ants, etc., that cause loss of wood volume, but usually won't kill

the tree. Similarly, trees with fading crowns or bleeding boles indicative of root disease that may kill some trees and create snags and coarse woody debris over time would not be disproportionately favored for cutting by the proposed treatment. The thinning treatment would reduce stand relative density to between 25 percent and 35 percent of maximum stand density index (SDI), a level between maximizing growth at the stand level and maximizing individual tree growth (Drew and Flewelling 1979). Approximately 100 to 180 trees per acre would remain in the post-treatment stands with a range of 60 percent to 90 percent canopy closure.

Cut-tree diameter limits

Within LSR stands, trees greater than 20 inches DBH would not be cut as part of the thinning treatment. Wherever possible, individual trees greater than 20 inches DBH cut for safety or operational reasons would remain on site as coarse woody debris (Knowles 1996a). Trees of this size may be converted to snags or coarse woody debris. Within AMA stands there would not be an upper diameter limit on trees cut as a part of the thinning treatment, however based on individual stand conditions, an upper diameter limit may be specified in some cases. Trees less than 8 inches DBH would be retained in all stands.

Reforestation

Post harvest surveys would be conducted to evaluate reforestation needs for created gaps, temporary roads and landings. Where there would be insufficient natural reseeding, or where resource concerns warrant, reforestation would be accomplished with an appropriate mix of native species.

Treatment specific to LSR stands

The Forest Service Region 6 Regional Ecosystem Office (REO) provided general recommendations for variable density thinning within LSR which were deemed to “have a high likelihood of benefiting late-successional forest conditions” (Knowles 1996a, Knowles 1996b). The REO recommendations provide the basis for the general prescription proposed for the stands, which would be a thinning from below (generally removing smaller trees and leaving larger trees) with at least 10 percent of the stand area in skips (unthinned areas) and up to 10 percent of the area in a combination of areas of heavy thinning and gaps (small openings).

Skips (no-cut areas)

Skips are undisturbed areas within thinning operations. Because they receive no thinning treatment, within skips the development of an understory continues to be suppressed. The skips maintain a component of dense overstory lacking much understory vegetation, and would provide patches of habitat for species that prefer closed canopy forest. Skips provide for the continued production of small diameter snags through competition-induced tree mortality, patches of smaller trees, thermal and visual cover for wildlife species, and protection for snags and CWD. The use of skips to protect sensitive features within stands would increase within-stand diversity by adding an element of randomness to the placement of uncut patches. Skip areas would include red alder patches; no-cut riparian buffers; buffers for potential nest trees, legacy trees, legacy snags; and additional no-cut buffers designated for protection or

conservation of other species or features. Potential additional skip locations could include rock outcrops, concentrations of CWD, groups of snags, brushy areas, vine maple clumps or other unique features that would benefit from protection. Additional designed skips between 0.5 and 1.5-acres in size would be assigned as needed in areas that lack these features.

Heavy thinning and gaps (openings)

Gaps and patches of heavy thinning would be incorporated into the thinning treatment to increase structural and spatial complexity, obtain desired characteristics such as longer live crowns and larger live branches on individual trees, and encourage growth of understory trees and vegetation. Low tree density within heavy thinning patches would allow the maximization of individual tree growth and the development of understory trees and vegetation. Gaps would allow the development of very large crowns and stems on edge trees that are able to occupy additional growing space, and would allow the rapid introduction and development of a mid-level canopy of conifers and hardwood trees and shrubs. Heavy thinning patches and gaps would be located to enhance existing desirable stand characteristics or to develop these characteristics in areas that lack them. For instance, it is possible to place a gap around patches of leave trees to allow them to more quickly develop desired crown structure. Gaps can be placed in locations designed to ensure the continued presence of minor tree species or protect existing concentrations of understory trees or vegetation. Gaps 0.1 to 0.25 acre in size (Knowles 1996b) would be designed in areas protected from wind and away from roads and landings. All conifers larger than the minimum diameter limit (but not over 20 inches DBH) would be removed from gaps (except any cedar and western white pine), while all hardwoods would be retained. Areas of heavy thinning ranging from 0.5 to 1.5 acre in size would be included in the prescribed treatment of the stands. Heavily thinned patches would be thinned to 20 to 50 trees per acre (Knowles 1996a, Muir et. al 2002), retaining hardwoods and minor conifer species.

Treatment specific to AMA stands

Stands proposed for treatment within the AMA (approximately 60 acres total) include stand S26 and the portion of stands S16 and S84 upslope of FSR 2360. These stands would be given a treatment similar to what is described above for LSR stands. The general prescription proposed for the AMA stands would be a thinning from below (generally removing smaller trees and leaving larger trees) for the majority of the stand area, with at least 10 percent of the stand area in skips (unthinned areas). Heavy thinning and gaps as described above for LSR stands would not be implemented, instead up to 25 percent of the stand area would be treated as “thinning from above” patches (generally removing larger trees and leaving smaller trees) ranging from about 0.5 acres to 2.5 acres in size. The overstory trees in these stands generally range from about 6 to 18 inches DBH. Within the thinning from above patches, all trees larger than about 10 inches DBH would be removed, and all smaller trees would remain. The creation of patches with contrasting tree height would produce heterogeneity in the vertical dimension, and would encourage the development of a patchy, multilayered canopy in the horizontal dimension. Additional structural diversity within the stands would be provided by variability in tree density (and average DBH) between areas designated as thinning from above, thinning from below or skip patches.

Other Treatments

Following the proposed commercial thinning, the creation of snags and CWD in the project stands would contribute to the attainment of the long-term desired future condition. In adjacent stands that are younger or smaller in size, selective non-commercial thinning would accelerate the development of desired tree and stand characteristics, and contribute to the future connectivity of late-successional habitat on the landscape.

Snag and CWD Creation

Limited mortality, windthrow or breakage of leave trees is expected following the commercial thinning treatment. Given the generally low levels of snags and CWD within project stands, the intentional creation of snags and CWD would further enhance the habitat values provided by the project stands. An inventory of CWD should be conducted three to five years after the commercial thinning treatment. At least 5 years, and preferably 10 years, should be allowed prior to a snag inventory so that the contribution of natural mortality to desired snag numbers can be more fully assessed in the project stands. Where these post-thinning inventories reveal substantial differences between the current condition and the desired future condition, snag and CWD creation can be used to make progress toward the long-term goals. Snag creation should employ a variety of methods (girdling, topping and fungal inoculation) that will delay mortality of some of the trees and produce snags in multiple decay classes. Estimated snag and CWD needs are listed in table 2.6, in the Additional Restoration and Improvement Activities section of chapter 2.

Non-commercial Thinning

Of the stands less than 35 years of age in the planning area, there are currently 77 stands, totaling 2,780 acres which may benefit from a non-commercial thinning treatment. Table 2.8 below displays 7 stands totaling 249 acres, which would be the highest priority for treatment due to their proximity (within 0.25 miles) to stands proposed for a commercial thinning treatment in the Proposed Action. These stands are listed in table 2.5, in the Additional Restoration and Improvement Activities section of chapter 2.

Recommended future treatments

For project stands currently less than 60 years old, a second commercial thinning treatment in approximately 20 years would further promote the development of a multi-layered canopy, retain understory vegetation cover and diversity, provide for the continued growth of overstory trees, and allow for the introduction of a third cohort of trees. Additionally a non-commercial thinning of understory trees (less than 8 inches DBH) could be used to accelerate the recruitment of midcanopy trees, promote minor species such a western redcedar and to increase the diversity of understory vegetation. These are recommendations that are consistent with current management direction and with the purpose and need of the current project; they are not proposed or analyzed as part of the current project.

Environmental Effects

No Action Alternative

Direct, Indirect and Cumulative Effects

Under the No Action Alternative, none of the approximately 880 acres of second-growth stands under consideration for active treatment would be commercially thinned.

The No Action Alternative would have no direct effects on stand development. Stands would continue through the stand development process without intervention, and late-successional habitat for old-growth dependent species would not be accelerated. The No Action Alternative would not fulfill the stated purpose of and need for increasing the structural and species diversity of forest stands.

Over time, opportunities for thinning would be reduced or eliminated, and as a result the opportunity to hasten the development of late-successional characteristics in these stands could be lost. Barring some other disturbance, these stands would remain in the stem exclusion stage of stand development for another 100 years or more, providing little value for species dependent upon late-successional habitat. Over time, these stands would eventually develop some late-successional habitat characteristics, such as large diameter trees, as natural agents reduce tree density at the scale of the single tree or small groups of trees; however, in the meanwhile the stands could stagnate, with tree growth virtually ceasing due to extreme inter-tree competition. Some desired characteristics such as large diameter trees with deep crowns and large diameter branches, a multi-layered canopy and a diversity of understory vegetation may not develop in the current stands without a moderate level of disturbance, or may not develop until after the next stand replacing disturbance. The current high stand density and declining tree vigor in these stands, compounded by environmental stressors such as climate change, could predispose them to less desirable stand replacing disturbances such as extensive windthrow or large scale insect or disease outbreaks before they develop the desired late-successional characteristics.

Because there would be no management action, there would be no cumulative effects with past, present, and reasonably foreseeable future actions.

Alternative B – The Proposed Action

The Action Alternative would implement a commercial thinning treatment on about 880 acres.

Direct and Indirect Effects

The proposed treatments would directly affect stand development in the treated stands by changing stand structure in a way intended to promote species diversity and the development of late-successional characteristics identified as priorities by the South Fork Skokomish Watershed Analysis (USDA 1995) and the Hood Canal South Late Successional Reserve Assessment (USDA 1996) by:

- reducing the density of stands, increasing the growing space available to individual trees, and transferring part of the stands' growth potential from the upper canopy to the forest floor; and
- emphasizing retention of minor species overlooked by past management practices while thinning the dominant tree species, thereby, increasing the relative abundance of those minor species.

The proposed thinning treatments would also enhance structural heterogeneity (both vertical and horizontal) through the inclusion of patches receiving different treatment intensities in the overall stand treatment. Design features and mitigation measures detailed in Chapter 2 would adequately minimize risk of any adverse effects on existing late-successional habitat elements.

Indirect effects are effects that result from an action, but are removed from the action in space, time, or both. A potential indirect effect to stand development outside of the treatment units may be an increase in tree growth at the edges of adjacent stands caused by a small amount of additional light reaching trees immediately adjacent to unit boundaries. Because of the feathering effect inherent at the edges of the designation-by-description silvicultural prescription this effect would be very minor, and if it occurred it would be consistent with the project's purpose and need.

Over time, the action alternative would, as intended, increase structural and species diversity, and enhance the development of late-successional characteristics within the project stands. In summary, the indirect effects include:

- accelerating tree growth for the development of large trees, snags, and coarse woody debris;
- promoting the increase and diversification of understory vegetation and the development of multiple canopy layers;
- promoting the development of relatively large diameter branches and deep tree crowns; and
- providing additional opportunities to create additional snags and ground coverage of coarse woody debris.

Cumulative Effects

As detailed in the descriptions of historic stand management activities and current stand conditions, past vegetation management activities have had a considerable impact on forest stand structure and landscape-level connectivity in the planning area. As a result of historic stand management activities, the current landscape has a larger proportion of dense young conifer stands, and less area of late-successional forest, than was historically present, and old-growth patches are fragmented and discontinuous, especially in the lower part of the subwatershed. The action alternative would expand the acreage within the overall subwatershed that has received silvicultural treatment to enhance habitat characteristics and promote development of late-successional structure, although the project would have only a slight effect at the landscape scale given the small scale of the project. The project would expand the effective size of adjacent late-successional patches as the treated stands develop desired characteristics, but would not notably increase connectivity between late-successional patches across the landscape.

BOTANICAL RESOURCES

Background

This section discusses the potential effects of the proposed Upper South Fork Skokomish Vegetation Management Project on threatened, endangered, proposed, and sensitive vascular and non-vascular plants, fungi, and lichen species, in accordance with the National Environmental Policy Act (42 USC 4321 et seq.), the federal Endangered Species Act (16 USC 1531 et seq.), and the National Forest Management Act (16 USC 1604 et seq.). In addition, Forest Service Manual 2600, Chapter 2670 provides direction designed to ensure that Forest Service actions (1) do not contribute to the loss of viability of any native or desired non-native species or cause a trend toward federal listing for any species; (2) comply with the requirements of the Endangered Species Act (ESA); and (3) provide a process and standard by which to ensure that threatened, endangered, proposed, and sensitive species receive full consideration in the decision-making process. Special status species include federally listed ESA species, as well as the updated 2008 Regional Forester's list of Sensitive Species for Forest Service Region 6.

This section also includes a discussion of the potential effects of the proposed action on invasive plant introduction and spread.

Affected Environment

The planning area contains three main potential natural vegetation (PNV) zones (Henderson et al 2011). The upper elevations (roughly above 3500 feet) along the northwest edges of the planning area are within the mountain hemlock zone, with a bit of parkland on the uppermost ridges; elevations between about 2000 feet and 3500 feet are in the Pacific silver fir zone; and the lower elevations are within the western hemlock zone. Nearly all of the acres proposed for thinning in this project are within the western hemlock zone.

The climate conditions on the eastern side of the Olympic Peninsula, where this planning area is located, are generally drier than those on the west side of the peninsula. The generally drier climate, combined with the high density and high canopy cover of trees in the stands under consideration, may contribute to less favorable habitat in this planning area for some of the sensitive lichens and mosses, relative to watersheds on the western side of the peninsula.

For this botanical resources analysis, the affected environment is the stands proposed for treatment, proposed roads and landings, access routes, and adjacent areas where project activities might change environmental conditions for the species under consideration.

Analysis Methods

Pre-field review

In order to determine whether the activities proposed in this project might affect Threatened, Endangered, Proposed, or Sensitive (TEPS) species, a pre-field review was conducted using data from the Forest Service's National Resource Information System (NRIS), the Bureau of Land Management (BLM) Geographic Observations (GeoBOB) database, the Washington State

Natural Heritage Program database, and the Olympic National Forest Ecology program database.

Sensitive species

Findings from the pre-field review showed that four sensitive species have previously been documented as present within the planning area (table Botany-1). However, none of these locations was within any of the proposed treatment units, temporary roads, or landing locations.

Table Botany-1. TEPS plant species previously documented in the planning area

Botanical name	Common name	Plant type	Status
Parnassia palustrus var. neogaea	Northern grass-of-Parnassus	Vascular plant	WA-Sensitive
Spiraea splendens	Subalpine spiraea	Vascular plant	WA-Sensitive
Tetraphis geniculata	-	Bryophyte (moss)	Sensitive
Pseudocyphellaria rainierensis	-	Lichen	Sensitive

Federally Threatened, Endangered or Proposed species

There are no federally Threatened or Proposed non-vascular plants, bryophytes, fungi or lichens documented or currently suspected on the Olympic National Forest. One federally Endangered vascular plant, *Arenaria paludicola* (swamp sandwort), is suspected to occur on the Forest. This species is considered extirpated in Washington, with historical sites recorded in Pierce county (Washington Natural Heritage Program (no date)). Swamp sandwort grows mainly in coastal and low-elevation wetlands and freshwater marshes.

There are no historical sites of swamp sandwort in the project area and due to lack of suitable habitat it is not likely this species would occur there. Were potential habitat to occur within a thinning unit, the riparian and wetland buffers described in Chapter 2, table 2.10, would provide adequate protection.

Field surveys

Intuitive-controlled field surveys for Region 6 Sensitive vascular plants, lichens, bryophytes (mosses and liverworts) and invasive plant species were conducted between June 22, 2010 and August 24, 2010. Forest botanists conducted botany surveys in most of the units of the units proposed for treatment. Because they were contiguous to adjacent surveyed units having similar habitat, several units were not surveyed.

One Sensitive lichen, *Usnea longissima*, was found in a large douglas-fir tree unit L01A. No other TEPS species were found in the surveyed treatment units. *Usnea longissima* is a pale greenish or yellowish tinged, pendulous, fruticose lichen that may grow more than 3 meters or more in length. This species was once widespread and fairly common, with a circumboreal range, but it has declined considerably throughout its global range due, in part, to habitat alteration and air quality degradation. It is now considered endangered in many areas of Europe and Scandinavia (Derr et al. 2003). In western North America, *U. longissima* ranges from

northern California to Alaska (Brodo et al. 2001). In Oregon, it occurs in the Willamette Valley, Western Cascades, Klamath, and Coast Range Physiographic Provinces. In Washington, it is found in the Western Lowlands, Western Cascades, and the Olympic Peninsula Physiographic Provinces. Its distribution within its range is patchy and limited (Keon & Muir 2002) and it may be locally abundant in some areas. This species primarily reproduces asexually by fragmentation of the main thallus, side branches and fibrils (Keon 2002).

Although not well documented, *Usnea longissima* is not uncommon within the Upper Skokomish Vegetation Management Project planning area. This species generally occurs in old-growth and late-successional conifer stands, hardwood stands and riparian areas especially where the climate is cool and moist. It can also grow in young stands where there is suitable substrate such as conifers or hardwoods.

Environmental Effects

Alternative A – No Action

Direct, indirect, and cumulative effects

Implementing the no action alternative would have no direct or indirect effects on the occurrence of *Usnea longissima* located in unit L01A, or on habitat for other TEPS plant species in the planning area.

Because there would be no management activities, the No Action alternative would have no cumulative effects with other past, present, and foreseeable future management actions.

Alternative B – the Proposed Action

Direct and indirect effects

Implementing Alternative B as proposed, including the project design criterion specified to protect the occurrence of *Usnea longissima* located in unit L01A, would have no direct effects on this sensitive lichen occurrence. The criterion is designed to protect the host tree from potential damage, and to improve the potential for reproduction of this lichen by providing suitable downwind substrates for fragments of this occurrence to land on. Assuming the criterion has the anticipated effect, the indirect effect of the project on this lichen occurrence would be a short-term increase in its reproductive spread. No other occurrences of TEPS botanical species were found during the pre-field review or field surveys. This project would not pose a risk to the viability or a trend towards listing of *Usnea longissima* or other TEPS plant species that might occur in the planning area.

Cumulative effects

The proposed project is designed to accelerate the development of late successional habitat conditions, and would therefore be likely to have a small positive incremental effect on these vascular plants, bryophytes, fungi, or lichen species. In the past 80 years, the units proposed for harvest have experienced stand-replacing events, largely from clearcut harvest followed by broadcast burning and replanting. It is reasonable to assume that botanical species richness in general has been altered in these areas, and that habitat was lost for species currently

considered threatened, endangered, or proposed for ESA listing. Foreseeable future actions on federal lands in the Upper South Fork Skokomish subwatershed that have the potential to impact TEPS plant species or their habitat include road decommissioning and invasive plant treatment. Those activities would be anticipated to improve habitat quality over time.

INVASIVE PLANTS

Noxious weeds and other invasive plants may pose a serious threat to the health of National Forests. Executive Order 13112, Invasive Species (Feb. 1999), provides direction that "Federal agencies shall: (1) prevent the introduction of invasive species; (2) detect and respond rapidly to and control populations of such species in a cost-effective and environmentally sound manner; (3) monitor invasive species populations accurately and reliably; (4) provide for restoration of native species and habitat conditions in ecosystems that have been invaded."

For this project, invasive species surveys were conducted concurrent with the sensitive plant surveys. Ten invasive vascular plant species were documented (table Botany-2). With few exceptions, the sites where these species occurred were strongly associated with roads in current use or closed or unclassified roads within the units.

Table Botany-2. Non-native invasive plants documented in units and roadsides

Scientific name	Common name	Washington State Weed Classification [1]
Cirsium arvense	Canada thistle	C
Cirsium vulgare	Bull thistle	C
Cytisus scoparius	Scotchbroom	B
Hypericum perforatum	Common St. John's Wort	C
Geranium robertianum	Herb Robert, stinky Bob	B
Hieracium caespitosum	Meadow (yellow) hawkweed	B
Hypochaeris radicata	Hairy catsear	B
Leucanthemum vulgare	Oxeye daisy	B
Phalaris arundinacea	Reed canary grass	C
Senecio jacobaea	Tansy ragwort	B

1 *Class B Noxious Weeds - Non-native species that are either absent from or limited in distribution in some portions of the state but very abundant in other areas. The goals are to contain the plants where they are already widespread and prevent their spread into new areas.*
Class C Noxious Weeds – Noxious weeds which are already widespread in WA or are of special interest to the state's agricultural industry. Class C status allows counties to enforce control if locally desired.

Environmental Effects

Alternative A – No Action

Direct, indirect, and cumulative effects

Implementation of the No Action alternative would have no direct or indirect effects on the current invasive plant species situation in the planning area. Existing invasive plant infestations

within proposed treatment units would remain untreated and may spread. No new infestations would become established as a result of project activities.

Because there would be no management activities, the No Action alternative would have no cumulative effects with other past, present, and foreseeable future management actions.

Alternative B – the Proposed Action

Direct and indirect effects

During the thinning treatments, additional invasive plants could be introduced to the units and roads used by project activities, brought in on equipment used for thinning, log haul, or transportation of crews and materials. The project design criteria for invasive plant species listed in Chapter 2 are designed to minimize the potential for introduction and spread of invasive plant species. Because project activities would include pre-thinning and post-thinning treatment of invasive plant infestations, the project has the potential to reduce the abundance of invasive plants within the treatment units and on roads used for project implementation.

Cumulative effects

Because the project includes invasive plant treatment, when combined with ongoing weed treatments and road decommissioning (which reduces the potential for introduction and spread of invasive plants), this project may contribute to a positive cumulative effect on (a reduction of) of invasive plant introduction and spread in the planning area. Given the project design criteria for invasive plants described in Chapter 2, no cumulative adverse impacts to invasive plant conditions (increased introduction and spread) would be anticipated from the project. Past management activities that have probably contributed to current levels of invasive plant abundance in the planning area include construction and use of roads, timber harvest, use of non-native plant species for erosion control or forage seeding, and use of livestock for work and recreation. On-going use and maintenance of roads contribute to the spread of invasive plants in the watershed. Foreseeable future activities that may reduce the spread of invasive plants in the watershed include weed treatment; and road improvement, repair, and decommissioning.

WILDLIFE AND WILDLIFE HABITAT

Affected Environment

Wildlife habitat in the Upper South Fork Skokomish Watershed encompasses several forest and riparian habitats that provide cover and forage for many species of mammals, birds, amphibians, reptiles, and mollusks. Habitat currently available reflects the various plant associations characteristic of low and high elevation temperate rainforest and the effects of past human activity, primarily logging and road construction and, to a limited degree, natural disturbances such as fire. Species that have been observed or heard during the field design and analysis for this project include, but are not limited to, common garter snake (*Thamnophis sirtalis*), ensatina (*Ensatina eschscholtzii*), western redback salamander (*Plethodon vehiculum*), snowshoe hare (*Lepus americanus*), Townsend's chipmunk (*Tamias townsendii*), Douglas tree squirrel (*Tamiasciurus douglasii*), band-tailed pigeon (*Columba fasciata*), common nighthawk (*Chordeiles minor*), pileated woodpecker (*Dryocopus pileatus*) and a slug, the yellow-bordered taildropper (*Prophysaon foliolatum*). Species for whom sign was observed include hairy woodpecker (*Picoides villosus*), Steller's jay (*Cyanocitta stelleri*), mountain beaver (*Aplodontia rufa*), and black bear (*Ursus americanus*). The watershed also has a number of resident, special-status species, including northern spotted owl (*Strix occidentalis caurina*), marbled murrelet (*Brachyramphus marmoratus*), Cascades frog (*Rana cascadae*), long-eared myotis (*Myotis evotis*), and Makah copper butterfly (*Lycaena mariposa charlottensis*).

Approximately 90 percent of the planning area is in the Late-Successional Reserve (LSR) management allocation. The South Fork Skokomish Watershed Analysis (USDA 1995) cites the following recommendations for improving wildlife habitat in areas designated as Late-Successional Reserve in the watershed:

- Restoring late-successional habitats with emphasis in those watersheds with less than 50 percent dispersal habitat.
- Restoring the amount of large woody debris in potential or existing spotted owl foraging areas in order to provide small mammal populations. Also, there should be an emphasis on understory shrubs as well as restoring adequate levels of snags.
- Restoring deciduous shrubs and trees in riparian zones to meet the needs of neotropical migrant bird species.
- Reducing road densities.
- Mitigating the effects of disturbance upon special habitats, such meadows, wetlands, riparian zones, caves, cliffs, etc.
- Restoring wetlands and riparian habitats that have been damaged by past activities.

Approximately 10 percent of the planning area is in the Adaptive Management Area land management allocation. The following are recommendations for Adaptive Management Area acres within the watershed:

- Restoring strategically located early and late seral stages, particularly within big game winter ranges.

- Maintaining existing hardwood stands and creating areas of hardwood species habitat by reducing coniferous tree competition.
- Improving levels of snag and large woody debris habitat. Exploring management options to maintain these habitats, including road closures, mitigation of prescribed fire effects, fuel wood cutting closures, and altered salvage cutting practices.
- Restoring the natural variability of plant species, with emphasis on minor tree species.
- Maintaining or restoring all special habitats, with emphasis on wetlands and riparian zones.
- Reducing road densities.

Regarding other land designations, approximately 67 percent of the watershed is designated critical habitat for the northern spotted owl (USDI 2008) and 85 percent is critical habitat for the marbled murrelet (USDI 1996). Critical habitat for the owl was revised in 2008, from an earlier assessment in 1992, which resulted in a decrease from 398,560 acres to 332,332 across the Olympic National Forest. For the Upper South Fork Skokomish, this has meant a decrease from 33,198 acres designated in 1992 to 25,966 designated in 2008.

In 2004, the Olympic National Forest developed the Strategic Plan (USDA Forest Service 2004b) to identify priority areas for aquatic and terrestrial ecosystems, restoration needs, and opportunities to integrate projects to achieve multiple benefits. Watersheds were ranked for priorities to wildlife based on: 1) maintaining and improving late-successional terrestrial wildlife species habitat; and 2) improving forage for Roosevelt elk. Those watersheds considered to be of “high” priority, in terms of spotted owls and murrelets, were ones that contained 1) extensive amounts of large, unmanaged forest areas (over 50 percent of the area); 2) a high number of northern spotted owl activity centers considered active and a high or moderate amount of suitable habitat within the 0.7-mile nesting cores; 3) a high amount of suitable and dispersal habitat connecting current activity centers; 4) presence of murrelets in the watershed, with a low predation risk (which is determined by such factors as stand structure, adjacency to edge habitats, and proximity to humans); 5) Roosevelt elk use of the area, and vegetative condition relative to big game species; and 6) open road density. The Upper South Fork Skokomish Watershed rated as being a high priority relative to spotted owl activity centers and habitat availability, as well as to elk use and vegetative condition. It rated moderate for amount of late seral habitat complexity, marbled murrelet predation risk, and open road density. The Strategic Plan (USDA Forest Service 2004b) specified the following general habitat restoration strategies for owls, murrelets, and elk:

- Thinning activities are recommended and are of higher priority in Designated Critical Habitat for the northern spotted owl (and are of higher priority in the mid- and lowlands) and in Designated Critical Habitat for the marbled murrelet (and are of higher priority in lower elevations, < 3,000’, and in the Sitka spruce, Douglas-fir and western hemlock series).
- Maintenance and/or creation of snag and coarse woody debris distribution patterns that more closely mimic natural conditions.

- Commercial and pre-commercial thinning designed to accelerate late-successional habitat characteristics should be a higher priority in:
    - Dispersal and non-dispersal stands located within the home range radius (2.7 mile) of spotted owl territories that are considered vacant or historic, or between population cores,
    - Non-suitable habitat between fragmented patches of murrelet habitat,
- Commercial and pre-commercial thinning designed to enhance forage for Roosevelt elk should be a higher priority in:
    - Winter range areas with emphasis on riparian zones, south slopes, and areas near high quality thermal cover,
    - Stands of mountain hemlock (for summer forage)
    - Western hemlock (wet) and Sitka spruce vegetation series (for early spring/summer forage)
- Silvicultural activities would not occur within the 0.7 mile radius of the activity center of currently occupied spotted owl sites or within population core clusters.
- Reduction of road densities through road obliteration or seasonal closures.

Analysis methods

The following wildlife analysis focuses on special status species and their habitats, including those listed under the 1973 Endangered Species Act (ESA) as amended, the Forest Service Region Six Regional Forester's Sensitive Species List, Management Indicator Species (from the Olympic National Forest's Land & Resource Management Plan), the U.S. Fish & Wildlife's Species of Concern list, and forest landbirds. An analysis of dead wood (snags and down logs) using DecAID and locally obtained information is contained in Appendix C.

Federally Listed Species

The Upper South Fork Skokomish Watershed provides habitat for two wildlife species currently listed as threatened under the Endangered Species Act: the marbled murrelet and the northern spotted owl. "Threatened" status means the species is likely to become endangered within the foreseeable future. The Final Rule to de-list the threatened Pacific bald eagle (*Haliaeetus leucocephalus*) was published in the Federal Register on July 9, 2007, and became effective August 8, 2007 (USDI 2007a). The bald eagle was subsequently categorized as a "sensitive" species and, on the Olympic National Forest, is also a "management indicator species" (MIS). Bald eagle will be discussed in the MIS section of this analysis.

Northern Spotted Owl

The northern spotted owl (*Strix occidentalis caurina*) was listed "due to loss and adverse modification of suitable habitat as a result of timber harvesting and exacerbated by catastrophic events such as fire, volcanic eruption, and wind storms" (USDI 1990). Suitable habitat is habitat that supports life history requirements such as nesting, roosting, and foraging. Nesting and roosting habitat generally includes attributes such as a moderate to high canopy closure (60-80 percent); a multi-layered, multi-species canopy with large (>30 inch dbh) overstory trees; a high incidence of large trees with various deformities (e.g., large cavities, broken tops, mistletoe infections, and other evidence of decadence); large (>30 inch dbh)

snags; large accumulations of fallen trees and other woody debris on the ground; and sufficient space below the canopy for owls to fly (Thomas et al. 1990). A wider range of habitats is used for foraging and dispersal. Habitat that meets nesting and roosting requirements also provides for foraging and dispersal (USDI 1992). Dispersal habitat is considered that habitat which functions to assist juvenile dispersal and breeding dispersal of adult spotted owls. It is also habitat which connects suitable habitat patches with one another. Dispersal habitat consists of stands with adequate tree size and canopy closure to provide protection from avian predators and at least minimal foraging opportunities. Dispersal habitat does not necessarily have old-growth or mature forest characteristics, though it may have some scattered components of suitable habitat. Dispersal habitat is generally classified as forested habitat having stands with average tree diameters of 11 inches dbh under canopy covers of 40 percent across 50 percent of a township (36 square miles) (Thomas et al. 1990).

For the Olympic Peninsula, the mean nest core and median home range areas for spotted owls are approximated by circles with a 1.4- and 2.7-mile radius, respectively, around an activity center. This is based on research from the Olympic Peninsula province which showed owls using a mean home range area of 14,271 acres (USDA/USDI 1994a). Because owl home ranges are generally not circular, this home range size can be approximated by a circle of 2.7 miles radius (whose area slightly exceeds the mean home range size). In order to stay above “take” thresholds for suitable habitat, a minimum of 40 percent of the home range area (5,708 acres) should consist of suitable habitat. The mean nest core radius was recently increased to 1.4 (from 0.7) miles for the Olympic Peninsula Province for purposes of this type of analysis (Forsman et al. 2005, as cited in USDI et al. 2008). The mean nest core circle should contain a minimum of 1,971 acres (50 percent of the circle’s area) of suitable habitat in order to stay above the threshold (USDI et al. 2008). Two activity centers in the planning area, Dry Creek and Mt. Tebo/LeBar, are below threshold for nest core habitat. The nest patch is defined as the 300-meter radius area around a known or likely nest site (USDI et al. 2008). No thinning activities for this project are planned within nest core areas of currently occupied or historical spotted owl activity centers.

Approximately 48 percent (17,571 acres) of the Upper South Fork Skokomish watershed is mapped as spotted owl suitable habitat, and 10 percent (3,566 acres) is mapped as dispersal habitat. The remaining 42 percent is currently deemed non-habitat, and includes such areas as young forest stands, natural openings, ponds, etc. A qualitative assessment of how the suitable habitat is currently distributed on the landscape shows the most contiguous pieces to exist in the headwaters of Pine Creek, Rule Creek, Steel Creek, and the upper reaches of the South Fork Skokomish River. The South Fork Skokomish River watershed has incurred extensive fragmentation, especially at lower elevations, in suitable habitat due to past timber harvest activities.

No surveys for northern spotted owls were conducted relative to this project. Previous surveys in the watershed have resulted in the mapping of six activity centers. This earlier work was conducted as part of the Olympic Demographic Study done by the Pacific Northwest (PNW) Research Station. However, due to budget shortfalls, there have been no surveys done on this part of the Forest since 2005. There are also two additional activity centers located outside the

watershed, but whose nest cores and home ranges overlap inside. One, Dry Creek, is located to the north of the lower part of the watershed, and a second, a randomly generated site (see the discussion below about the "ITS Methodology for Northern Spotted Owl") is located to the west of the upper end of the watershed. Table Wildlife-1 provides status and current habitat information for these owl activity centers located within or overlapping the Upper South Fork Skokomish subwatershed.

Table Wildlife-1. Current status and habitat information for owl activity centers

Site Name	Site Number	ITS Status[1]	Acres of Suitable and Dispersal Habitat within the nest core[2] (1.4 mile radius)	Acres of Suitable and Dispersal Habitat within the home range[3] (2.7 mile radius)
Startup Creek	440	Occupied	Suitable— 2,278 Dispersal—12 Non-Habitat— 681	Suitable—6,796 Dispersal— 311 Non-Habitat—2,063
Rule Creek	17	Occupied	Suitable—2,835 Dispersal—148 Non-Habitat—959	Suitable—9,836 Dispersal— 674 Non-Habitat—3,475
Steel Creek	84	Occupied	Suitable—2,865 Dispersal—146 Non-Habitat— 928	Suitable—9,509 Dispersal—1,381 Non-Habitat—3,418
Mt. Tebo/Upper Lebar	885	Historic	Suitable—1,306 (Below threshold) Dispersal—962 Non-Habitat—1,673	Suitable—7,204 Dispersal—2,177 Non-Habitat—4,687
Lebar Creek	709	Occupied	Suitable—2,272 Dispersal—115 Non-Habitat—1,052	Suitable—6,325 Dispersal—1,663 Non-Habitat—3,579
Church/Pine Creek	63	Occupied	Suitable—2,387 Dispersal—100 Non-Habitat—777	Suitable—6,929 Dispersal—1,248 Non-Habitat—2,603
Dry Creek		Historic	Suitable—1,718 (Below threshold) Dispersal—722 Non-Habitat—1,494	Suitable—7,025 Dispersal—2,058 Non-Habitat—4,567
Randomly generated site	---	---	Suitable—2,562 Dispersal—447	Suitable—9,033 Dispersal—1,186

1 *From "Incidental Take Status" (ITS), a methodology for estimating the number of spotted owls affected by proposed federal actions (ISDI et al. 2008).*
2 *Nest core is a 1.4-mile radius around the activity center*
3 *Home range is a 2.7-mile radius around the activity center*

Based on the data from the Olympic Demographic Study, most of the activity centers appear productive, with a number of pairs confirmed and juveniles documented. Given the lack of more recent survey information, it is difficult to make any firm conclusions about the current status of northern spotted owl populations within the Upper South Fork Skokomish Watershed.

While habitat quality within the project area varies, all of the proposed Upper South Fork Skokomish commercial thinning units generally consist of single-layer canopy stands which, at present, likely function only as spotted owl dispersal habitat. The proposed units are all mapped in GIS as dispersal habitat, and field review has confirmed structural conditions that correspond with dispersal habitat function. Most units have suitable nesting, roosting or foraging habitat adjacent to them. There are also scattered remnant old-growth trees and legacy snags within several units. A total of 26 of these remnant trees and snags have been marked for buffering in units L01A, L60, S010, S036, S052C, S072, and S099A/B/C, although the overall stands would still be characterized as dispersal habitat. The remaining units also potentially contain snags and remnant trees. Some of these trees or snags have the structural potential to be nesting trees, either at present or in the future. On a functional basis, current use of these trees for nesting may be less likely than would be expected to occur within stands of pure old-growth, however, habitat selection on the Olympic Peninsula is probably influenced by factors other than stand age, such as prey availability, availability of suitable nests and roosts, and presence of escape cover (Forsman and Giese 1997). Individual suitable habitat trees within or near thinning units would be protected from damage or removal under all alternatives. Any nearby or adjacent suitable habitat blocks are considered occupied for the purpose of applying disturbance buffers (in the absence of surveys to protocol).

In Washington, northern flying squirrels (*Glaucomys sabrinus*) form the overwhelming bulk of the spotted owl diet in terms of the percent of prey taken and overall biomass (Forsman et al. 2001). A variety of other small to medium-sized mammals can also form a major portion of the diet. On the eastern Olympic Peninsula specifically, northern flying squirrels make up 45.2 percent of prey consumed, southern red-backed vole (*Clethrionomys gapperi*) comprise the second highest percentage at 10.3 percent, the bushy-tailed woodrat (*Neotoma cinerea*) at 9.6 percent, snowshoe hare (*Lepus americanus*) at 8.5 percent, and deer mice (*Peromyscus* spp.) at 7.0 (Forsman et al. 2001).

A requirement of listing under the Endangered Species Act is that each species' status will be reviewed at least once every five years. Several recent reports, including the 2004 Status Review (Courtney et al. 2004) have looked at what is currently known about spotted owls across their range and what the last decade of federal management (i.e., the Northwest Forest Plan) has or has not accomplished in terms of conserving the species. Additionally, according to Anthony et al. (2004), northern spotted owl populations are performing most poorly in Washington despite the protection of a substantial amount of habitat on federal lands. Though some decline was expected, even with the implementation of the Northwest Forest Plan, the downward trends, even in areas with little timber harvest, suggest that other factors are responsible for the declines (Courtney et al. 2004). While a number of explanations are possible, the decline cannot be definitively attributed to any particular cause. Anthony et al. (2004) noted declining populations in areas without timber harvest, and populations remaining

stable in areas with harvest of mature forest. Additionally, the 2004 Status Review recognized the threat posed by the closely related barred owl (Strix varia) (which had not been listed as a threat when the spotted owl was first listed), stating that barred owls are having a negative impact on spotted owls in some areas. In November 2010, the U.S. Fish & Wildlife Service initiated the next 5-year review for the northern spotted owl (USDI 2010a). Although this review is still in process, in September, 2010, the Draft Revised Recovery Plan for the Northern Spotted Owl (USDI 2010b) was released. This document recognized that, "Many populations of spotted owls continue to decline, especially in the northern parts of the subspecies' range, even with extensive maintenance and restoration of suitable habitat in recent years" (page IX). Additionally, "it is becoming more evident that securing habitat alone will not recover the spotted owl. Based on the best available scientific information, competition from the barred owl (*S. varia*) poses a significant and complex threat to the spotted owl" (page IX).

There were no barred owls detected during the 2001, 2002, 2003, and 2005 survey seasons for the Hood Canal portion of the Olympic Peninsula Spotted Owl Demography Study. A male barred owl was heard in 2004 at Lena Lake (in the Hamma Hamma watershed), and again in 2005. According to the 2001 summary for the Demography Study, only six barred owls have ever been detected in the Hood Canal survey area, none of them in the Upper South Fork Skokomish watershed.

Context for Consultation using ITS Methodology for Northern Spotted Owl

On February 16, 2007, the Ninth Circuit Court rendered a decision in the ONRC v. Allen case that invalidated the Incidental Take Statement (ITS) of a U.S. Fish and Wildlife Service (FWS) Biological Opinion that covered all US Forest Service (USFS) and Bureau of Land Management (BLM) timber harvest activities affecting the northern spotted owl in the Rogue Basin, Oregon for Fiscal Years 2002-2003. The Court concluded the ITS was arbitrary and capricious because: (1) the underlying Biological Opinion had been withdrawn; (2) the ITS failed to provide a numerical limit on take of the spotted owl without explaining why such a limit is impractical to obtain and employ; and (3) the ITS did not provide an adequate trigger for re-initiation of consultation (USDI et al. 2008).

In response to the 9th Circuit Court, spotted owl specialists from Region 1 of the US Fish and Wildlife Service (FWS), the Oregon/Washington State Office of the Bureau of Land Management (BLM) and Region 6 of the USFS developed a methodology for quantifying and monitoring incidental take of the northern spotted owl that addressed the 9th Circuit's decision. The methodology estimates the number of northern spotted owl home ranges that are likely to occur within the area affected by a proposed Federal action in areas without adequate recent surveys, based on the amount and distribution of suitable owl habitat and best available information on known owl locations and spacing patterns for that area. The methodology relies on known spotted owl locations derived from surveys as the foundation for a "northern spotted owl occupancy" map, and then estimates the placement of modeled activity centers. The FWS, BLM, and USFS believe the methodology provides a basis for the FWS to assess anticipated incidental take of the spotted owl caused by a proposed Federal action, and includes procedures for monitoring take-related effects such that re-initiation of consultation can be triggered, as appropriate, prior to completion of the action (USDI et al. 2008).

BLM and USFS Administrative Unit Staff and Level 1 Teams are encouraged to follow this methodology when planning projects, assessing effects, and tracking project implementation in situations where no or only partial spotted owl survey information is available for the analysis area. However, if current survey information is available, it represents the best available information and should be used instead of the ITS methodology to assess the effects of a proposed action on the spotted owl. In the case of the Upper South Fork Skokomish Watershed, although survey information does exist, it is now six years old.

The new ITS system for estimating disturbance/harassment places a premium on disturbance potential centered on the mapped owl activity site centers, based on distances around that site specific to various types of equipment (chainsaws, trucks, helicopters, etc.). Because the site center is known and is where effects are most critical, the greatest effects are assumed to occur closest to that center. A determination of Likely to Adversely Affect (LAA) is warranted when disturbance occurs within the equipment-specified distance to the site center during the early breeding season. The amount of suitable habitat affected within that distance is tallied. The effects determinations gradually decrease in concentric circles outward from the site. Beyond harassment distances from the site center, all suitable habitat within the specified ring is assumed to be "exposed" to harassment regardless of its distance to proposed activities. The rationale is that suitable habitat further out from a site center may not experience critical effects if disturbed during the breeding season, but still may incur some effects as foraging owls are moving through the area during an energetically demanding time of the year. Given that the Upper South Fork Skokomish River watershed has not been surveyed in several years, the owls may no longer be in these known locations and it therefore seems prudent to estimate disturbance to all suitable habitat (all of which is assumed to be occupied) adjacent to project activities.

Despite the apparent lack of barred owl presence in the watershed during previous survey efforts, it is possible that barred owls have moved into the area since (B. Biswell, personal communication, 2010). In general, barred owls tend to prefer lower elevations and river bottoms, but they have been found in higher country as well. Courtney et al. (2004) devote an entire chapter of the Northern Spotted Owl Status Review to the interactions and potential threats posed to northern spotted owl populations by barred owls. Drawing from a number of studies and other observations, they describe the general agreement among researchers that barred owls have undergone range expansion and population increases throughout the range of the northern spotted owl. Barred owls use similar habitats to those preferred by spotted owls, as well as some habitats not used by spotted owls, including more fragmented landscapes or those dominated by second-growth forests. There is overlap in the diet of the two species, but barred owls generally consume a wider variety of prey items. In addition to the potentially competitive elements of habitat and diet overlap, observations indicate that barred owls are more aggressive in interactions between the two species. Throughout the range of spotted owls, barred owls now occupy many territories once occupied by northern spotted owls. In light of all of this evidence, there is the presumption that barred owls have had a role in displacing spotted owls (Courtney et al. 2004). Additionally, Olson et al. (2005) found that the presence of barred owls had a substantial negative effect on the probability of site occupancy by spotted

owls, and can lead to declines in spotted owl occupancy. Overall, an examination of patterns of coexistence between owl species shows the great potential for these two species to be strong competitors, with the larger barred owl likely being competitively superior to the slightly smaller spotted owl (Gutierrez et al. 2007).

Designated Critical Habitat for the Northern Spotted Owl

As required by the Endangered Species Act, the U.S. Fish and Wildlife Service has designated critical habitat for the northern spotted owl. The first iteration of this effort occurred on January 15, 1992 (USDI 1992) on National Forest lands outside congressionally designated wilderness. In 2008, critical habitat was re-delineated (USDI 2008). The conservation principles in developing critical habitat were to:

- Develop and maintain large contiguous blocks of habitat to support multiple reproducing pairs of owls;
- Minimize fragmentation and edge effect to improve habitat quality;
- Minimize distance to facilitate dispersal among blocks of breeding habitat; and
- Maintain range-wide distribution of habitat to facilitate recovery (Thomas et al. 1990).

By its very designation, critical habitat indicates lands that may be needed for a species' eventually recovery and delisting. Critical habitat will not in itself, lead to the recovery of the species, but is one of several measures available to contribute to a species' conservation (USDI 1992).

Primary constituent elements for northern spotted owls were characterized as nesting, roosting, foraging, and dispersal habitats (Thomas et al.1990). Suitable habitat typically contains large trees within a diverse forest structure, while dispersal habitat consists of smaller diameter trees (on average 11 inches dbh) within stands having a minimum canopy cover of 40 percent (Thomas et al. 1990). On the Olympic Peninsula, the average owl home range was estimated extend 4.3 kilometers (2.7 miles) from an established site center. As stated above, reproduction success may be diminished if there is less than 50 percent of the area in nesting, roosting, foraging, and dispersal habitat (less than 1,971 acres within 1.4 miles of a site; less than 5,708 acres within 2.7 miles).

With the 2008 designation revision, critical habitat on the Olympic Peninsula became lumped into one large unit, classified as #1, comprising 332,100 acres. Within the Upper South Fork Skokomish River watershed, there are approximately 25,966 acres (67 percent of the watershed) designated as critical habitat, which is 8 percent of the total Olympic Peninsula critical habitat unit (CHU). At present, 14,600 acres within the Upper South Fork Skokomish River watershed portion of the CHU are mapped as suitable habitat (1,915 acres are classified as dispersal; 9,451 acres as non-habitat).

Marbled Murrelet

The marbled murrelet (*Brachyramphus marmoratus*) was listed as a threatened species due to extensive harvest of late-successional and old-growth forest, which provides nesting habitat for the species. Tree attributes that provide nesting platforms for murrelets include large diameter

(over 5 inches) or forked branches, deformities, mistletoe infections, "witches brooms," or other similar structures. These attributes are generally found in old-growth and mature forests, but can be found on remnant trees in younger stands (USDI 1996). On the Olympic Peninsula, murrelet populations are divided into two geographic zones: Conservation Zone 1 (the Puget Sound, Hood Canal, and the Strait of Juan de Fuca); and Conservation Zone 2 (along the Pacific Coast). The Upper South Fork Skokomish subwatershed is located within Conservation Zone 1.

Suitable nesting habitat for marbled murrelet in the Upper South Fork Skokomish River watershed can generally be approximated by northern spotted owl suitable (nesting, roosting, foraging) habitat. Dispersal habitat for northern spotted owl is not suitable nesting habitat for marbled murrelet. All of the proposed project stands in the Upper South Fork Skokomish River watershed are classified as dispersal habitat. As previously noted, field reconnaissance has verified that several units contain one or more scattered remnant old-growth trees within their boundaries. These trees are classified as potentially suitable murrelet nesting trees because of their limb structure and the presence of nesting platforms. However, the structural condition of the surrounding forest, including a low density of such remnant trees with platforms, and the fact that many platforms occur well above the surrounding canopy, make it unlikely that these stands currently *function* as suitable murrelet nesting habitat. Remnant trees that are located in stands within murrelet critical habitat would each have a 100-foot no-cut buffer as mitigation for protecting "primary constituent elements" (PCEs) of critical habitat (USDI 1996). The topic of PCEs is further discussed in the section on marbled murrelet critical habitat.

No surveys for marbled murrelet were conducted relative to this project. Previous surveys in the watershed have documented the birds occupying stands around Spider Lake and in the Pine Creek, Cedar Creek, and LeBar Creek drainages. Table Wildlife-2 provides survey information for these murrelet sites. Data presented in the table are from Data from GIS and district files; dates of surveys not available. As mentioned earlier, the largest contiguous blocks of habitat exist in the headwaters of Pine Creek, Steel Creek, Rule Creek and the South Fork Skokomish River. Because no surveys have been conducted to established protocols in the project area for either spotted owls or marbled murrelets, any nearby or adjacent suitable habitat blocks are considered occupied for the purpose of applying disturbance buffers. This is consistent with direction given in the programmatic Biological Opinion (USDI 2003).

Table Wildlife-2. Marbled Murrelet known sites and survey information

Site Area [1]	Occupied/Presence?	Notes
Pine Creek-6 detections	Occupied	Mostly circling above the stands but one observation of the bird flying along Pine Creek.
No Name Creek, east of Pine Creek-1 detection	Occupied	None specifically—bird noted to be flying through canopy.
Cedar Creek, east of No Name Creek-1 detection	Occupied	None specifically—bird noted to be flying below the canopy.

Table Wildlife-2. Marbled Murrelet known sites and survey information		
Site Area [1]	**Occupied/Presence?**	**Notes**
2352 Road, near headwaters of two creeks: No Name Creek and Walter Creek, 2 detections	Occupied	Bird was heard, then seen before it entered the canopy. Also, just outside watershed boundary.
Lebar Creek—near the headwaters of two tributaries to Lebar Creek, 1 detection	Occupied	None specifically—bird noted to be flying through the canopy.
Spider Lake—23 road at 2352 and around lake	Occupied	None specifically—bird noted to be flying below the canopy.

1 *Data from GIS and district files. Dates of surveys not available.*

As with the northern spotted owl, status reviews for the marbled murrelet are required under the Endangered Species Act. The 2004 Status Review (McShane et al. 2004) described:

- declines in murrelet populations in all conservation zones, from British Columbia to middle California;
- an expectation that there would be no significant improvements in breeding habitats;
- suitable breeding habitat and number of occupied sites declining throughout Washington, Oregon, and California; and
- trends in threats:
    - some threats increasing (threat of nest predation and threat of adult predation by raptors in some areas);
    - some threats remaining about the same (effects from ongoing and past habitat loss, oil spill mortality, and risks from unpredictable events like wildfire, disease outbreaks, etc.);
    - some threats being reduced (rate of annual habitat loss and mortality from gill-net fishing).

Based on new estimates of terrestrial habitat loss and ongoing threats in the marine environment, where it feeds, the 2009 5-year Status Review (USDI 2009) concluded that the listed marbled murrelet population (Washington, Oregon, and California) has declined considerably since 2002, the year of the estimate documented in the 2004 Status Review. The estimate in 2002 for the three states was 24,400 (USDI 2004) birds; in 2008, the population estimate was approximately 18,000 birds, a decline of about 26 percent (USDI 2009). More recently, the total population was estimated at 16,691 (a decline of 29 percent) (G.Falxa, pers. comm., 2011). The population estimates for only Conservation Zones 1 and 2 are even more dramatic. In 2002, Zone 1 had 9,717 birds; in 2010, it was down to 4,393 birds, a decline of 55 percent. In Zone 2, during the same time period, the population decreased 51 percent, from 2,619 murrelets in 2002 to 1,286 in 2010 (G.Falxa, pers. comm., 2011). The 2009 review states that, “the species’ decline has been largely caused by extensive removal of late-successional

and old growth coastal forest which serve as nesting habitat for murrelets. Additional factors in its decline include high nest-site predation rates and human-induced mortality in the marine environment from disturbance, gillnets, and oil spills." The document adds that should observed population trends continue to decline, "a change in listing status to endangered may be warranted in the future" (USDI 2009).

Designated Critical Habitat for the Marbled Murrelet

In 1996, the U.S. Fish and Wildlife Service designated critical habitat for the marbled murrelet (USDI 1996). Designated marbled murrelet critical habitat units (CHUs) in Washington State are primarily on federal lands within Late-Successional Reserves. Critical Habitat Units WA-01, WA-02, WA-03 and portions of WA-06 are located within Olympic National Forest. The total acreage of designated critical habitat on Olympic National Forest is 411,900 acres, of which 50 percent is suitable habitat. These CHUs serve as part of a network of marbled murrelet habitat across the Olympic Peninsula, along with habitat available in Olympic National Park and wilderness areas. The WA-03-b marbled murrelet CHU, which falls across the boundaries of the Upper South Fork Skokomish River watershed, consists of a total of 48,800 acres. Within just the watershed, approximately 32,856 acres (85 percent) are designated as marbled murrelet critical habitat, which is 67 percent of the total WA-03-b CHU. At present, 17,134 acres of murrelet CHU within the Upper South Fork Skokomish River watershed are mapped as suitable habitat (2,954 acres are classified as spotted owl dispersal habitat; 12,768 acres are non-habitat). The WA-03-b CHU falls adjacent to Marbled Murrelet Conservation Zone 1 (USDI 1997) for this project.

Criteria used in selecting specific areas for inclusion into critical habitat areas include:

- presence of suitable nesting habitat,
- survey data indicating murrelet use areas,
- proximity to marine foraging habitat,
- large, contiguous blocks of nesting habitat,
- range-wide distribution,
- adequacy of existing protection and management (USDI 1996, USDI 2003).

Although the marbled murrelet nests in old-growth and late-successional forests, it feeds in near-shore marine waters. It is likely that proximity to the marine environment (the Upper South Fork Skokomish River watershed, at its closest point, is only 5.6 miles from Hood Canal), the adequacy of existing protection and management (a large amount of land comprising the CHU is managed by the US Forest Service under the Northwest Forest Plan), the presence of some amount of suitable nesting habitat, and survey data indicating use figured into this area's inclusion as critical habitat.

The U.S. Fish & Wildlife Service identified two habitat features within marbled murrelet critical habitat, referred to as primary constituent elements (PCEs), associated with the terrestrial environment that support the species' requirements for nesting, roosting, and other normal behaviors (USDI 1997). Both constituent elements are present within the Upper South Fork Skokomish project area:

1. individual trees with potential nesting platforms (PCE 1); and
2. forested areas within 0.5 mile of individual trees with potential nesting platforms and a canopy height of at least one-half the site-potential tree height (PCE 2) (USDI 1996).

Because the trees in the stands proposed for thinning in the Upper South Fork Skokomish Vegetation Management Project are at least one-half the site-potential tree height, and because nearly all the stands are in marbled murrelet critical habitat block WA-03-b (USDI 1996), surveys were appropriate to determine if PCE 1 existed within certain stands. After an initial field reconnaissance of all proposed stands, in which the presence or absence of potential nest trees was noted, a second survey was conducted to identify and mark legacy trees, and legacy snags (PCE1 are distinguished from legacy trees by having at least one branch 4 inches in diameter that is at least 33 feet high (McShane et al. 2004) that can function as a platform, either by having a flat surface, some amount of moss or lichen, mistletoe, or other deformities, while legacy trees may or may not have larger diameter branches but would have at least some late-successional characteristics such as deeply furrowed bark, at least 25 percent or more crown cover than adjacent trees, or multiple live tops). The following stands were surveyed for PCE1: L01A, L60, S010, S112, S029, S036, S052, S053C, S070, S071, S072, and S099. Snags suitable for spotted owl were also marked. The remaining units were not surveyed. Table Wildlife-13 later in this section shows the results of these surveys. Because the proposed thinning prescription excludes harvest of trees greater than 20 inches dbh, all PCE1 and legacy trees within all stands would be retained whether they occur in surveyed or unsurveyed stands.

As already mentioned, suitable habitat for marbled murrelet can be approximated by the habitat for the northern spotted owl. Some stands that have not quite developed into suitable habitat for the spotted owl may contain mistletoe brooms or large diameter limbs that are large enough to provide nesting platforms for the marbled murrelet; however, marbled murrelet nest trees are typically greater than 80 cm (32 inches) dbh (Hamer and Nelson 1995), considerably larger than the less than 20-inch dbh trees that would be removed in the thinning prescription. On the Olympic National Forest, the manageable limiting factors for the marbled murrelet are quantity and quality of nesting habitat for the species, and the potential for disturbance.

Regional Forester's Sensitive Species

The species in table Wildlife-3 are listed on the Regional Forester's Sensitive Species List (USDA 2008). The Pacific bald eagle was placed on the Sensitive Species List concurrent with its federal de-listing in August 2007. Designation as "sensitive" means these species are given special management considerations to ensure their continued viability on National Forest lands. Except for the Pacific bald eagle, Pacific fisher, Townsend's big-eared bat, Johnson's hairstreak, and some incidental salamander surveys, there have not been any surveys done for sensitive species relative to this project. The bald eagle is also listed as a management indicator species (MIS) and is discussed further in that section.

Table Wildlife-3. Wildlife species on the Regional Forester's Sensitive Species List				
Wildlife type	**Common name**	**Species name**	**Suitable habitat present in project area**	**Documented sightings in project area**
Bird	Pacific Bald Eagle	*Haliaeetus leucocephalus*	Yes	Yes
Bird	American Peregrine Falcon	*Falco peregrinus anatum*	Yes	No
Bird	Common Loon	*Gavia immer*	No	No
Bird	Harlequin Duck	*Histrionicus histrionicus*	Yes	No
Mammal	Pacific Fisher	*Martes pennanti*	Yes	No
Mammal	Townsend's Big-Eared Bat	*Corynorhinus townsendii*	Yes	Yes
Mammal	Keen's Myotis	*Myotis keenii*	Yes	No
Mammal	Olympic Marmot	*Marmota olympus*	No	No
Mammal	Olympic Pocket Gopher	*Thomomys mazama melanops*	No	No
Amphibian	Van Dyke's Salamander	*Plethodon vandykei*	Yes	Yes
Amphibian	Cope's Giant Salamander	*Dicamptodon copei*	Yes	Yes
Amphibian	Olympic Torrent Salamander	*Rhyacotriton olympicus*	Yes	Yes
Butterfly	Johnson's Hairstreak	*Callophrys johnsoni*	Yes	No
Butterfly	Taylor's Checkerspot	*Euphydryas editha taylori*	No	No
Butterfly	Olympic Arctic	*Oeneis chryxus valerata*	No	No
Butterfly	Dog Star Skipper	*Polites sonora siris*	No	No

American Peregrine Falcon

The American peregrine falcon (*Falco peregrinus anatum*), a formerly listed endangered species, was removed from federal listing status in August 1999 after the U.S. Fish & Wildlife Service determined that it was no longer endangered or threatened. This finding was based on available data indicating that the species had recovered following restrictions on organochlorine pesticides and the implementation of successful management activities (USDI 1999).

Peregrine falcon need cliffs or rock outcrops for suitable nesting habitat. While there are such cliffs in the upper part of the watershed, around Mt. Church and in scattered locations further north, there have not been any documented sightings of the species. Peregrines feed on a variety of smaller birds (Hays and Milner 2004), many of which could be present in the project area.

Common Loon

The common loon (*Gavia immer*) inhabits both salt and fresh water bodies, nesting in inland lakes and ponds and foraging in both types of water systems (Ehrlich et al. 1988). There are no large inland bodies of water within the Upper South Fork Skokomish River watershed that

would provide nesting habitat for loons. There are smaller pond systems, such as Pine Lake and Spider Lake, however, loons have not been documented in these locations and good shoreline aquatic vegetation does not exist for nesting. The species is regularly observed in the winter on the Hood Canal, approximately 5.6 miles from the watershed.

Harlequin Duck

The Harlequin duck (*Histrionicus histrionicus*) is a sea duck that winters along rocky Pacific coasts and moves inland to breed in the Olympic Mountains. During the nesting season, from April to June, the adults require fast-flowing streams with loafing sites nearby (Lewis and Kraege 1999). Harlequin ducks appear to be sensitive to human disturbance, which can discourage use at traditional nesting sites and thereby lower productivity. In addition, aquatic insect larvae make up the bulk of the diet during the breeding season and low levels of benthic invertebrates can also impact their productivity (Lewis and Kraege 1999). There have been no documented observations of this species in the Upper South Fork Skokomish River watershed, however, given the ample supply of streams, it is assumed to be present.

Pacific Fisher

The Pacific fisher (*Martes pennant*), a secretive member of the weasel family, is strongly associated with forested landscapes and will actively avoid open areas (Maser 1998). Fisher commonly occur in landscapes dominated by mature forest cover and have been categorized by some researchers as “closely-associated” with late-successional forests (Thomas et al. 1993). Fishers have been found selecting for stands with higher overhead canopy cover due to the increased security and snow-interception that it provides, as well as those areas with high structural complexity on the forest floor (Weir and Harestad 2003). Seasonally, fishers are known to use both young and mature forest types depending on the shift in prey availability. Additionally, female fishers utilize two distinct sites as dens. Natal dens are comprised of living and dead standing trees with cavities. Maternal dens have been documented as occurring in downed wood, or logs (USDA 1994). Trees used as resting structures are often the largest trees, snags, or down logs available (Weir and Harestad 2003, Zielinski et al. 2004). No known populations of fishers have been documented in recent decades in Washington and it has been thought that the species was extirpated from the state (Lewis and Hayes 2004). Extensive surveys conducted between 1990 and 2003 within and outside of Olympic National Park did not detect any fishers.

In September 2007, the Fisher Reintroduction Plan/Environmental Assessment was completed, which outlined a program to contribute to the species’ reintroduction to the state by establishing a self-sustaining fisher population in Olympic National Park (USDI 2007b). The preferred alternative involved bringing animals from a source population in Canada and releasing them into three areas of Olympic National Park: the Elwha-Sol Duc area, the Hoh-Bogachiel area, and the Queets-Quinault area. Beginning in January 2008, a total of 90 fishers were released over the next three winters. Very quickly, the animals spread out across the Peninsula, occupying National Forest, state, and private lands. The one area of the National Forest seemingly used the least by the animals has been the southeast quadrant, where the Upper South Fork Skokomish River watershed is located; however, animals have presumably moved through this vicinity as they became residents on private land south of the National

Forest. Remote camera stations set up during the summer of 2010 in the Church Creek area to document American marten (*Martes americana*), a close cousin of the fisher, did not yield photographs of either species.

Townsend's Big-Eared Bat

The Townsend's big-eared bat (*Corynorhinus townsendii*)is a cave-dwelling species that will also utilize human-built structures, such as buildings, if they provide a "cavern" component. They will night roost in more open settings, including under bridges. There seems to be a preference for I-beam or cast-in-place bridges, as opposed to wooden or cement flat bottom bridges, because of the heat-capturing properties of the former (Perlmeter 1995). Suitable roosts are critical components for the survival of the Townsend's big-eared bat (Woodruff and Ferguson 2005). Many species of bat also utilize the areas beneath sloughing bark, most often found on old-growth trees and snags.

There are no caves in the Upper South Fork Skokomish River watershed that would serve as likely roosts. There are shelters throughout the watershed, at LeBar Horse Camp, Church Creek, and the Upper South Fork (Harps Shelter); however, these are not likely to be adequate for bat roosting. In 2005, day and night surveys for Townsend's big-eared bat were done under bridges across the forest. The species was documented under a bridge over the South Fork Skokomish River watershed at the 2300/2353/2354 road junction. The remnant late-successional forest in the Upper South Fork Skokomish project area contains large trees and snags that could be suitable for bat roosting. Because there are few if any of these remnant trees or legacy snags in proposed units, the likelihood of this bat species roosting within proposed units is much lower than surrounding areas of remnant forest. Those remnant trees or legacy snags that do exist would be retained under the project's thinning prescription.

Keen's Myotis

Keen's Myotis (*Myotis keenii*) has a very limited distribution, ranging from Southeast Alaska down the coast of British Columbia and to the Puget Sound area in Washington. Keen's Myotis and western long-eared bats (*Myotis evotis*) are virtually indistinguishable in the hand, and where the two species' ranges overlap most studies lump data regarding the two species together (Grindal 1998). As with other bats, Keen's Myotis primarily consumes invertebrates and, more specifically, has been documented consuming those in the Diptera, Lepidoptera, Neuroptera, Arachnida, and Trichoptera groups (Kellner and Harestad 2005).

The probability that Keen's Myotis will use a tree for roosting increases with increase in tree diameter, presence of defect, decreasing bark, and increasing proportion of old-growth on the landscape or increasing proportion of trees in the early to late stages of decay in the surrounding area (Boland et al. 2009). Grindall (1998) found very low roosting potential for this species in second-growth stands. While this species is probably foraging over the project area, the likelihood that the proposed thinning stands contain suitable roost trees is low compared to that of surrounding late-successional forest.

Olympic Marmot

Olympic marmots (*Marmota olympus*) are endemic to the Olympic Peninsula, meaning that the species is not found anywhere else. They are found in sub-alpine and alpine meadows and talus slopes (Linzey and Hammerson 2008), and as such the majority are found in Olympic National Park. The project area does not contain any alpine or sub-alpine meadows or other suitable habitat for Olympic Marmots. Therefore it is highly unlikely that the species inhabits the area.

Olympic Pocket Gopher

There are 15 recognized subspecies of pocket gophers, eight of which occur in Washington. In western Washington, the Olympic Mazama pocket gopher (*Thomomys mazama melanops*) is associated with glacial outwash prairies, although its distribution seems patchy as some high-quality prairies within the species' range lack gophers (Steinberg and Heller 1997). The species is seriously imperiled in Washington, primarily due to habitat destruction and degradation from agricultural expansion, livestock grazing, fire suppression, exotic plant invasion, and urban sprawl, and many of the historic populations have disappeared or diminished to such a degree that their presence is not obvious (Steinberg 1995). It is also threatened by pesticide and herbicide spraying. The Olympic pocket gopher subspecies is found in the Olympic National Park in Clallam County where it is restricted to subalpine habitat of the higher Olympic Mountains.

The Upper South Fork Skokomish project area does not contain any glacial outwash prairie systems so it is unlikely that pocket gophers inhabit the area.

Van Dyke's Salamander

This rare salamander (*Plethodon vandykei*), generally considered the most "aquatic" of the woodland salamanders, is usually associated with seeps and streams, but it can also be observed far from water (Leonard et al. 1993). Overall, it requires moist, shady environments with cool temperatures and high humidity, which often involves a sufficient overstory in order to maintain microclimate stability (Nordstrom and Milner 1997). It can be found in the splash zones of creeks or waterfalls under debris, or under logs, bark, and bark on logs near water. It is also found in wet talus and forest litter from sea level to 3,600 feet (Nordstrom and Milner 1997). Van Dyke's salamander is found only in Washington and only from three areas: the Olympic Mountains, the southern Cascades, and the Willapa Hills. Documented populations have tended to be small and separated from one another (Leonard et al. 1993).

Surveys conducted in the late 1987 and 1991 documented Van Dyke's salamander along the South Fork Skokomish River at Brown Creek Campground, as well as higher in the watershed. Habitat also exists along many of the numerous streams within the project area, and therefore, the species is assumed to be present throughout the watershed.

Cope's Giant Salamander

The Cope's giant salamander (*Dicamptodon copei*)is found in small, steep-gradient, permanent streams with clear, cold water (Corkran and Thoms 2006). Terrestrial Cope's giant salamanders are very rare (Leonard et al. 1993), as the species generally remains in its aquatic larval and neotenic forms, which spend their days concealed beneath rocks or in other hidden cavities in

the stream. The few terrestrial forms that have been found were located beneath surface debris adjacent to the water.

Surveys conducted in 1993 documented Cope's giant salamander in LeBar Creek. Potential habitat exists along the steeper, colder portions of streams, particularly in the headwater areas. Therefore the species is assumed to be present throughout the watershed.

Olympic Torrent Salamander

The Olympic Torrent Salamander (*Rhyacotriton olympicus*) is the only species of torrent salamander found on the Olympic Peninsula. The southernmost boundary of the range is uncertain, but probably does not extend further south than the Chehalis River Valley (Leonard et al. 1993). Olympic torrent salamanders are nearly always found around the splash zone of cold, clear streams, seeps, or waterfalls. Seeps running through talus slopes also provide habitat. The streams and riparian forest in the project area provide habitat for this species.

Surveys conducted in 1991 documented Olympic torrent salamander along a tributary to the South Fork near Steel Creek in the upper watershed. The species is assumed to be present throughout the watershed.

Butterflies

The Johnson's hairstreak (*Callophrys johnsoni*) is considered the only old-growth obligate butterfly in this region (Pyle 2002). Conifer forests containing mistletoe of the genus *Arceuthobium* are necessary for this species (WDFW 1995), as that is what emerging larvae feed upon (Pyle 2002). One survey visit was conducted for larval Johnson's hairstreak in the Upper South Fork Skokomish River watershed in July 2010, with no conclusive results. Hemlock containing mistletoe was collected, however much of it was too high to collect. Given the presence of late-successional old-growth in portions of the project area, this species is likely to be present, but is not expected in proposed thinning units.

The Taylor's checkerspot (*Euphydryas editha taylori*), Olympic Arctic (*Oeneis chryxus valerata*), and Dog star skipper (*Polites sonora siris*) are all found in meadow and prairie habitat. The Taylor's checkerspot tends to be found in lower elevation, post-glacial grasslands, prairies and meadows (Pyle 2002). The Olympic Arctic, an endemic to the Olympics, is found in higher elevation meadows and along shale ridges and summits with sparse grasses (Pyle 2002). The Dog Star skipper is found in post-glacial prairies and meadows (Pyle 2002). None of these habitats have been documented in the project area.

Regional Forester's Sensitive Species—Mollusks

The mollusk species in table are listed on the USFS Region 6 Regional Forester's Sensitive Species list.

Table Wildlife-4. Sensitive mollusk species			
Common Name	**Species Name**	**Suitable Habitat Present in Project Area**	**Documented Sightings in Project Area**
Puget Oregonian (snail)	*Cryptomastix devia*	Yes	No
Hoko Vertigo (snail)	*Vertigo n. sp.*	No	No
Blue-gray Taildropper Slug	*Prophysaon coeruleum*	Yes	No
Malone's Jumping Slug	*Hemphillia malonei*	Yes	No
Warty Jumping Slug	*Hemphillia glandulosa*	Yes	No
Burrington's Jumping Slug	*Hemphillia burringtoni*	Yes	No
Oregon Megomphix	*Megomphix hemphilli*	Yes	No

The Puget Oregonian snail is associated with hardwood shrubs and trees. It is only known from the Olympic National Forest from one shell found on the Hood Canal Ranger District. Despite extensive surveys across the Forest, no other shells or live animals have been discovered (J. Ziegltrum, personal communication, 2006). Regardless, habitat for the Puget Oregonian does occur within the project area in the form of hardwood trees, particularly big leaf maple and vine maple. It is assumed the Puget Oregonian could occur in the project area. Prescriptive measures protecting hardwoods would protect habitat for this species.

The Hoko Vertigo snail is arboreal and occurs in moist forest conditions within 200 meters of water where deciduous shrubs and small hardwood trees are present (Duncan et al. 2003), but has only been documented in the Hoko River drainage on the western Olympic Peninsula, in Clallam County. The project area is outside of the documented range of occurrence of the Hoko Vertigo snail. Due to a lack of occurrence, lack of habitat, and lack of potential impacts , no project-related effects are anticipated for this species.

The blue-gray taildropper slug occurs in moist conifer and mixed conifer-hardwood forests, usually located in sites with relatively higher shade and moisture levels than those of general forest habitat. It is usually associated with partially decayed logs, leaf and needle litter (especially hardwood leaf litter), mosses and moist plant communities, including big leaf maple, and sword fern plant associations (Duncan et al. 2003). The project area is within the reported range of these species. However, this species has not been found on the Olympic National Forest despite extensive surveys in similar habitats (J. Ziegltrum, personal communication, 2006), making its presence in the project area highly unlikely.

The Malone's jumping slug occurs in moist forested habitats, generally over 50-years-old with greater than 50 percent canopy cover, especially where dense sword fern, conifer logs, coarse woody debris, exfoliated bark piles, and large decaying stumps are present. It can also be found in marshy open sites with dense skunk cabbage, fallen logs and other low vegetative cover (Duncan et al. 2003). This species has not been found on the Olympic National Forest despite extensive surveys in similar habitats (J. Ziegltrum, personal communication, 2006). Additionally, while the project area is technically within the range of this species, the only area with documented suitable habitat on the Olympic National Forest is a small portion of the

Wynoochee River watershed. The larger diameter and moderately decayed logs associated with the species are present in only very limited numbers in proposed units, and would be protected by project design criteria. No project-related effects are anticipated to this species.

The warty jumping slug and the Burrington's jumping slug occur in moist conifer forest, and are locally common and abundant on the Olympic National Forest (Ziegltrum 2001, Ziegltrum 2004). It should be noted that Burrington's and warty jumping slugs are no longer considered distinct species, but rather a species complex (Wilke 2004). Both species are probably present in the project area due to available habitat and documentation elsewhere on the Forest.

The Oregon Megomphix has been found in mature or late-seral, moist, conifer-hardwood forests. It is usually found in the hardwood leaf little and decaying non-coniferous plant matter under bigleaf maple trees. In the absence of big leaf maple, it would be more likely to be found at moist sites where deciduous shrubs, coarse woody debris, rotten logs or stumps, and large sword ferns provide abundant cover (Duncan et al. 2003). This species was added recently as a Region 6 Sensitive Species. There are no known sites for this species in the project area.

Olympic National Forest Management Indicator Species

Management Indicator Species (MIS) are either selected species whose welfare is believed to be an indicator of the welfare of other species using the same habitat, or species whose condition can be used to assess the impacts of management actions on a particular area (Thomas 1979). The species listed in table Wildlife-5 were identified as MIS for the Olympic National Forest (USDA 1990a). The northern spotted owl was discussed in a previous section, and will not be discussed again here

Table Wildlife-5. Management Indicator Species for the Olympic National Forest

Common Name	Species Name	Indicator of Habitat Presence	Suitable Habitat Present in Project Area	Documented Sightings in Project Area
Bald Eagle	*Haliaeetus leucocephalus*	Mature forest stands	Yes	Yes
Northern Spotted Owl [1]	*Strix occidentalis caurina*	Old-growth/Mature forest stands	Yes	Yes
Pileated Woodpecker	*Dryocopus pileatus*	Mature coniferous forest	Yes	Yes (foraging sign and visual detection)
Primary Cavity Excavators	(Various species)	Dead and dying trees	Yes	Yes (foraging sign)
American Marten	*Martes americana*	Mature coniferous forest	Yes	No
Roosevelt Elk	*Cervus canadensis roosevelti*	Balance of cover and forage habitats; amount of vehicle disturbance	Yes	Yes

Table Wildlife-5. Management Indicator Species for the Olympic National Forest				
Common Name	**Species Name**	**Indicator of Habitat Presence**	**Suitable Habitat Present in Project Area**	**Documented Sightings in Project Area**
Columbia Black-tailed Deer	*Odocoileus hemionus*	Balance of cover and forage habitats; amount of vehicle disturbance	Yes	Yes

Bald Eagle

Listing Status History

The Pacific bald eagle (*Haliaeetus leucocephalus*) was listed as a threatened species in 1978 (USDI 1978) in Washington, Oregon, Minnesota, Wisconsin, and Michigan (in the rest of conterminous United States the species was listed as endangered). The factors in listing the bald eagle included:

- destruction or modification of habitat from such activities as logging, housing developments, and recreation;
- direct mortality of adult and immature eagles as a result of shooting;
- inadequacy of existing regulatory mechanisms (i.e. the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act); and
- human pollutants causing reproductive failure (USDI 1978).

The final recovery plan (USDI 1986) cited historical sources documenting evidence of the decline of eagles in the Pacific Northwest and also determined that the largest nesting population in the seven-state Pacific recovery area was in Washington, with most nesting habitat located in the San Juan Islands and on the Olympic Peninsula coastline (Grubb 1976, as cited in USDI 1986). Regarding nesting territories, the recovery plan stated, “The high percentage of nest territories on private lands represents a potential threat to eagles in Washington, since private land owners are not legally mandated to manage and protect bald eagle habitat” (USDI 1986, page 6). The stepdown outline to achieve recovery included: 1) providing secure habitat; 2) inventorying and monitoring habitat and populations; 3) developing and maintaining public awareness and law enforcement programs; and 4) augmenting bald eagle population levels through management and protection.

As a result of nearly three decades worth of work by numerous individuals and agencies, the bald eagle in the Pacific states has made a dramatic recovery. The final rule to delist the species was published in the Federal Register on July 9, 2007 and became effective on August 8, 2007 (USDI 2007a). Despite the removal of status under the Endangered Species Act, the bald eagle will continue to be federally protected under the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act. In Washington it remains a state listed sensitive species. Section 4(g)(1) of the Endangered Species Act requires that species that have been recovered and delisted should be monitored for not less than five years after their removal from the ESA (USDI 2007a). The final post-delisting monitoring plan for the bald eagle came out in May 2010 (USDI

2010c) and describes a 20-year monitoring program beginning in 2009. The idea behind this post-delisting monitoring is to make sure that any failures of the species to sustain itself are detected and that, if warranted, listing procedures are initiated, including emergency listing if needed (USDI 2010c). This monitoring includes nest check monitoring.

Washington Eagles

The information in this section on Washington eagles is from the Washington Department of Fish & Wildlife's Status Report for the Bald Eagle from October 2007 (Stinson et al. 2007). Eagles occur in all forested parts of the state, but the largest concentrations by far are in the maritime regions west of the Cascade Range. Eagle nests are more common near marine shorelines, but also can be found at inland lakes, rivers, and reservoirs. The winter distribution of birds is similar to the breeding distribution, with heavier concentrations at salmon spawning streams and waterfowl wintering areas. Washington's breeding adults typically leave their territories in late summer to migrate northward to British Columbia and southeast Alaska in search of seasonally available foods (spawning salmon runs). Juveniles and fledglings will also head north, but juvenile movements can be more nomadic and random, and fledglings may stay away from Washington for several months. The two most critical habitat features necessary for breeding bald eagles are the presence of large, dominant trees capable of supporting their weight and their massive nests, and adequate food supplies. The trees must be located near water with a low level of human activity, and replacement nest trees are critical, given the eagles' relatively long average life expectancy of 5-20 years. Perch trees scattered throughout a territory are also necessary.

In Washington, approximately 104 nesting bald eagle pairs were documented in 1980; by the time of delisting, 848 had been documented. The Status Report for the Bald Eagle (Stinson et al. 2007) estimates that the historical early summer population of eagles before white settlement was approximately 8,800 birds. Between 1981 and 2005, the nesting population in Washington increased 707 percent and, though the true carrying capacity is unknown, a recent decline in nest occupancy rates may indicate that some places in western Washington are approaching saturation. Evidence for this may be seen in declines of active nests in highly productive areas (e.g., San Juan County), while increases of nests in developed areas may be related to increased competition. By contrast, the number of territories along rivers on the western Olympic Peninsula has continued to increase. Despite high eagle productivity overall throughout the state, two regional populations, the lower Columbia River and the Hood Canal, have experienced less success, although they do appear to be improving. The Hood Canal eagle nests are more widely spaced than nearby territories and the eagles here have experienced lower foraging success.

Olympic Peninsula

The interior of the Olympic Peninsula is almost entirely federally owned (National Forest and National Park); however, the prime eagle habitat, along the three shorelines, including the Pacific Coast, Strait of Juan de Fuca, and Hood Canal, is primarily in private or state ownership, and these areas are where most bald eagle nests on the Peninsula are located (figure Wildlife-1). In terms of management of eagles on the National Forest, the Olympic Land and Resource Management Plan (LRMP) (USDA 1990a) describes 16 bald eagle existing and

potential nesting areas. These were originally identified in the Pacific States Bald Eagle Recovery Plan (USDI 1986) as the Forest's share of sites determined necessary for recovery (USDA 1990b, pg. III-69). Consequently, the LRMP outlined that a bald eagle management plan (BEMA) would be prepared for each of these 16 sites and would address such factors as eagle history of the site, forest stand characteristics, human activities, and information needs. One BEMA was completed in October 2007 for the Camp Creek site along the Sol Duc River. The FEIS (USDA 1990b, pg IV-55) also states that the primary limiting factor for bald eagle populations on the Forest is the amount of feeding habitat, and that, "Nesting habitat is not currently nor is it expected to be a limiting factor for bald eagle populations on the Olympic National Forest if the standards and guidelines are followed."

On the GIS eagle layer for the Olympic National Forest, there are 17 historic sites listed for the Forest, including 16 nests and one communal roost. All the nest sites have had some level of monitoring by Washington Department of Fish and Wildlife (WDFW), including occupancy and productivity surveys conducted as early as the late 1970s. Most WDFW survey work was done each year during the early eagle breeding (occupancy) period (April 7-25), and included documenting activity at historic nests as well as searching for new nests. Likewise, mid-winter surveys were done throughout the Olympic Peninsula from 1982-1989. Figure Wildlife-1 shows locations of known bald eagle nests on the north Olympic Peninsula.

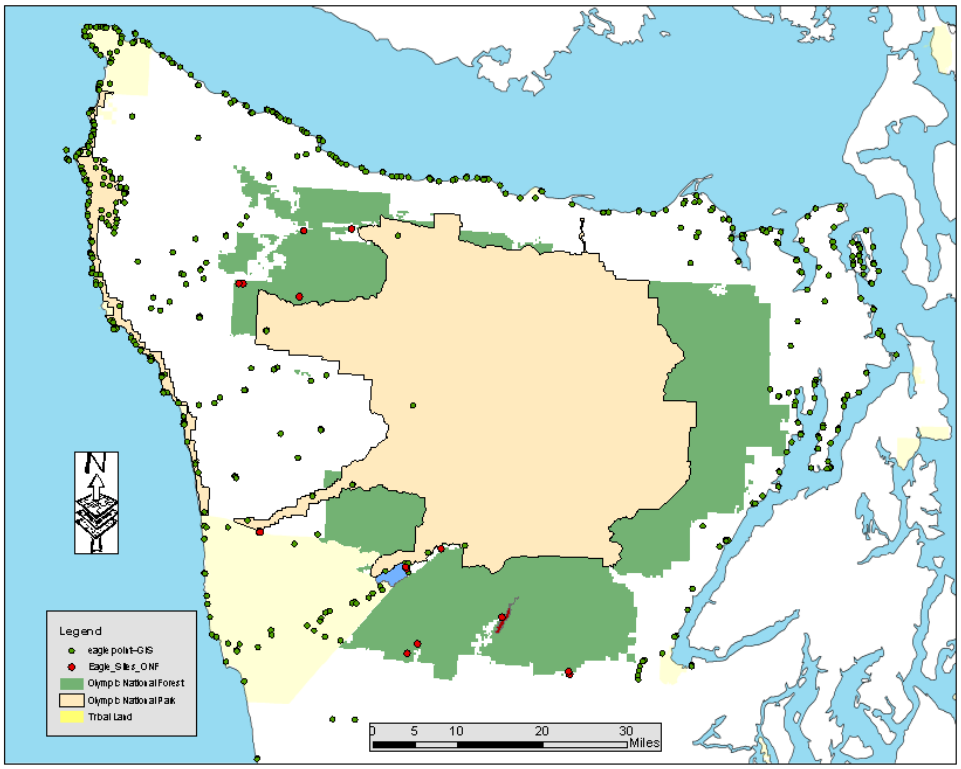


Figure Wildlife-1. Bald Eagle nest locations on the north Olympic Peninsula (from GIS data, Olympic National Forest). Red dots are nests on National Forest Lands.

Beginning in 2008, the Olympic National Forest began doing its own contracting for eagle surveys, which has included monitoring of specific nest sites as well as inventories of planning areas for new nests and other eagle activity. These surveys also take place primarily during the early eagle breeding time (occupancy surveys), though we did follow-ups of some sites in 2009 and 2010 during the later (reproductive) season (June 10-25). Of the 16 nests listed in GIS, 11 sites were monitored between 2008 and 2010, and all but one was monitored each of those three years. Thus, we were able to determine that four historic nests, two at Wynoochee Lake, one along the West Fork Humptulips River, and one along the Sol Duc River ("Snider" site), had blown down, or otherwise vanished. Additionally, the surveyors discovered six new nests at the following sites: Lower Sitkum River, East Fork Humptulips River, Wynoochee River 1 & 2, Wynoochee Lake NE, and Camp Creek 2 (along the Sol Duc River). During each year of surveys, two active nests were observed:

- 2008—Wynoochee Lake NE, and Wynoochee River; no follow-up surveys.
- 2009— Wynoochee Lake NE, and Wynoochee River; follow-up—one eaglet found perched on the edge of the river nest in July, and the lake nest could not be found from the ground.
- 2010—Wynoochee River, and Camp Creek; follow-up—the Wynoochee River nest apparently failed and one eaglet was observed at Camp Creek in June (an August follow-up at Camp Creek revealed numerous pin feathers at the base of the Camp Creek nest, leading us to conclude that the eaglet ultimately perished at this site).

In 2011, the Camp Creek and Snider nests along the Sol Duc River and the two South Fork Calawah River nests were again monitored, as well as two other locations, Baker Creek, in the Satsop River watershed, and Lower Salmon River, in the Queets watershed. Two active nests were documented, at Camp Creek and Wynochee River; an occupied but inactive territory was found at Lower Salmon River; and an active nest with an unattended egg was observed at Wynoochee Lake (an adult was perched nearby). This observation of an unattended egg is something the surveyor had never seen before (M. Stalmaster, pers. comm. 2011). The two nests along the South Fork Calawah River, the one alternate nest along the Wynoochee River, and the one at the Snider site along the Sol Duc River were all in poor, untended condition. No nests were observed at the Baker Creek site.

South Fork Skokomish River Watershed

Eagle surveys in the South Fork Skokomish River Watershed, from the forest boundary up to where Steel Creek enters the South Fork mainstem, were conducted in April of 2009 and 2010. No nests or birds were observed during either flight. The 2009 surveyor commented that the lower and upper stretches of the survey area had smaller trees and were therefore possibly less suitable for eagles (Olympic National Forest Bald Eagle Survey, 2009). The surveyor in 2010 remarked on the low flow rate of the river and that it would "not [be] likely to have a substantial fishery capable of supporting an eagle population," and that "few waterfowl were seen on the river" (Olympic National Forest Bald Eagle Survey, 2010).

Conclusion

Most of the prime bald eagle habitat and the productive eagle nests on the Olympic Peninsula are adjacent to marine waters, not on the Olympic National Forest. Nonetheless, the Forest generally does have some nesting activity each year. Based on the more recent survey information, it would seem that the Sol Duc River, Wynoochee River, and Wynoochee Lake are the best places on the Forest for eagles. While several areas surveyed since 2008, including the West Fork Humptulips River, the South Fork Calawah River, the South Fork Skokomish River, and the Little Quilcene River, have adequate nesting habitat, they may not provide enough forage for breeding eagles (M. Stalmaster, pers. comm. 2010). Large trees suitable for nesting eagles are protected during all Forest project activities and would not be cut unless they posed a human safety hazard. The bigger impact to eagles from Forest activities would include any work (timber harvesting, road decommissioning or building, etc.) that might cause negatively affect water quality and the fisheries resources.

Pileated Woodpecker (*Dryocopus pileatus*)

Listing Status:

U.S. Forest Service: Management Indicator Species (MIS)

NatureServe:

- Global – G5 – Widespread, abundant, secure
- Oregon – S4 – Apparently secure
- Washington – S4 – Apparently secure

Washington Department of Fish & Wildlife: Priority species, rank Candidate

USFWS Birds of Conservation Concern: The pileated woodpecker is not listed as a species of concern in any of the Bird Conservation Regions occurring in Oregon and Washington.

Habitat use on the Olympic Peninsula

The pileated woodpecker is a resident in forested areas across Oregon and Washington. The birds use mature and older, closed canopy stands for nesting and roosting, but may use younger (40-70 years), closed-canopy stands for foraging if large snags are available. Large snags and decadent trees are critical habitat components for pileated woodpeckers. Down logs do not appear to be an important foraging substrate for pileated woodpeckers on the west side of Oregon and Washington (Hartwig et al. 2004, Mellen et al. 1992, Raley and Aubry 2006).

Pileated woodpecker nests on the Olympic Peninsula have been documented in decadent live trees (portions of tree dead) and in snags (entire tree dead). Aubry and Raley (2002) found that Pacific silver fir was the preferred species, but many nests were in decadent western hemlock trees. Nest snags were primarily broken topped. Roost trees were larger than nest trees; typical roosts were in western hemlock snags or live western redcedar. Roost trees contained extensive hollows created by heartwood decay. Pileated woodpeckers used an average of seven different roost trees per year. Sites used for foraging had higher densities of large snags (over 51cm (21”) dbh and over 7.5 m (25’) tall), which were sound or moderately decayed (Raley and Aubry 2006). The average density of large snags in plots with recent pileated

woodpecker foraging activity was 100 percent greater than in plots with no recent foraging activity (Raley and Aubry 2006). Patches of these large, relatively hard snags in closed-canopy habitat conditions provide optimal foraging habitat.

The mean home range size for female pileated woodpeckers on the Peninsula is 960 ha (2371 acres); for males the size is 894 ha (2208 acres); and for pairs, it is 863 ha (2132 acres) (Aubry and Raley 1996).

Threats

The availability of large snags on the Olympic National Forest is the likely limiting factor for pileated woodpeckers, given that several large snags per acre are required to meet the nesting, roosting, and foraging requirements of the species. Forested areas on the landscape that have not ever been harvested are more likely to meet these requirements, while managed stands may or may not, depending on how many legacy snags were left during the initial harvest operations. Approximately half of the Upper South Fork Skokomish River watershed is currently designated as northern spotted owl and marbled murrelet "suitable habitat," which largely corresponds with late-successional forest conditions and would likely meet pileated woodpecker needs. The remaining areas probably do not, and figure Wildlife-2 illustrates how well the watershed is meeting the species' needs at different tolerance levels. Tolerance levels are estimates of the percent of all individuals in the population that are within some specified range of values, and these values refer to habitat characteristics. (See the full DecAid analysis in Appendix D for more information).

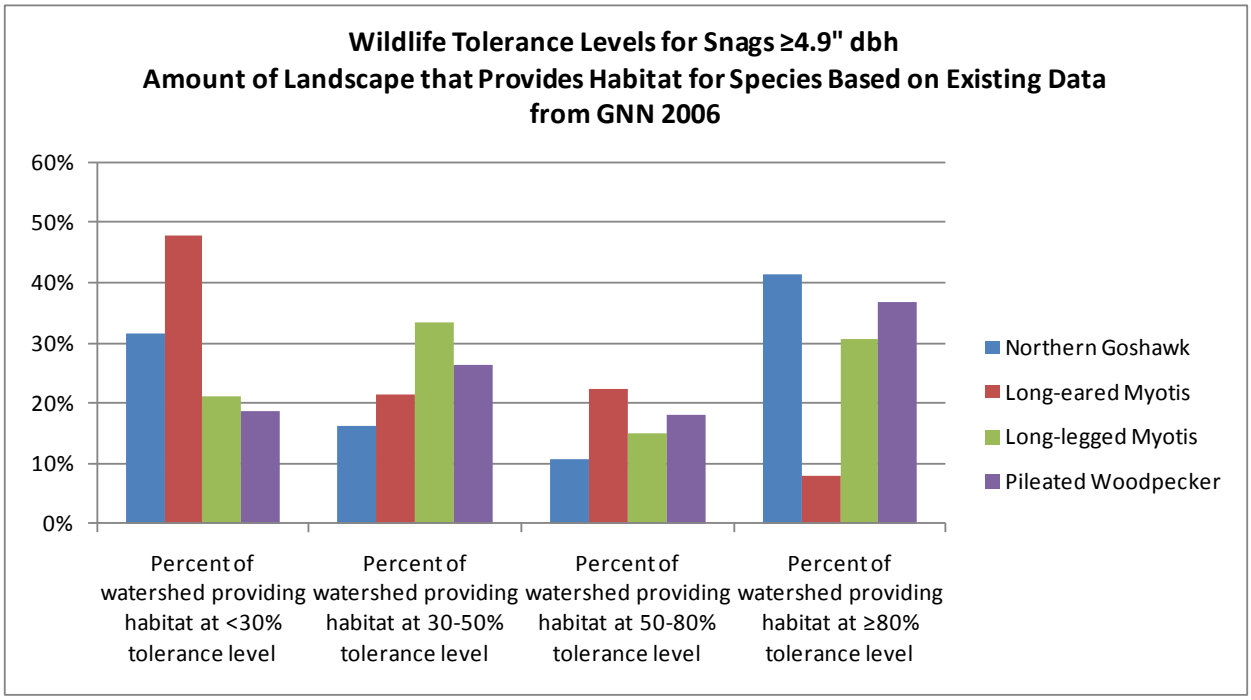


Figure Wildlife-2. Percent of the Upper South Fork Skokomish River watershed meeting four species' snag needs at different tolerance levels

Basically, the higher the tolerance level, the higher the proportion of individuals in the population that are being provided for, and the more assurance there is that the area is providing habitat that will meet the needs of more individuals in the population. The basic assumption is that more is better and bigger is better. In terms of the Upper South Fork Skokomish River watershed, less than 40percent of the watershed is providing habitat for pileated woodpecker at the most optimal level (80 percent tolerance).

Population trends from breeding bird data for pileated woodpecker are negative, however some concerns (small sample sizes, imprecise results, and inconsistent trends) exist with the numbers (Sauer et al. 2008). From the Partners in Flight database (Panjabi et al. 2005), the population trend is described as "highly variable, or unknown," and threats listed as "expected future conditions for breeding populations are expected to remain stable; no known threats."

Future

The selected alternative for the Northwest Forest Plan (NWFP) (USDA/USDI 1994a) was determined to meet the NFMA requirement to provide for a diversity of plant and animal communities.

The pileated woodpecker was one of 36 birds determined to be closely associated with late-successional and old-growth forests, with occurrence of large snags necessary for optimal habitat (USDA/USDI 1994b; 3&4-177). A viability assessment was completed by the Forest Ecosystem Management Assessment Team (FEMAT) (Forest Ecosystem Management Assessment Team 1993). The viability outcome for the pileated woodpecker was 100 percent likelihood of Outcome A – "Habitat is of sufficient quality, distribution, and abundance to allow the species population to stabilize, well distributed across federal lands" (USDA/USDI 1994b; 3&4-179). This outcome determination was based on provisions of: 1) a large system of late-successional reserves, 2) standards and guidelines for riparian reserves, and 3) retention of green trees, snags, and coarse woody debris within the matrix.

The Forest Service has been implementing the NWFP and monitoring late-successional habitat trends since 1994. The 10-year monitoring report (Haynes et al. 2006) states "…it appears that the status and trends in abundance, diversity, and ecological functions of older forests are generally consistent with expectations of the Plan. The total area of late-successional and old-growth forest (older forests) has increased at a rate that is somewhat higher than expected, and losses from wildfires are in line with what was anticipated." Hence, projects consistent with the NWFP should be expected to maintain viability of late-successional associated species such as the pileated woodpecker.

Primary Cavity Excavators

As a group, primary cavity excavators represents species dependent on standing dead trees or snags of varying sizes for feeding, resting and nesting. Five species of primary cavity excavators commonly occur on the Olympic Peninsula: the downy woodpecker (*Picoides pubescens*), hairy woodpecker (*Picoides villosus*), northern flicker (*Colaptes auratus*), red-breasted nuthatch (*Sitta canadensis*), and red-breasted sapsucker (*Sphyrapicus thyroideus*). A sixth species, the northern

three-toed woodpecker (*Picoides tridactylus*) has been documented nesting in Olympic National Park, however it is not a common resident west of the Cascade Range.

Listing Status

The Forest Service status of these primary cavity excavators species is MIS (none are Sensitive). Table Wildlife-5 shows the NatureServe (http://www.natureserve.org/explorer/) conservation status.

Table Wildlife-5. NatureServe conservation status for primary cavity excavator species

Species	NatureServe Ranks[1]		
	Global	OR	WA
Downy woodpecker	G5	S4	S4S5
Hairy woodpecker	G5	S4	S5
Northern flicker	G5	S5	S5
Red-breasted nuthatch	G5	S5	S5
Red-breasted sapsucker	G5	S4	S4S5

1 *NatureServe Ranks: (NatureServe 2010)*

- *G5 or S5 – Widespread, abundant, secure*
- *G4 or S4 – Apparently secure*
- *G3 or S3 – Vulnerable*
- *G2 or S2 – Imperiled*

Habitat use on the Olympic Peninsula

All of these species require snags of the appropriate size, species, condition and density, but the snags must be provided in the right habitat type. Table Wildlife-6 summarizes the general habitat of each species. Habitat descriptions are taken from general reference books (Marshall et al. 2003, Wahl et al. 2005) and research (Huff and Raley 2001, Wisdom et al. 2000).

Table Wildlife-6. Habitat descriptions for snag-associated Management Indicator Species

Species	Habitat description
Downy woodpecker	Deciduous riparian woodlands and lowland deciduous forest (alder, cottonwood, willow, aspen, oaks). Also found in urban parks and orchards. Low and mid-elevations. Nest primarily in dead trees.
Hairy woodpecker	Dry and wet coniferous forests at low to mid-elevations. Also use deciduous forest and riparian areas, especially if adjacent to coniferous forest. Use all ages of forest stands, though some authors report preference for older stands for nesting. Nest primarily in moderately decayed snags. Occur in higher densities in mature and old-growth stands on the west side of the Cascades.
Northern flicker	Habitat generalists, though most abundant in open forests or forest edges. Use coniferous and deciduous forest, riparian woodlands, and urban areas. Nests are in large snags.
Northern three-toed woodpecker	Source habitat is old forests in subalpine and montane forest (lodgepole pine, grand fir-white fir, Engelmann spruce-subalpine fir, white-bark pine and mountain hemlock).

Table Wildlife-6. Habitat descriptions for snag-associated Management Indicator Species	
Species	**Habitat description**
Red-breasted nuthatch	Breeding habitat is conifer and mixed conifer-hardwood forest. West of the Cascades the species may be more abundant in older forests. East of the Cascades they are absent from very young stands. During non-breeding season they may occur in deciduous woods and urban areas. Nest in snags or dead limbs.
Red-breasted sapsucker	Wet and moist coniferous forests and mixed deciduous-coniferous forests. Abundance increases with stand age. Nests are typically in large snags or trees with decay. Occur in higher densities in mature and old-growth stands on the west side of the Cascades.

In general, larger snags are better and provide for more individuals in a population. The following DecAid table, table Wildlife-7, shows snag sizes at different wildlife "tolerance levels," which are estimates of the percent of all individuals in the population that are using a specified range of habitat values. Providing habitat at the 80 percent tolerance level provides for the most individuals of a species. (The full DecAid analysis is in Appendix D.)

Table Wildlife-7. Snag sizes at different wildlife tolerance levels			
Species/Group	**Snag size (in) for 30%, 50%, 80% tolerance levels**	**Snag decay**	**Primary Snag Species**
Downy woodpecker			Red alder
Hairy woodpecker	Nesting: 19.6, 29.0, 41.6 Foraging: 50% tl = 24.2	Moderate to hard	Douglas-fir, western hemlock
Northern flicker	Nesting: 22.1, 30.3, 42.3 Foraging: 50% tl = 37.1	Soft to Moderate	Douglas-fir, western hemlock
Primary cavity nesters/ excavators/ woodpeckers	Nesting: 21.3, 34.2, 53.6	Soft to Moderate	
Red-breasted nuthatch	Nesting: 18.0, 32.1, 49.9	Moderate	Douglas-fir, grand-fir, big-leaf maple
Red-breasted sapsucker	Nesting: 25.3, 35.7, 50.2	Moderate to hard	Douglas-fir, western hemlock, grand-fir

From 1993 to 2001, landbird monitoring was conducted in eight watersheds on Olympic National Forest (Whittaker and Engelman 2001, Huff and Brown 1998). Results from this survey effort indicated that primary cavity excavators, including the hairy woodpecker, red-breasted nuthatch, northern flicker and pileated woodpecker, were fairly widespread on the Forest. Two other species, the downy woodpecker and red-breasted sapsucker were also detected but not extensively, likely because the study sites included only old coniferous forest habitats, and these species frequently use hardwood species. Systematic landbird surveys have not been conducted since 2001, but incidental sightings also indicate that these cavity nesting species occur and are widespread on the Forest.

Threats

As with the pileated woodpecker, the availability of large snags of a variety of tree species on the Olympic National Forest is the likely limiting factor for primary cavity excavators. Forested areas on the landscape that have not ever been harvested are more likely to meet these requirements, while managed stands, in most cases, probably do not. Approximately half of the Upper South Fork Skokomish River watershed is currently designated as northern spotted owl and marbled murrelet "suitable habitat," which largely corresponds with late-successional forest conditions and would likely have the range of sizes and species of snags required by this group of animals. Figure Wildlife-3 illustrates how well the watershed is meeting the species' needs at different tolerance levels (less than 5% of the watershed meets the 80% level).

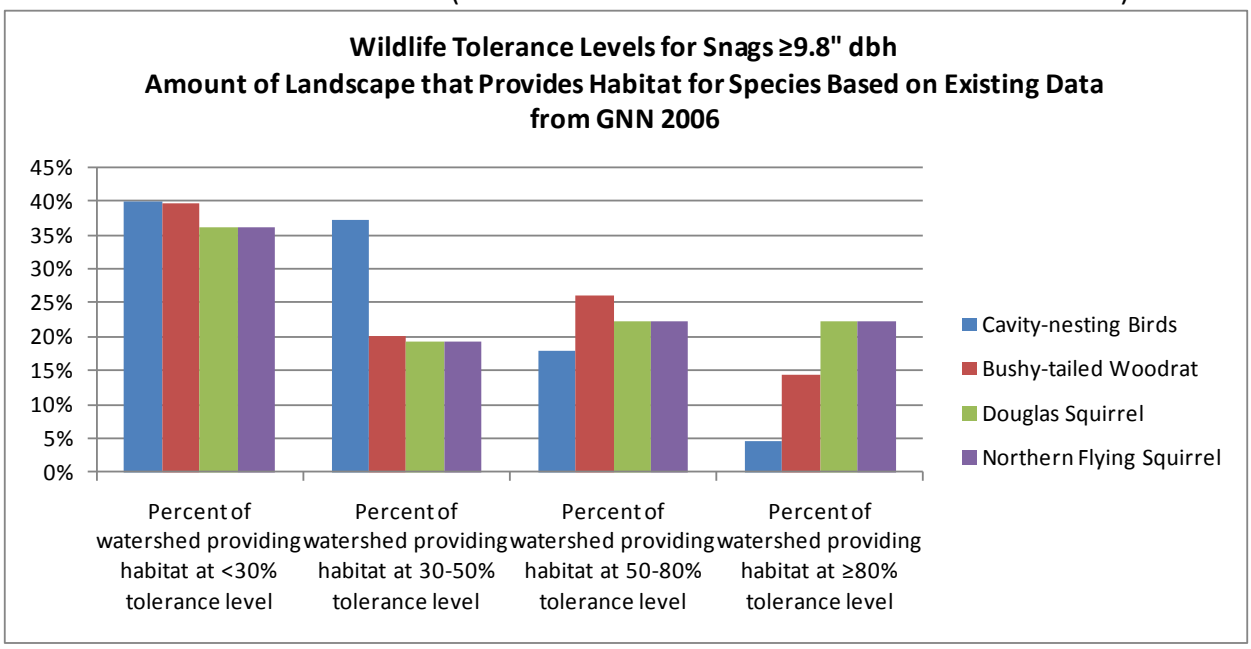


Figure Wildlife-3. Percent of the Upper South Fork Skokomish River watershed meeting primary cavity excavator snag needs at different tolerance levels

Future

The selected alternative for the Northwest Forest Plan was determined to meet the NFMA requirement to provide for a diversity of plant and animal communities (USDA and USDI 1994a).

Ten cavity-nesting MIS were determined to be closely associated with late-successional and old-growth forests, with occurrence of large snags necessary for optimal habitat (USDA and USDI 1994b, 3&4-177). A viability assessment was completed by the Scientific Analysis Team (SAT) (Thomas et al. 1993). The viability outcome for all but the black-backed woodpecker was 100 percent likelihood of Outcome A – "Habitat is of sufficient quality, distribution, and abundance to allow the species population to stabilize, well distributed across federal lands" (USDA and USDI 1994b). This outcome determination was based on provisions of: 1) a large system of late-successional reserves, 2) standards and guidelines for riparian reserves, and 3) retention of

green trees, snags, and coarse woody debris within the matrix. The four species of late-successional and old-growth forest-associated primary cavity excavators on the Olympic National Forest – hairy woodpecker, red-breasted sapsucker, northern flicker, and red-breasted nuthatch – were among the ten species in the viability assessment.

The Forest Service has been implementing the NWFP and monitoring late-successional habitat trends since 1994. The 10-year monitoring report (Haynes et al. 2006) states "…it appears that the status and trends in abundance, diversity, and ecological functions of older forests are generally consistent with expectations of the Plan. The total area of late-successional and old-growth forest (older forests) has increased at a rate that is somewhat higher than expected, and losses from wildfires are in line with what was anticipated." As a result projects consistent with the NWFP should be expected to maintain viability of the ten late-successional associated MIS.

American Marten *(Martes americana)*

Listing Status

U.S. Forest Service: Management Indicator Species (MIS)

NatureServe:

- Global – G5 – Widespread, abundant, secure
- Oregon – S3S4 – Vulnerable to Apparently secure
- Washington – S4 – Apparently secure

Washington Department of Fish & Wildlife:

- Priority species, Criterion 3. Species of Recreational, Commercial, and/or Tribal Importance: Native and non-native fish and wildlife species of recreational or commercial importance, and recognized species used for tribal ceremonial and subsistence purposes, whose biological or ecological characteristics make them vulnerable to decline in Washington or that are dependent on habitats that are highly vulnerable or are in limited availability. (http://www.wdfw.wa.gov/conservation/phs/list/2008/2008-sept_terrestrial_carnivores.pdf).
- Harvested as a furbearer state-wide (http://wdfw.wa.gov/publications/00769/wdfw00769.pdf).

Population Status

The current geographic distribution of martens in the Pacific Northwest has been dramatically reduced from its historical extent, which is likely attributable to the loss of late-successional forests (Buskirk and Ruggiero 1994). Likewise, there is evidence that populations may have declined on the Olympic Peninsula (Zielinski et al. 2001). Yet, despite data supporting these statements, as well as the fact that the species is listed as "vulnerable" in Oregon and a "priority" species in Washington, it is also designated in both states as a furbearer. There are three known subspecies of marten. The range of the Pacific Northwest subspecies, *Martes americana caurina*, extends throughout the coastal forests Oregon and Washington and into

British Columbia. It appears that this subspecies has been extirpated in the coast range in southwest Washington and that it is rare on the Olympic Peninsula (Sheets 1993).

Using a variety of sources including field surveys; all available published and unpublished information; and interviews with agency biologists, representatives of Native American tribes, and fur trappers, Zielinski et al. (2001) determined that the harvest of martens in the coastal forests of Washington has never been consistent. In the 1940s, 83 animals were taken from Clallam, Jefferson, and Mason counties, which was the largest harvest for any decade during the 20th century. Additionally, only a few records exist of martens being harvested in southwestern Washington counties.

Documented sightings on the Olympic National Forest are also scarce. In August 1988, a marten was incidentally photographed in The Brothers Wilderness as it worked to drag a showshoe hare off a hiking trail. In terms of field surveys, there has been little evidence of the species on the Peninsula. During a spotted owl prey study conducted in 1989/1990, two different martens were trapped in Tomahawk live traps (in August 1990) in the Dosewallips River drainage. Remote camera surveys on the national forests in the Cascade Range and on the Peninsula in 1991 yielded 39 photos of marten (out of 260 taken), all of them from the Cascades (Jones and Raphael 1991). Camera surveys conducted from March through October in 1992 documented only one photo of a marten in Olympic National Park from approximately 50 cameras placed in the Hoh, Dosewallips, Duckabush, Hamma Hamma, and Gold Creek drainages. That one photo was from a site along the Dosewallips River (Sheets 1993). More recently, extensive surveys conducted in Olympic National Park during the winters of 2001-2002 and 2002-2003 also produced no photos of American marten, nor any of fisher (*Martes pennanti*), another target species (Happe et al. 2005). The mystery on the Peninsula increased when a dead juvenile marten was found in August 2008 on the Olympic National Forest near Lake Cushman. This was the first verifiable evidence of the species since 1990. This particular animal, presumed to be local given her age (K. Aubry, pers. comm. 2010), appeared to have starved to death. In response to this finding, more recent remote camera surveys were done during the summer of 2010 and the fall/winter of 2011 on the Olympic National Forest: in The Brothers Wilderness Mount Skokomish Wilderness, the Church Creek drainage, and the Mount Rose area (where the 2008 animal was found). No photos of martens were obtained at any of these stations.

An additional factor potentially affecting any marten populations that remain on the Peninsula is the recent reintroduction of fisher into Olympic National Park. Over three winters, a total of 90 fishers were released and are now occupying many areas of the Peninsula. With remote infrared cameras, several females with kits have been documented as well as young animals recently independent of their mothers (Lewis et al. 2010), indicating that the fishers are successfully reproducing. Martens and fishers have evolved sympatrically in the late-successional forests of the Pacific Northwest, though in the West martens generally occur at higher elevations than fishers (Ruggiero et al. 1994). Martens are also more arboreal, exhibit more subnivean activity, and eat smaller prey than fisher (Buskirk and Ruggiero 1994). In areas where fishers and martens coexist, they may do so via niche partitioning with martens eating smaller prey (eg. voles) under the snow (Martin 1994). Competitive interactions between martens and other mustelids have not been reported (Buskirk and Ruggiero 1994) and given

the fact that fishers are estimated to have been extirpated from the Peninsula for possibly several decades, the potential disappearance of marten continues to be perplexing.

Habitat use in Washington

There have not been any studies conducted on American marten on the Olympic Peninsula; all information on habitat use for Washington is derived from work done in the Cascade Range. Jones and Raphael (1991) found that martens used old-growth forests more frequently than expected based on availability within the home range. They also documented that martens used areas near streams heavily; most telemetry locations were within 150 m (492 ft) of perennial streams (Raphael and Jones 1997, Jones and Raphael 1991). Additionally, marten selected sites with higher canopy closure during snow periods than during snow-free periods (Raphael and Jones 1997). In Washington, canopy cover at rest sites averaged 75 percent in snow periods and 67 percent in snow-free periods. By contrast, in Oregon, canopy closure at rest sites in lodgepole pine dominated stands averaged 36 percent in snow periods and 27 percent in snow-free periods.

Marten use a variety of structures for resting and denning sites. Resting and denning sites offer protection from predation and thermal stress; thus, availability of good quality denning sites likely increases the rates of survival and fecundity in marten (Raphael and Jones 1997). In the Washington Cascades, Jones and Raphael (1991) found martens resting in live trees (42 percent), snags (23 percent), and slash piles (11 percent). Large diameter trees were used more often than smaller trees, with an average dbh of live trees of 100 cm (39 inches) and 81 cm (32 inches) for snags. They also located five natal dens in large diameter live trees or snags near water. The predominant species of den trees was western hemlock. Table Wildlife-8, adapted from Table 1 in Raphael and Jones (1997), displays the types of structures used as resting or denning sites.

Table Wildlife-8. Structures used by American marten in the Washington Cascade Mountains

Structure	Resting Sites (%)	Den Sites (%)	Comments
Live Tree	46	54	
Snag	21	31	
Logs	8	4	
Slash pile	9	8	More important when snow was present
Rock	4	4	
Subnivean	3	0	
Other	8	0	
Sample size	391	26	

In addition to providing resting and denning sites, down wood is an important component of marten habitat because the primary prey of martens is small mammals associated with down wood. Subnivean (under snow) spaces created by logs provide marten with access to prey during the winter (Bull and Blumton 1999, Buskirk and Ruggiero 1994, Sherburne and Bissonette 1994).

On the Olympic National Forest, there are two vegetative types, "Westside Lowland Conifer-Hardwood (WLCH) Forest, Washington Coast" and "Montane (higher elevation) Mixed Conifer (MMC) Forest" (see a full explanation of these in the "DecAid Analysis" section in Appendix D). Densities of snags are relatively high (DecAid Figures MMC_L.inv-14 & 15) in Montane Mixed Conifer Forests, late-seral stands. MMC Forests naturally provide more dead wood habitat across the landscape than the other habitat types. This habitat type likely provides the best habitat for marten.

Threats

Trapping and past extensive logging of mature forests have led to extirpation of marten in some areas (NatureServe 2010). This reduction in the amount of late-seral habitat, as well as fragmentation of the remaining habitat, and associated declines in snags and coarse wood all continue to be of concern with marten populations (Wisdom et al. 2000; Hargis et al. 1999). Further, roads that fragment habitat can also lead to continued trapping pressure (Wisdom et al. 2000). Other threats include limited availability of prey (Wisdom et al. 2000), predation (Bull and Heater 2001), and mortality resulting from territorial interactions between martens (Bull and Heater 1995).

Future

The selected alternative for the Northwest Forest Plan (USDA and USDI 1994a) was determined to meet the NFMA requirement to provide for a diversity of plant and animal communities.

The American marten was one of 15 mammals determined to be closely associated with late-successional and old-growth forests (USDA and USDI 1994b; 3&4-182). A viability assessment was completed by the Forest Ecosystem Management Assessment Team (FEMAT) (1993). The viability outcome for the American marten was:

- 67 percent likelihood of Outcome A – "Habitat is of sufficient quality, distribution, and abundance to allow the species population to stabilize, well distributed across federal lands"
- 27 percent likelihood of Outcome B – "Viable populations with gaps in distribution"
- 3 percent likelihood of Outcome C – "Populations relegated to refugia"
- 3 percent likelihood of Outcome D – "Extirpation(s) likely"

Additional mitigation measures were implemented to increase the likelihood of Outcome A for the preferred alternative to be similar to 83 percent likelihood of Option 1 (the most restrictive alternative). The mitigation measures were to increase the amount of "coarse woody debris" in the matrix and to implement wider riparian reserves. Implementation of these mitigation measures "would be sufficient to support a stable, well-distributed population throughout most of its range. However, marten populations are low in the Olympic Peninsula and the Oregon Coast Range, and there is some chance that populations may not recover in those provinces" (USDA and USDI 1994b; J2-473).

The Forest Service has been implementing the NWFP and monitoring late-successional habitat trends since 1994. The 10-year monitoring report (Haynes et al. 2006) states "…it appears that

the status and trends in abundance, diversity, and ecological functions of older forests are generally consistent with expectations of the Plan. The total area of late-successional and old-growth forest (older forests) has increased at a rate that is somewhat higher than expected, and losses from wildfires are in line with what was anticipated."

As a result projects consistent with the NWFP should be expected to maintain viability of late-successional associated species such as the marten. This assumption will need to be supported with additional analysis on the Siuslaw and Olympic National Forests. Projects designed to enhance late-successional forest should result in a call of improving habitat conditions.

Roosevelt Elk (*Cervus canadensis roosevelti*) and Black-tailed Deer (*Odocoileus hemionus columbianus*)

Listing Status

U.S. Forest Service: Management Indicator Species (MIS)

Washington Department of Fish & Wildlife: Game species

Habitat use on the Olympic Peninsula

Roosevelt elk and Columbia black-tailed deer are known throughout the Olympic National Forest and Olympic Peninsula. Elk on the Olympic Peninsula are associated with the Olympic elk herd, although they are distributed throughout a variety of watersheds in smaller groups (WDFW 2005). Deer occur throughout the subwatersheds associated with the project area. Both species use a combination of habitats comprised of cover, forage, water, and space.

The Olympic National Forest LRMP requires that twenty percent of the area necessary for winter survival should be managed as optimal cover (USDA 1990a). Winter range for deer and elk on the west side of the Olympic Peninsula is typically defined as land below 1,500 feet in elevation, due to snow accumulations at higher elevations (Taber and Raedeke 1980a, 1980b). In the Upper South Fork Skokomish River watershed, approximately 10,324 acres, out of a total of 38,500, acres are below 1,500 feet.

Optimal cover has understory and overstory components that provide forage as well as a snow-intercepting canopy that allow more forage to be available. These criteria are generally achieved when dominant trees average 21 inches in diameter or greater, there is 70 percent or greater canopy closure, and the stand is predominantly in the large sawtimber condition (USDA 1990a). Remnant forest being maintained for suitable northern spotted owl and marbled murrelet habitat may also function as optimal cover, though may vary in the amount of forage available. Activities intended to develop late-successional conditions should also help to develop optimal cover for deer and elk.

New models to evaluate elk habitat have recently been developed and validated by researchers, and include elk nutrition and elk habitat use components (Boyd et al. 2011, in draft). These new models have placed more emphasis on summer range because of the

importance of this period to elk productivity (Hutchins 2006). The Westside Elk Summer Nutrition model predicts the amount of dietary digestible energy (DDE) that elk can acquire from a given plant community during this period. It can be used on its own or with the more comprehensive elk habitat use model. The inputs that drive the nutrition model are potential natural vegetation zone (PNV), modeling region, percent canopy cover of all live trees, and the proportion of total live trees that are hardwoods. Only the latter two inputs are generally subject to management manipulation. In general, higher DDE values are attained with decreasing canopy cover and increasing proportion of hardwoods. Forage quality is inherently limiting in most Westside environments. Therefore any increase in the amount of area within the higher DDE values can potentially result in benefits to elk nutrition and associated productivity.

The Westside Elk Habitat Use model incorporates the nutrition model along with additional inputs to predict levels of elk use across the landscape. Those inputs are distance to cover-forage edge, mean slope, and distance to public use roads. In general terms, higher use occurs closer to cover-forage edges, on more gentle slopes, and further from public use roads.

Reported home range size for elk varies widely on the Olympic Peninsula, depending on the study area and habitat quality, as well as the estimation technique used. Mean home range sizes of up to 7,240 acres (Hutchins 2006) or 12,108 acres (Storlie 2006) have been recently reported for elk within managed forests within their home range. Home range size is generally smaller where habitat quality is higher. Concentrated use or “core” areas, where the elk spend the majority of their time, are generally much smaller than the home range size.

For the past two years, the Skokomish Indian Tribe has been studying the elk herds associated with the Tribe’s Usual and Accustomed areas in the Skokomish and Wynoochee watersheds. Radio collars have helped to document movements and habitat use. In the Skokomish River watershed, the herd seems to consistently use private land in and around Vance Creek, south of the National Forest boundary (B. Brinkerhoff, pers. comm., 2011). During mid-summer, the herd moves north onto the forest in the Brown Creek area (in the lower part of the Upper South Fork Skokomish watershed), though they do not generally stay there, but rather move back and forth between the two areas. The theory is that forage is limiting higher in the watershed compared with the agricultural fields lower down (B. Brinkerhoff, pers. comm., 2011).

Home range sizes for deer on the Olympic Peninsula are much smaller, with a recent study showing an average of 373 acres (range 168-1583 acres; McCoy and Gallie 2005). That particular study area likely has more early seral habitat than typical National Forest project planning areas. Therefore, home ranges on National Forest Lands may be larger. As with elk, there is generally a much smaller concentrated use area for deer.

Threats

The availability, abundance and quality of forage are important factors influencing the productivity of populations of both deer and elk. Elk reproductive rates and survival are influenced by home range quality and nutrition (Cook et al. 2004, Hutchins 2006). Preferred

forage areas are in natural openings or managed stands generally less than 20 years old. Lower elevation, south-facing slopes in the late winter or early spring that have an earlier emergence of grasses and forbs are a particularly important source of forage for cow elk in the late term of pregnancy (M. Zahn, pers. comm., 2009). The enhancement of forage through management activities such as thinning and the creation of openings can have a positive benefit on elk home range quality. Complex, uneven-aged timber stands are generally preferred by deer over more simplified, even-aged stands. Small openings and structural heterogeneity within and between stands are also beneficial to deer (Nelson et al. 2008).

In the short term, thinned areas, especially the more open "gaps," would likely develop more understory that could be available as forage for a longer period, due to minor reductions in canopy cover. This would benefit both species. Silvicultural prescriptions which retain and favor hardwoods would also benefit the elk nutrition component. Currently, the stands proposed for thinning in the proposed action probably function primarily as hiding cover.

Both elk and deer are susceptible to disturbance or direct mortality associated with motor vehicle access. Harvest of both species is generally allowed, though restrictions vary by Game Management Unit. Winter mortality, legal harvest, and poaching were reported as the primary causes of elk and deer morality in Washington (Taber and Raedeke 1980a, 1980b, Bender et al. 2004). Poaching of elk is believed to be prevalent on the Olympic Peninsula (WDFW 2005). A high density of roads can have a negative impact on elk, due to increased disturbance from both legal hunting and poaching (Cooperative Elk Management Group 1999, McCorquodale et al. 2003). Therefore, closing roads no longer needed results in a notable reduction in disturbance to elk (Witmer and deCalesta 1985), and would also benefit deer. Habitat guidelines for black-tailed deer suggest decommissioning of unneeded roads after management activities are complete in order to reduce road effects, as well as the monitoring and treatment of invasive plant species along road systems (Nelson et al. 2008).

The Washington Department of Fish and Wildlife (1996) recommends that road densities stay below 1.5 miles per square mile (mi/mi^2) in elk summer/fall range and below 1.0 mi/mi^2 in winter/spring range. Roads closed to highway vehicle traffic that are accessible to OHVs and other forms of travel can still have impacts on elk (Naylor 2009). Across the entire Upper South Fork Skokomish watershed, the road density for open, driveable roads is 1.25 mi/mi^2. In the area of summer range (above 1,500 feet), the road density is 0.74 miles/square mile, and in winter range (below 1,500 feet) it is 2.56 miles/square mile. Table Wildlife-9 shows road densities for the Upper South Fork Skokomish watershed broken down by smaller, 7th field subwatersheds.

Table Wildlife-9. Road densities by 7th-field subwatersheds in the planning area

Subwatershed Name	Acres	Square Miles (mi^2)	Miles of Road (mi)	Road Density (mi/mi^2)
Brown Creek	5,106	8.0	6.8	0.85
Cedar Creek	3,607	5.6	15.2	2.70
Church Creek	2,502	3.9	2.3	0.59
Lebar Creek	6,278	9.8	14.3	1.46

Table Wildlife-9. Road densities by 7th-field subwatersheds in the planning area				
Subwatershed Name	**Acres**	**Square Miles (mi^2)**	**Miles of Road (mi)**	**Road Density (mi/mi^2)**
Upper South Fork Skokomish River	9,246	14.4	7.3	0.51
Middle South Fork Skokomish River	6,859	10.7	22.2	2.07
Pine Creek	2,413	3.8	1.2	0.32
Rule Creek	1,407	2.2	0.0	0.00
Steel Creek	1,126	1.8	0.3	0.17

In the Upper South Fork Skokomish watershed, there are three seasonally closed gates on FS roads 2361, 2353, and 2354. These roads are closed to public traffic between October 1 and April 30, although there is some limited use by Forest Service personnel and contractors during that time period.

On the Olympic Peninsula, deer populations have increased in some GMUs and have decreased in others. The 2009 game status and trend report (WDFW 2009) predicted there may be longer-term declines on National Forest System lands where there is little timber harvest or strategies that target older stand ages classes, but stated that populations may have stabilized in these areas over the past decade. The particular population management unit (PMU 65) that includes that project area showed a general increase from 2004 through 2008, but a slight decrease in 2009 (WDFW 2009, 2010).

For elk on the Olympic Peninsula, overall populations appear to be stable to increasing (WDFW 2010). A three-point minimum antler restriction on harvested bulls was established in 1997 to increase bull escapement (WDFW 2005). State data suggests that bull harvest in the greater "population management unit" since that time has increased from the very low levels of the early to mid-1990's but is still below the levels of the 1980's (WDFW 2009), though this does not address localized patterns of harvest. For elk in PMU 65, the population estimate based on harvest data modeling shows an overall increasing trend from 2004 through 2009, though there can be year-to year fluctuations. Timber harvest on state and private lands is believed to be resulting in increased forage supply on those lands, although open roads can offset some of those benefits (WDFW 2009, 2010). Variable density thinning on National Forest System lands is also expected to increase forage, although the gains may be more modest (WDFW 2010).

Future

The selected alternative for the Northwest Forest Plan (USDA/USDI 1994a) was determined to meet the NFMA requirement to provide for a diversity of plant and animal communities. Project activities should improve the quality and quantity of understory forage resources for both deer and elk, however moderately. Reduction in open road densities should reduce effects from disturbance and direct mortality and enhance foraging in those areas. As such, activities should maintain or improve summer range habitat in the short term and enhance optimal cover over the long term. As a result, the project should be expected to maintain the viability of early-successional associated species such as the Roosevelt elk and black-tailed deer.

Neotropical Migratory Birds

Executive Order (EO) 13186 signed by the President on January 10, 2001 defined the responsibility of federal agencies to protect migratory birds and their habitats. The intent of the EO was to strengthen migratory bird conservation by identifying and implementing strategies that promote conservation and minimize the take of migratory birds through consideration in land use decisions and collaboration with the U.S. Fish and Wildlife Service (FWS). Pursuant to EO 13186 the Forest Service entered into a Memorandum of Understanding with the FWS in January 2001 with the express purpose of incorporating migratory bird habitat and population management objectives and recommendations into the agency planning processes. To that end, bird conservation is an issue and shall be discussed in terms of effects as well as incorporation of mitigation.

The Olympic National Forest falls within the Northern Pacific Rainforest delineation of Bird Conservation Regions (BCR) identified by the North American Bird Conservation Initiative (Partners in Flight 1998). High priority breeding forest birds include the spotted owl, marbled murrelet, northern goshawk (*Accipiter gentilis*), chestnut-backed chickadee (*Poecile rufescens*), red-breasted sapsucker (*Sphyrapicus ruber*), and hermit warbler (*Dendroica occidentalis*). The project area provides habitat to all four of the species mentioned above. The northern goshawk will be discussed in more detail in the following section on "Species of Concern." The factors to address for neotropical migratory birds include the effects to seasonal habitats.

In coniferous forests of Western Oregon and Washington, 27 species of neotropical migratory birds have experienced substantial recent declines (1980-1996) or long-term (1966-1996) declining trends based on breeding bird surveys, while 12 species have seen notably increased population trends (Link and Sauer 1997). The reasons for the decline vary with species. Past intensive forest management practices may have lead to declines due to the loss of older forest habitats. However, more recent forest management may have led to the increase of some species due to the increase in a variety of forest seral stages across the landscape. For many species the reason behind the decline is unknown.

Of the other neotropical migratory bird species, many occur in coniferous forest. Some are associated with taller trees while others are found in closer association with understory shrubs or early successional habitats. Hagar et al (1996) found bird species richness was correlated with habitat patchiness and the density of hardwoods, snags and conifers. Hardwood stands, particularly those associated with riparian areas, are of particular importance as a key habitat for some breeding neotropical and winter resident songbirds and can be an important predictor of bird species richness (Hagar et al. 1996). There are small patches of hardwood and mixed hardwood/conifer habitat scattered throughout the proposed project stands of the Upper South Fork Skokomish project area, as well as in the areas between the stands. For most species, critical breeding periods last from early spring through late-summer Although there have been no surveys conducted specifically for forest landbirds relative to this project, a variety of species is likely to occupy the area.

U.S. Fish & Wildlife Species of Concern

The species in table Wildlife 10 are listed as Federal Species of Concern (USDI 1993), a category defined as those species that might be in need of conservation action. These actions may include periodic monitoring of populations and threats as well as possible listing as threatened or endangered. There is no legal protection for Species of Concern and the term does not necessarily mean they will be listed. The table and discussion below includes only those Species of Concern not previously discussed elsewhere in this document. No surveys were conducted for these species relative to this project.

Table Wildlife-10. Federal Species of Concern

Common Name	Scientific Name	Other Designations	Indicator of Habitat Presence on Olympic National Forest	Habitat Present In Project Area?	Documented Sightings in Project Area?
Makah Copper Butterfly	*Lycaena mariposa charlottensis*	State Candidate	Open wetlands, prairies.	No	No
Long-eared Myotis	*Myotis evotis*	State Monitor	Coniferous forests, tree cavities, rock crevices.	Possible at higher elevations	No
Long-legged Myotis	*Myotis volans*	State Monitor	Coniferous forests, tree cavities, rock crevices.	Possible at higher elevations	No
Northern Goshawk	*Accipiter gentilis*	State Candidate	Coniferous forests with open understories.	Yes	Yes
Olive-sided Flycatcher	*Contopus cooperi*		Coniferous forests with uneven canopies and interspersed openings and wet areas, dead or partially dead trees.	Yes	No
Cascades Frog	*Rana cascadae*	*State Monitor*	Small lakes, ponds, marshy areas adjacent to streams. Usually found above 2000 feet elevation.	*Yes*	*Yes*
Tailed Frog	*Ascaphus truei*		Fast, cold streams, sea level to 5,250’ (Mt. Rainier), with cobble or boulder substrates.	Yes	Yes
Western Toad	*Bufo boreas*	State Candidate	Ponds/shallow lakes, but may be found near streams during dry periods.	Yes	Yes

Makah Copper Butterfly (*Lycaena mariposa charlottensis*)

The Makah copper butterfly is a new subspecies of the Mariposa copper (*Lycaena mariposa*) found on the Washington Coast. This population, at the boggy Ahlstrom's Prairie, between Lake Ozette and the Pacific Ocean in Olympic National Park, approximately 70 miles northwest of the project area, was first documented in 1975 (Pyle 2002). The Makah copper's main nectar source is a small, white bog gentian (*Gentiana douglasiana*). This type of bog habitat, with this bog gentian species, has not been found in the Upper South Fork Skokomish watershed. Populations of this butterfly species are small, and very fragile. They rely upon the vegetation that grows only on the few prairies in the region. It is unlikely that they can migrate to any other suitable habitat. Because there is no habitat suitable for Makah copper butterfly in the project planning area, the species will not be analyzed further in this assessment.

Long-eared Myotis (*Myotis evotis*) and Long-legged Myotis (*Myotis volans*)

Both the long-eared myotis and the long-legged myotis inhabit coniferous forests where they roost under bark, in tree cavities and rock crevices. Bats in the Pacific Northwest tend to use old-growth Douglas-fir stands disproportionately more than young or mature stands. This is presumably due to increased roost availability in old-growth stands and the paucity and lower suitability of roost trees in second-growth stands (Wunder and Carey 1996, Grindal 1998). As mentioned previously, the remnant late-successional forest in the project area contains large trees and snags that could be suitable for bat roosting. Because there are fewer remnant trees or legacy snags in proposed units, especially those units that have a history of intensive management, the likelihood of bat species roosting in areas of possible activity is much lower than in the surrounding remnant forest. These two species are generally found at higher elevations but could potentially be found using the project area. Lepidopteran insects form a major component of the diets of long-eared myotis and long-legged myotis in coastal rainforests to the extent that the long-legged myotis has been described as a lepidopteran "specialist" (Kellner and Harestad 2005). Braun et al. (2002) found that vine maple may have an important influence on the forest lepidopteran communities and leaf-based food webs, which has implications for these two species as well as other species of bats.

Northern Goshawk (*Accipiter gentilis*)

The northern goshawk uses mid- to large-diameter trees for nesting and perching, and requires an open flight corridor beneath the canopy to be successful in searching for food and capturing prey. Suitable nesting habitat for the northern goshawk includes mature or old coniferous forest, with relatively closed canopies and multiple canopy layers, and a high density of larger trees (over 23 inches in dbh). At the nest stand level, Finn et al. (2002) found a higher occupancy rate on the Olympic Peninsula when shrub cover was relatively low in the stand and when there was a greater depth of the overstory canopy. At the landscape level, Finn et al. (2002) found lands surrounding occupied historical goshawk nest sites to be dominated by late-seral forest and to a lesser degree by mid-seral forest. Bloxton (2002) found the dominant avian prey on the Olympic Peninsula included grouse, pigeons and Steller's jay, and the important mammalian prey included snowshoe hare, Douglas squirrel, and northern flying squirrel. Douglas squirrels, grouse, and Steller's jays were noted on numerous occasions in the proposed project stands; snowshoe hare were observed once and their sign was also noted.

Suitable goshawk habitat occurs in the Upper South Fork Skokomish project area, and the species has been documented in the upper watershed near Rule Creek and at several sites along the South Fork.

Olive-sided Flycatcher (*Contopus borealis*)

The olive-sided flycatcher is a long-distance, neotropical migrant that breeds throughout coniferous forests in western Washington and Oregon. Preferred habitat consists of mid- to high-elevation montane and coniferous forests. This bird species is positively associated with edge habitats (natural or man-made), landscape heterogeneity, and juxtaposition of early and late-seral habitats (Shirley and Smith 2005; Altman and Hagar 2007). Various diameters of hemlock and either Pacific silver or noble firs are preferred nest trees. This species gleans insects from foliage, and its presence in early successional forests appears to depend on availability of snags or live trees that provide suitable foraging and singing perches.

Suitable habitat for the olive-sided flycatcher exists throughout the project area, in those areas that provide a mixture of deciduous forest riparian zone and late-seral habitat as well as in those forested areas adjacent to openings. Although the species was not observed during field reconnaissance, it is undoubtedly found throughout the project area.

Cascades Frog (*Rana cascadae*)

The Cascades frog is typically found in or near water or pools off of streams adjacent to mountain meadows, moist forests, and other seasonally flooded or marshy areas, and has been documented in the Olympic Mountains. They occur only rarely below 2000 feet in elevation, and 2500-6000 feet is more usual (Corkran and Thoms 2006), though earlier records indicate they may have occurred at lower elevations on the Olympic Peninsula in the past (Leonard et al. 1993). They breed in bogs or ponds with cold springs or snowmelt (Corkran and Thoms 2006). The species has been documented in a wet meadow off the 2363-070 road (Church Creek drainage); the sighting included one adult, as well as numerous larvae. The preferred habitat for adults or for breeding activities has not been observed within proposed thinning units.

Tailed Frog (*Ascaphus truei*)

Suitable habitat for the tailed frog consists of fast, clear, cold streams with cobble or boulder substrates and little silt, from sea-level to high elevation (Corkran and Thoms 2006). Adults can also be found occasionally along stream banks and in riparian forests where they forage for insects. The streams and riparian forests of the project area and surroundings provide suitable habitat for this species and it has been documented along Steel Creek, the South Fork Skokomish River, and an unnamed tributary to the South Fork. Few nests of the tailed frog have been found in the wild, but Bury et al. (2001) documented tailed frog nests in a tributary of the Dosewallips River in Olympic National Park.

Because they spend the majority of their life in aquatic environs, the tailed frog is vulnerable to management practices that alter the riparian or aquatic zones of streams, especially those that change the moisture regime, increase stream temperature, increase sediment load, reduce woody debris input, and alter stream bank integrity (Leonard et al. 2003, Hallock and McAllister

2005a). Protection of the upper reaches of streams is particularly important for this species (Hallock and McAllister 2005a).

Western Toad (*Bufo boreas*)

The western toad occurs in a variety of terrestrial habitats. Transformed (adult) toads are terrestrial but often can be found near streams or other water bodies during dry periods. Adults are believed to take cover in burrows and under woody debris. Breeding waters are usually permanent, containing water year-round. This can include wetlands, ponds and shallow lakes, reservoir coves, and still-water, off-channel habitats of rivers (Corkran and Thoms 2006, Hallock and McAllister 2005b). In the Upper South Fork Skokomish River watershed, western toads have been documented at Pine Lake and along the 2361-600 road (Church Creek drainage).

Direct threats to western toad include direct mortality due to road traffic during adult movements to and from breeding sites in the spring, and during dispersal of newly metamorphosed toads away from the breeding sites in the summer and fall (Hallock and McAllister 2005b). Breeding sites appear to be vulnerable to successional changes in vegetation (Hallock and McAllister 2005b) and the species is also affected by loss of wetlands (Leonard et al 1993).

Wildlife – Environmental Consequences

Environmental Consequences for Northern Spotted Owl, Marbled Murrelet and Designated Critical Habitats

Alternative A – No Action Alternative

Direct and Indirect Effects

Under the No Action Alternative, current conditions would be maintained in the watershed. None of the 880 acres of relatively simplified forest included in the project stands would be commercially thinned. There would not be any direct effects due to habitat manipulation, which would not occur, nor disturbance, to any individuals of these species that may be using the project area. Likewise, there would be no effect to the mapped critical habitat areas.

Indirect effects would include the delayed development of additional acreage of late-successional/old-growth forests that could provide potential nesting opportunities for murrelets as well as future nesting, roosting, and foraging habitat for spotted owls. These stands would remain longer in early- or mid-seral conditions, generally overstocked with a single canopy layer, fewer than optimal larger diameter snags and coarse woody debris, and a high canopy closure with a corresponding lack of vegetation on the forest floor. Natural tree mortality due to competition would conceivably continue to provide some snags and woody debris in the smaller size classes. These stands would continue to provide dispersal and some roosting and foraging habitat for northern spotted owl, but not nesting habitat for marbled murrelet or spotted owl.

Cumulative Effects

Because there would be no management activities, there would be no cumulative effects with other past, present, or reasonable foreseeable actions.

Previous timber harvest, road building, and, to a lesser degree, catastrophic natural fire events have had the greatest impact on these two threatened species in the project area, either due to habitat removal, habitat alteration that favors competing species, or human disturbance. The large-scale, timber extraction that has occurred in the past on federal lands will not be taking place again in the foreseeable future. However, even-aged, regeneration (clearcut) harvest is still occurring in many areas on private and state lands to the east of the project area. It can be assumed that these areas will not be available as either dispersal or suitable habitat in the next several decades. This makes the continued existence of owl and murrelet habitat on federal lands even more critical, particularly if such areas can be utilized as breeding sites.

Alternative B – Proposed Action

Direct and Indirect Effects

Direct Effects

Habitat

Variable density thinning prescriptions would create conditions that would foster growth of old-growth structural characteristics necessary for murrelet and owl nesting, such as multi-story canopies; large, lateral branch growth; large trees; and maintenance of existing dead and down wood habitat on approximately 880 acres. Treated stands will continue to function as spotted owl dispersal habitat, through the implemented prescription, by maintaining more than 40 percent canopy cover with trees averaging larger than 11 inches dbh (Thomas et al. 1990). These areas would not immediately become nesting habitat and the activities, in the short-term, may disturb individual owls that are using the proposed stands for dispersal, or murrelets moving through or overhead as they return from foraging trips. There would not be any acres treated within the spotted owl 1.4 mile nest core areas; by contrast, 745 acres (83 percent of the proposed total) fall within at least one 2.7 mile owl activity center home range. Approximately 106 acres (12 percent of total) will be treated within 0.5 miles of sites of documented murrelet activity.

This project would not remove or degrade any habitat suitable for nesting, roosting, or foraging by spotted owls, however some larger trees (over 21” dbh) may need to be removed for safety issues associated with aircraft on helicopter units, including around landings, as well as adjacent road construction sites. Some of these trees may be potential nest trees (PNTs) and the following points show what is allowed for removal under the current forest Programmatic Biological Opinion (USDI 2003):

- 30 PNTs per year may be removed along roads or landings associated with the commercial thin units;
- For road reconstruction, some >21” trees may be removed from road rights-of-way, but only 10 of these can be PNTs (per year);
- For road construction, some large trees deemed hazardous may be removed from right-of-way (25 PNTs may be removed);
- For temporary roads, some >21” trees may be removed from road rights of way, 15 may be PNTs along existing grades, 50 PNTs along new temporary roads;

Approximately 3.52 miles of temporary road construction would occur with this alternative, which includes 2.27 miles of existing temporary road, 0.91 miles of new temporary road, and 0.37 miles of existing decommissioned road. The 0.91 miles of new temporary road would be constructed almost entirely within the proposed stands, which means that dispersal habitat would be removed along those stretches (approximately 1.77 acres). Likewise, helicopter landings that fall within stands would result in the removal of dispersal habitat (approximately 12 acres). Immediate post-operation decommissioning and revegetation of these temporary roads and landings would help to mitigate the effects of this loss. Dispersal habitat would be maintained in the watershed, and current habitat connections, which facilitate dispersal of individuals, would remain.

This project does not propose to remove any snags or downed wood unless there are safety concerns, and would place no-cut buffers around larger (30 inch dbh) legacy snags that are identified in units (see Project Design Criteria section in Chapter 2). Therefore, there would be minimal effects on current snag and downed wood levels. However, because the thinning operations would improve the vigor and survival of remaining trees, there would be some loss of natural self-thinning (competition-related) mortality in stands that are thinned. Suzuki and Hayes (2003) found that thinning activities can reduce the frequency and cumulative length of small (defined as 4 to 12-inch diameter in their study) and medium (13 to 19-inch diameter) downed wood. This likely would have the most impact on numbers of small snags and logs that would be naturally produced in the Upper South Fork Skokomish project area in the future, and that size class is currently well-represented. In addition, trees that remain will grow in size more quickly to become larger potential snags in the future, including snags that would be beneficial to the spotted owl in terms of potential nesting sites for itself and for its prey. The unthinned areas ("skips") would allow for some natural self-thinning mortality to continue producing smaller snags, as well as serve to protect and retain other wildlife values such as the larger legacy snags.

Disturbance

Spotted owls, as well as marbled murrelets, are more vulnerable to disturbance during the early breeding season (March 1-August 5) when they are producing and incubating eggs than they are during all other times of year. Noise or visual disturbance has the potential to cause nest abandonment and aborted feeding attempts by adults, which could result in undernourishment of the chick or premature fledging (USDI 2003). Most of the proposed Upper South Fork Skokomish stands are either completely surrounded by or adjacent to stands of suitable habitat. Given the recent dramatic decrease in marbled murrelet numbers, in order to minimize potential disturbance, work associated with commercial thinning in several of the units would be scheduled outside of the early breeding season. In some units, however, due to other resource concerns, thinning would occur between March 1 and August 5. For these units, an area of "disturbance" was calculated, which included: 1) suitable habitat immediately around the unit (65 yards for ground-based equipment and 360 feet for helicopter); 2) suitable habitat immediately around log and service helicopter landings (360 feet); and 3) suitable habitat directly along the flight lines (360 feet). This was calculated only for those units proposed to be thinned during the early breeding season, and resulted in 246 acres of suitable habitat being

disturbed. Tables Wildlife-11 and Wildlife-12 break this total down by thinning unit and helicopter flightline. Finally, for any temporary road construction and reconstruction associated with early season units, disturbed suitable habitat within 65 yards of those road segments was determined to be 11 acres. Total potential early breeding season disturbance would be 257 acres.

Table Wildlife-11. Suitable Habitat Disturbance by Proposed Thinning Unit		
Unit	**Logging System**	**Acres Disturbed**
S036	Helicopter with Prebunching	13
S036A	Ground-Based Yarding	17
S052A	Helicopter with Prebunching	31
S053C	Ground-Based Yarding	3
S074A	Ground-Based Yarding	7
S099A	Ground-Based Yarding	8
S099B	Cable Yarding	8
S099C	Helicopter with Prebunching	19
	Total acres disturbed by thinning unit operations	*106*

Table Wildlife-12. Suitable Habitat Disturbance by Proposed Helicopter Flightline			
Flightline [1]	**Log Landing ID**	**Service Landing ID**	**Acres Disturbed**
FLS036LS	HL04	HL03	45
FLS036UL	HL04		9
FLS036US		HL03	30
FLS052ALS	HL02	HL01	8
FLS052AUL	HL02		1
FLS052AUS		HL01	8
FLS099CLS	HL07	HL08	17
FLS099CUL	HL07		2
FLS099CUS		HL08	20
		total acres disturbed by helicopter operations	*140*

1 *Flightline number key: FL (flightline) + thinning unit ID (i.e., S036) + FL type (LS, UL, or US (below))*
- *LS means flightline between log landing and service landing*
- *UL means flightline between centriod of unit and Log landing*
- *US means flightline between service landing and centroid of unit*

Critical Habitat

Two primary constituent elements (PCE) within the marbled murrelet critical habitat units have been identified as essential for marbled murrelet nesting: trees with potential nesting platforms (PCE1), and forest areas within 0.8 km (0.5 miles) of trees with potential nesting platforms that have canopy heights of at least one-half the site-potential tree height (PCE2). These elements

are considered essential for successful nesting (USDI 1997). Marbled Murrelet nest trees are typically greater than 80 cm (32 inches) dbh (Hamer and Nelson 1995).

Because the trees in the proposed Upper South Fork Skokomish stands are at least one-half the site-potential tree height of that stand, and because most the units (except for S026 and S026A, and parts of S016 and S084) are in marbled murrelet critical habitat block WA-03-b (USDI 1996), surveys were conducted to identify and mark PCE1, legacy trees, and legacy snags in the following units: L01A, L60, S010, S029,S036/S036A, S052, S053C, S070, S071, S072, S099, and S112. Table Wildlife-13 shows the results of these surveys.

Table Wildlife-13: PCE1 and Snags located and marked in surveyed thinning units

Unit ID	Number of PCE 1	Number of snags
L01A	0	4
L60	3	0
S010	1	0
S029	0	0
S036/S036A	10	1
S052	0	1
S053C	0	0
S070	0	0
S071	0	0
S072	0	0
S099	3	0
S112	0	0

Marbled murrelet critical habitat block (CHU) WA-03-b is approximately 48,800 acres in size. Of that, 17,134 acres within the planning area are currently identified as suitable habitat. Most of the proposed thinning acres lie within the CHU. The accelerated development of these additional acres of suitable habitat in the planning area represents a potential increase of approximately 2 percent for suitable habitat in the CHU overall, and about 5 percent for that portion of the CHU that lies within the Upper South Fork Skokomish subwatershed. Although this is a small amount compared to what presently exists across the landscape, these acres would provide future suitable nesting habitat within six miles of marine foraging areas in the Hood Canal, which is an important feature to CHU function (USDI 1996, USDI 2003).

For the spotted owl critical habitat block, which currently contains approximately 332,100 acres, 404 treatment acres fall within the CHU. This reflects an increase of approximately 1 percent in suitable habitat. The PCE of suitable habitat would not be removed in critical habitat with this project, so implementation of Alternative B would maintain the long-term viability of critical habitat.

Conclusion

The proposed action should not result in the direct harm to any nesting northern spotted owls or marbled murrelets.

Indirect Effects

Indirect effects would include both positive and negative elements. For both owl and murrelet critical habitat acres that fall within the Upper South Fork Skokomish project area, only about half of those acres are currently designated as suitable nesting habitat. Given this, any gain at all in late-successional habitat conditions would be beneficial. Additional activities to further enhance habitat in the planning area, primarily in the form of snag creation, coarse woody debris structures, etc, could occur via other funding sources. Future road decommissioning in addition to closing the temporary roads opened for this project would lead to eventual reduction in habitat effects as these areas are allowed to re-vegetate.

The potential negative indirect impacts to murrelets and northern spotted owls, however, arise from increased nest predation risk from road corridors and developing habitat adjacent to clearings and other conditions that favor predators, as well as changes in abundance of prey for spotted owls following thinning, and the potential for disturbance that results in nest abandonment. The effects of developing habitat from opening up travel corridors (roads), even though ultimately closed, may include enhancing these areas for corvids (ravens, crows, and jays), which are predators on nests and chicks. McShane et al. (2004) summarize information suggesting that murrelets are highly sensitive to habitat fragmentation and that increased edge effects can affect nesting success through changes in predation rates and microclimate conditions. Predation rates on forest birds are generally higher at hard edges (abrupt transition from forest to open area) than at softer or more gradual edges with different forest types or partial harvest (thinning). Additionally, abrupt edges may serve as corridors for predators. While some information suggests that increasing complexity may decrease the search efficiency of nest predators, other information suggests that increasing habitat productivity along edge habitat may simply increase the number and diversity of predators and competitors (various studies as summarized in McShane et al. 2004). None of the Upper South Fork Skokomish units are adjacent to hard edges, such as those that occur on private or state forest lands (the nearest, L13A and B, are approximately 1,200 feet from a recent clearcut). This distance from abrupt edges which should minimize some edge-associated risks.

Thinning may cause a short term impact on the food source (truffles) of flying squirrels, which could in turn, lead to a short term (less than 5 year) decline in flying squirrel numbers (Courtney et al. 2004, Carey 2006, pers. comm.). However, response to management activities may differ between truffle species, and legacy retention (in stands that have remnant trees) would also benefit truffle abundance and diversity in those stands (Carey 2002). Thinning may also reduce potential or actual flying squirrel den trees (Carey et al. 1997), although conservation measures and silvicultural prescriptions for this project would, wherever possible, protect trees with defects, cavities and other features that could provide suitable dens. While thinning appears to increase the abundance of some small mammals in the longer term (7-24 years), especially those associated with understory cover, short term effects are less clear or less consistent (Suzuki and Hayes 2003). Thinning can also have negative short-term effects on flying squirrels, the spotted owl's main prey in the Olympics (Carey 2000, 2002). This may have to do with the removal of protective cover and the potential increase in other predators at the site, including other owls, weasels, etc (Wilson, pers. comm., 2009). Over the long run, variable density

thinning would likely provide adequate prey for northern spotted owls (Courtney et al. 2004). Prescriptive measures that retain existing seed-source trees and shrubs for rodents would also be beneficial to spotted owls under all action alternatives.

It is unclear whether forest management activities would affect the outcome of interactions between barred owls and spotted owls (Courtney et al. 2004), or whether commercial thinning would favor the barred owl, even though thinning practices are designed to create late-successional characteristics. Barred owls have a wider breadth in habitat use and prey species taken. As mentioned previously, barred owls had not been documented during surveys completed in the watershed through 2005, though they may well now be occupying the watershed (B.Biswell, pers. comm., 2010).

Context for Consultation using ITS Methodology for Northern Spotted Owl

BLM and FS Administrative Unit Staff and Level 1 Teams are encouraged to follow this methodology when planning projects, assessing effects, and tracking project implementation in situations where no or only partial spotted owl survey information is available for the analysis area. However, if current survey information is available, it represents the best available information and should be used instead of the ITS methodology to assess the effects of a proposed action on the spotted owl. Spotted owl survey data provides thorough coverage from the Olympic Demography Study Area (up through 2005) and estimates on the number and distribution of spotted owls within the USFS watershed. Olympic Demography Study survey protocol requires coverage out to 1.5 miles (2.5 km) from all site centers for each owl territory (Biswell, 2008, pers. comm.). In 2006, the Demography Study discontinued annual surveys in the southern portion of the Olympic National Forest, however the majority of the USFS Planning Area had been surveyed.

Direct and Indirect Effects Summary

In summary, while there may be some direct and indirect negative effects in the short term, the longer term and net effects would be expected to be beneficial to both the spotted owl and marbled murrelet under this alternative (longer term negative effects to flying squirrels should be diluted by the relatively small area that is being treated compared to the remainder of the watershed). There would be gains to these species in terms of how habitat improvement on these thinned acres would balance the minimal amount of suitable habitat on USFS lands.

Cumulative Effects

The cumulative effects of the proposed action, combined with the effects of past, present, and foreseeable future actions, would be to slightly ameliorate the large-scale loss of late-successional habitat by accelerating the development of late-successional forest characteristics on 880 acres of previously harvested stands that currently lack many of these features.

Endangered species restrictions and Northwest Forest Plan requirements have curtailed road building and clearcut logging of late-successional forest stands on Federal lands in all the subwatersheds of the Upper South Fork Skokomish planning area since 1993. Timber harvest and road building were the biggest landscape-level impacts to spotted owl and murrelet habitat prior to 1993, and the effects of these activities have shaped the resulting quantity, quality and

distribution of wildlife habitat in general. The 2004 Status Review for marbled murrelet indicated that some population threats had decreased, including rate of habitat loss, however the effects from past habitat loss continue at about the same level (McShane et al. 2004).

The Silviculture and Forest Stand Development section on this EA details the natural and human-caused activities that have shaped the landscape in the project area in the past, and those that continue to operate. Even-aged harvesting on National Forest System (NFS) and non-NFS lands in the planning area has resulted in large areas of young, simplified forest and fragmented remnants. Other activities that have influenced habitat development include previous commercial thinning, pre-commercial thinning, and snag creation, all within the project area boundary between the 1920s and the late 1980s. Since the designation of Late Successional Reserves on National Forest System Lands in 1994, management activities in those land designations have been designed to protect and enhance late-successional habitat characteristics.

It is assumed that logging and road building will continue on state and private lands east of the Upper South Fork Skokomish planning area. Therefore, few non-NFS lands are expected to provide additional late-successional habitat, making the habitat remaining on federal acres key to population health. Actions on those lands may also affect conditions for wildlife on adjacent federal lands (see discussions on edge effects above).

Endangered Species Act (ESA) Effects Determination

Marbled Murrelet

Individuals: The proposed action is a *"may affect, likely to adversely affect"* action to individual murrelets potentially nesting in suitable habitat within the planning area due to harassment (246 acres) from project activities during the early breeding season.

Marbled Murrelet Critical Habitat Unit WA-03-b: The proposed action is a *"may affect, not likely to adversely affect"* action to designated critical habitat since primary constituent element 1 may not be buffered in all project stands.

Northern Spotted Owl

Individuals: The proposed action is a *"may affect, likely to adversely affect"* action to individual spotted owls potentially nesting in suitable habitat within the planning area due to harassment (246 acres) from project activities during the early breeding season.

Northern Spotted Owl Critical Habitat Unit 1: The proposed action is a *"may affect, not likely to adversely affect"* action to designated critical habitat within the Planning Area as there would be no removal or degradation of suitable habitat.

Environmental Consequences for Regional Forester's Sensitive Species

Alternative A – No Action Alternative

Direct and Indirect Effects

The No Action Alternative would not result in any direct impacts to any sensitive species for which there is suitable habitat in the project area. Current forest conditions would not change.

Accelerated development of late-successional characteristics, including large trees for species such as the Townsend's big-eared bat or fisher, would not occur and would comprise the indirect impacts of no action. Ongoing effects to aquatic habitat in terms of sediment delivery from existing road infrastructure, as discussed in the Aquatic Habitat and Fisheries section, could still potentially impact amphibians during their aquatic phase.

Cumulative Effects

In the No Action alternative, no thinning or associated management actions would take place, so there would be no cumulative impacts with past, current, and foreseeable actions.

Timber harvest on state and private lands east of the Upper South Fork Skokomish project area is expected to continue and it is assumed that most areas on these ownerships will not provide late-successional forest characteristics for sensitive species, such as the Pacific fisher, Townsend's big-eared bat, or Johnson's hairstreak.

It is probable that there has never been habitat in the project area for common loon (large, inland bodies of water), Olympic marmot (high, alpine meadows), Olympic Mazama pocket gopher (glacial outwash prairies), and the other three butterflies (meadow and prairie habitat). Therefore, the cumulative impacts of maintaining the current condition would have little impact on these species.

The effects of previous harvest, road building, and human disturbance would have had the greatest impact on Pacific fisher and, indeed, their present status as "extirpated" from Washington is likely based on past over-exploitation due to commercial trapping as well as loss, degradation, and fragmentation of suitable habitat (Lewis and Hayes 2004). A similar loss of habitat situation exists for Keen's myotis, because its forested habitat includes the sloughing bark of old-growth trees and snags, which were removed in great quantities in the past. The "No Action" alternative would not add to these historic impacts.

Alternative B – Proposed Action

Direct and Indirect Effects

Due to a lack of potential habitat in the planning area, there would be no impacts to common loon, Olympic marmot, Olympic Mazama pocket gopher, and three butterflies: Taylor's checkerspot, Olympic arctic, and Dog star skipper. Although there is habitat for American peregrine falcon in the project area, there are no project activities near any cliffs or rock outcrops, so there would be no effects to this species.

The total of 880 acres that would be thinned would assist in the development of structural characteristics needed for Pacific fisher. The loss of some small diameter snag recruitment from self-thinning mortality would be offset by "skip" areas and the development of larger trees that would serve as more suitable potential resting or denning sites in the future. Recruitment and retention of large trees, along with overall development of forest structural diversity, will benefit fisher (Zielinski et al. 2004) over the long-term. Fishers tend to avoid areas without overhead cover, so any fishers in the vicinity of the thinned stands would be expected to avoid the small "gaps" created by the thinning until overstory cover fills back in. In short, while there might be short term minor impacts, long term impacts to fisher would be beneficial. The

conservation measure, as outlined in the Reintroduction Plan Environmental Assessment (USDI 2007b) that would be applicable in the Upper South Fork Skokomish project area is the implementation of seasonal restrictions around all known, active denning sites between mid-March and late May for motorized, mechanized activities.

The trees harvested do not likely provide microhabitat needs for the Townsend's big-eared bat. The types of roosts most commonly used by this species (caves, mines, buildings) would not be impacted under any alternative. Bats roosting under bridges could potentially be affected by nearby road construction and reconstruction activities, though this work is mostly planned away from such bridge structures. There could be minor, short-term disturbance impacts to any Keen's myotis roosting in residual trees or legacy snags in stands to be thinned, due to harvest activities. Long-term impacts would more likely be positive given that thinning would promote the growth of larger trees for roosting. This would also hold true for Johnson's hairstreak butterfly,

Thinning the proposed stands, as well as the construction of temporary roads, may have a short-term, negative effect on Van Dyke's salamander, if individuals are in the forested areas as opposed to the stream corridor. The other two salamanders are almost exclusively associated with stream channels and it is assumed that riparian reserve buffer widths adequately protect microclimate for both of them. The impact from temporary road construction and reconstruction could include some direct mortality to salamanders, but would likely be minimal in terms of effects upon the entire population. Changes in micro-climate of the thinned stands could have minor impacts on Van Dyke's salamanders in the terrestrial environment. As mentioned in the Soil, Aquatic Habitat, and Fisheries sections of this EA, due to riparian no-cut buffers, impacts to aquatic habitat through sediment delivery are expected to be negligible under all action alternatives. Amphibians would likely experience minimal impacts from changes in water quality. The mobility of aquatic-phase amphibians could be impacted by culverts at temporary road-stream crossings during project implementation, but these would return to pre-project conditions after the roads are decommissioned.

Riparian no-cut buffers would protect from disturbance any harlequin ducks that may be nesting near streams within and adjacent to proposed thinning units.

Cumulative Effects

Continued harvest on state and private lands east of the project area will mean continued lack of mature forest for Pacfic fisher, Townsend's big-eared bat, Keen's myotis, and Johnson's hairstreak in those areas. Thinning 880 acres, however, would add to the acres previously thinned within the project area boundary (See Silviculture and Forest Stand Development section) and would promote the growth of large trees suitable for nesting and roosting or denning by these species. Previous aerial fertilization on nearby private lands may have impacted amphibian species, though to what degree is not known. Relative to, and cumulative with, other past, present, and foreseeable management actions in the watershed, it is anticipated that this project would have either neutral (no impact) or positive long-term effects on habitat for any Regional Forester's Sensitive Species.

Sensitive Species Determination

Due to a lack of habitat, the proposed project activities will have no impacts to American peregrine falcon, common loon, Olympic marmot, Olympic mazama pocket gopher, Taylor's checkerspot, Olympic arctic, or Dog star skipper under any alternative.

The proposed activity may impact individual Pacific fisher, Townsend's big-eared bat, Keen's myotis, Olympic torrent salamander, Cope's giant salamander, and Van Dyke's salamander, but would not likely contribute to a trend towards federal listing or cause a loss of viability to any populations or species. Harlequin duck in the project area should be minimally affected, if at all, given the implementation of riparian no-cut buffers.

Environmental Consequences for Regional Forester's Sensitive Species—Mollusks

Alternative A – No Action Alternative

Direct and Indirect Effects

There would not be any direct impacts to any of the mollusk species likely found in the project area with the No Action alternative. Given that these species seem to be associated with hardwood or mixed conifer-hardwood forests, and wetland or riparian areas, there would be no indirect negative impacts from not developing late-succession habitat because these species do not depend on this habitat type.

Cumulative Effects

The impacts of previous harvest, road building, and human disturbance would have had the greatest impact on mollusk species. A "No Action" alternative would not add to the historic impacts. There would be no additional impacts, beyond what has occurred previously.

Alternative B – Proposed Action

Direct and Indirect Effects

The potential effects to mollusk species would include removal of overstory vegetation that provides microclimate buffering of habitat, removal of habitat, and the potential for direct loss of individuals during thinning operations or the construction and use of temporary roads. Duncan et al. (2003) state that in cases where habitat elements being used by a particular species are being negatively affected by a project, negative impacts are not expected if less than 5% of the available amount of that element, or 5% of the project area, is affected. Project design criteria that retain coarse woody debris and avoid excessive soil compaction will minimize direct and indirect impacts to many mollusk species. In addition, silvicultural prescriptions which retain and promote maintaining hardwood species and shrub and ground cover species diversity should also provide microclimate, food and substrates for the fungi that mollusks feed upon and are consistent with management recommendations (Burke et al. 1999). However, as mentioned in the spotted owl section, there may be some short term impacts to fungi associated with thinning operations and construction of temporary roads.

Because the project area is outside of the documented range of occurrence of the Hoko Vertigo snail, there would be no expected impacts to this species.

Silvicultural prescriptions and project design criteria would maintain hardwood patches in proposed units and would not thin them. Incidental removal of individual trees could occur due to road construction and yarding corridors, but this would represent less than 5% of the available habitat in proposed units and across the project area. Therefore, there would be negligible direct or indirect effects to Puget Oregonian snails, a species that has been documented on the forest at only one location.

Project design criteria that retain coarse woody debris, protect riparian areas, and protect or promote vegetative diversity will minimize impacts to Malone's jumping slug. Previous surveys on the forest have not identified any sites for the species and indicate its presence to be highly unlikely in the project area. Therefore, while the proposed activity may impact individual Malone's jumping slugs, it would not likely contribute to a trend towards federal listing or cause a loss of viability to the population or species.

Project design criteria that maintain hardwoods, along with coarse woody debris retention and riparian reserves, would also minimize impacts to the mixed conifer-hardwood portion of blue-gray taildropper slug habitat. Information from previous surveys on the forest indicates that the presence of the blue-gray taildropper in the project area would also be highly unlikely. However, project activities would still occur in habitats potentially used by this species. Therefore, while the proposed activity may impact individual blue-gray taildropper slugs, it would not likely contribute to a trend towards federal listing or cause a loss of viability to the population or species.

Some level of mortality could be expected for individuals of the Burrington's and warty jumping slug species, given that these jumping slugs have been found to be locally common and abundant on the forest, however, there should be no risk to species viability or a trend toward federal listing.

The Oregon megomphix is more commonly found in mature or late-seral forests and so should not be affected by project activities in younger stands. The retention of hardwoods and coarse wood habitat throughout the treated stands will provide habitat should the species be located in some areas of project activities, particularly along edges that border late-successional forest.

Cumulative Effects

Historic timber harvest and road building have had the greatest impact on these mollusk species. Harvest of conifer habitat around the project area is expected to continue on other ownerships, limiting the potential of these species to occur on private lands. Removal of conifers in the proposed USFS thinning units, and the associated short-term disturbance, may impact certain individuals. Given the large amount of habitat in the watershed not being treated and the project's short-term impacts on mollusks, any lasting, negative effects upon these species should be minimal.

Sensitive Species Determination - Mollusks

Because the project area is outside of its range, the proposed activities would not impact the Hoko Vertigo snail.

Because of hardwood protection guidelines, the low likelihood of occurrence, and the small scale of impact to existing hardwood habitat in the project area, the proposed activities may impact individual Puget Oregonian snails, but would not likely contribute to a trend towards federal listing or cause a loss of viability to the population or species.

Because of project design criteria and the low likelihood of occurrence, project activities may impact individual Malone's jumping slug, blue-gray taildropper slug, the evening fieldslug, and the Oregon megomphix, but would not likely contribute to a trend towards federal listing or cause a loss of viability to the population or species.

Project activities may impact individual Burrington's jumping slug and the warty jumping slug, however due to being common and abundant, these effects would not likely contribute to a trend towards federal listing or cause a loss of viability to the population or species.

Environmental Consequences for Olympic National Forest Management Indicator Species

Alternative A – No Action Alternative

Direct and Indirect Effects

There would be no direct effects to any management indicator species with the No Action alternative. Indirect effects would include delayed development of late-successional forest characteristics for all MIS and lost opportunities to decommission roads and enhance forage opportunities (through thinning) for deer and elk. An opportunity to increase the levels of snags and down wood in the stands would also be foregone.

Cumulative Effects

The effects of previous harvest, road building, and human disturbance would have had the greatest impact on management indicator species. The early successional habitat created through previous harvest did offer forage benefits to elk and deer, especially when combined with commercial thinning, pre-commercial thinning, and fertilization. A "No Action" alternative would not add to the historic impacts. There would be no additional impacts, beyond what has occurred previously.

Alternative B – Proposed Action

Direct and Indirect Effects

Bald Eagles. There should not be any direct effects, negative or positive, to eagles from this project. Given the apparent lack of eagles in the upper watershed, there should be no effects from disturbance to eagles that may be in the area during project activities. Most of the best bald eagle habitat on the Olympic Peninsula is not located on the National Forest. Eagles need a combination of both large trees and adequate foraging resources and while the Olympic National Forest does have good amounts of nesting habitat along its major rivers, the amount of feeding habitat is limiting (USDA 1990a). For this reason, there are far fewer nesting territories in the interior of the Peninsula as compared with the coast, strait, and Hood Canal. Two years of surveys along the South Fork Skokomish River turned up no sightings of eagles, nor any documentation of nests. Thinning activities would contribute to the development of future large trees that could serve as eagle nest trees along the South Fork Skokomish

mainstem (approximately 130 acres in units S53B1 and B2, S52B and C, S74A, S72, S71, and S70A and C), and improvements to river and stream habitat would increase foraging opportunities. The potential for sedimentation as a result of project activities is minimal (see Fisheries and Soils sections of this EA). Therefore, indirect impacts to the bald eagle in terms of prey populations (resident and anadromous fish) would likely be negligible.

Pileated Woodpeckers and Primary Cavity Excavators. Although these species may be directly affected by disturbance during active project operations, this would likely only impact foraging by the smaller species, as current nesting opportunities in the project stands are limited. Pileated woodpeckers need large snags for nesting, roosting and foraging. This habitat is not abundant at present in the Upper South Fork Skokomish project stands – less than 40 percent of the watershed provides optimal habitat for this species. Thinning the proposed stands may have short term negative impacts from disturbance on foraging pileated woodpeckers and other primary cavity excavators. Additionally, short-term future recruitment of snags would be affected as trees are removed as part of the thinning process. However, the long-term impact would be to increase the size of future snags due to increased tree growth, and improve overall habitat, including the snag and down wood component. Currently existing snags and down wood would not be removed in the thinning prescriptions unless necessary for safety reasons. Large snags have been marked and would be buffered to retain what currently exists in the units. Given the amount of treated area across the watershed (880 acres) compared with the size of the watershed (38,500 acres), habitat gains from this project would not be substantial at the watershed scale, but may be meaningful at the local scale. Post-project sale area improvement measures, such as snag and down wood creation, would further enhance this benefit.

A similar situation exists for the primary cavity excavators, which also rely on snags, as well as down wood. There is a greater range of snag sizes and snag densities required and decay classes used among this group of species. In general, the homogenous nature of the Upper South Fork Skokomish project stands does not provide the full range of habitat needs to enable species such as the downy woodpecker, hairy woodpecker, and red-breasted nuthatch to occur in the same area. It is expected that some species, such as red-breasted nuthatch and hairy woodpecker, may be more common in older forests and so would not be as affected by project activities, although foraging activity by hairy woodpeckers was observed in project stands, and would be disturbed during actual project operations. Downy woodpeckers tend to be more associated with deciduous forests and within riparian woodlands, habitat that would be protected by the mitigation measures and the silvicultural prescription for this project.

In summary, for pileated woodpecker and primary cavity excavators, it is expected that there may be some disturbance, particularly within units that are to be done during the breeding seasons (see writeup on owl and murrelet disturbance effects). Because these species are unlikely to be nesting within project units, the impacts should not be adverse. Habitat capability will improve over the long-term. The DecAid analysis done for the Upper South Fork Skokomish watershed concludes that there are fewer medium-large snags (≥10” dbh), that there are also fewer large snags (≥20” dbh), that there is less small-large down wood cover, and that there is less large down wood cover. The silvicultural prescriptions used with this project would

maintain all snags of all size classes unless they pose a human safety hazard. Likewise, coarse wood would not be removed and, if disturbed, would in some instances be returned to its original location. This project is expected to improve habitat conditions for users of snags and down wood on 880 acres of the watershed.

American Marten. American martens use live trees, snags, and slash piles for resting, denning and foraging. Efforts to maintain these habitat components within project units would benefit marten, and post-project enhancement activities, such as snag and down wood creation (slash piles, log pyramids) would also benefit the species. At the present time, it is uncertain if marten even exist in the watershed, therefore negative impacts are not expected and habitat would be improved in future across 880 acres.

Roosevelt Elk and Black-tailed Deer. Black-tailed deer appear to be common and abundant residents of the Upper South Fork Skokomish watershed, while Roosevelt elk are typically found only in the very lowest part of the watershed and only then at certain times of the year. In order to determine potential project effects to elk and deer, we used the Westside Elk Summer Nutrition Model, with forage presumed to be limiting, to assess the current capability of the area to support elk, and to model the project's effects on forage.

The new elk models (summer nutrition and elk habitat use) are intended to be applied across "regional" landscapes of at least 25,000 acres. For planning purposes, this may equate to watershed or subwatershed boundaries. At the regional landscape level this typically involves multiple land ownerships. For the South Fork Skokomish project we started with the Skokomish watershed boundary (66,238 acres). We then enlarged the boundary slightly to include small pieces of adjacent watersheds since several units were right on the watershed boundary. This resulted in a "regional" analysis area of approximately 69,691 acres. However, a subset of the results from the regional landscape can also be summarized for the local landscape of 2,000 acres or larger, nested within the regional landscape. For this planning effort, the proposed thinning units were buffered by 1km to include potential effects of adjacent forage resources and roads and to provide a relatively meaningful scale for more localized effects. This resulted in an area of approximately 14,713 acres, which is large enough to include the average home range size reported for elk in two studies on the Olympic Peninsula (Hutchins 2006, Storlie 2006).

The DDE (dietary digestible energy) values output from the model are expressed in kilo-calories of energy per gram. "Poor" refers to nutrition levels that would markedly affect reproduction and reduce survival probability. "Marginal" pertains to nutrition levels that may affect nutrition and survival through enhanced probability of winter death, delayed breeding, delayed puberty, etc. "Good" refers to autumn-summer nutrition levels that may exert minor limitations on performance, but the small magnitude of the limitations may not have any practical effects. "Excellent" summer-autumn nutritional status indicates settings in which there are virtually no nutritional limitations during that period, and therefore approximate the maximum for elk (Boyd et al. 2011).

Running the model at the two scales for initial conditions (essentially the "no-action" alternative) yielded interesting but not entirely surprising results. At both the regional and local scales the majority of the area falls within the lower quality nutrition categories, although there are slightly higher values overall for the regional scale. Looking at the distribution, some of the difference can be attributed to the state and private lands in the Lower South Fork Skokomish subwatershed. There are also higher DDE values shown for the higher elevation or southerly aspect areas of the Upper South Fork Skokomish subwatershed, likely driven at least in part by lower canopy cover values in those areas. The central portion of the regional analysis area, where the local scale analysis was centered around proposed thinning units, is where a large proportion of the landscape was displayed in the lowest DDE classes. Our current understanding of elk use patterns in the analysis area bear this out. The radio-collared elk primarily use the Lower South Fork Skokomish subwatershed where some of the higher DDE values occur. Likewise, there have also been reports of elk using the higher elevations in the upper end of the Upper South Fork Skokomish subwatershed. Those elk likely originate from Olympic National Park.

Interestingly, the model shows that the Upper South Fork Skokomish subwatershed area includes more of the highest quality foraging ("excellent") habitat than the lower subwatershed, although it also includes a greater proportion of the lowest quality habitat.

At the regional scale, model results that incorporate proposed commercial thinning show no changes in DDE from the current conditions. This is not unexpected given the large scale of the analysis area and the small amount of area receiving the commercial thinning treatment. Model results show only a very slight improvement in nutritional values at the local scale after treatment. This does not imply that there will be no benefits to elk as a result of the proposed action. Values are likely to increase a small amount, and in an area with overall poor forage conditions to begin with, any improvement is a benefit. Of the 880 acres proposed for thinning, 819 acres are within winter range habitat, and 61 acres are within summer range. In the Lower South Fork Skokomish subwatershed, ongoing timber harvest on state and private lands contributes to greater forage biomass and higher DDE values. In large part that may explain current elk use patterns in that area. However, model parameters also suggest that practices that remove hardwoods, create large openings with little nearby cover, and increase public access during the summer period – all three of which are components of regeneration (clearcut) timber harvest – would reduce the potential benefits to elk.

In summary, the summer nutrition and elk habitat use models suggest a slight benefit to elk from the proposed action. It is reasonable to assume that these same benefits would also apply to black-tailed deer. Alternative B also includes 250 acres of pre-commercial young stand thinning proposed as post-project improvement activities, which would have a benefit on future forage areas in the vicinity of the commercially thinned stands.

Apart from enhancing habitat, direct disturbance from project activities would have the biggest impact on both deer and elk. This effect would be temporary, and would cease as operations were completed. Because all temporary roads constructed and reconstructed would be closed following completion of project activities, and several additional road segments are proposed

for decommissioning with this project (see table 2.7), ultimately the project would contribute to lower road densities. Seasonally closed gates in the Upper South Fork Skokomish watershed would continue to be closed from October 1 through April 30 to provide escapement for animals during the fall and winter seasons.

Cumulative Effects

Historic timber harvest and road building have had the greatest impact on management indicator species. Commercial thinning and pre-commercial thinning in the project area in the past likely benefited elk and deer. Increasing the complexity of the proposed Upper South Fork Skokomish stands by thinning would benefit all MIS species by accelerating the development of late-successional habitats. Benefits to deer and elk would also include forage enhancement and decreased road density.

Management Indicator Species Determination

Approximately 880 acres of presently homogenous second-growth stands would be improved as future habitat for MIS species. Increasingly large trees and snags will benefit cavity users, such as various bird species and marten, and in the very long term may also benefit bald eagles by providing future nest trees. Project activities to improve habitat for anadromous fish would also benefit eagles. The commercial thinning work specifically would benefit foraging habitat for deer and elk.

Environmental Consequences for Neotropical Migratory Birds

Alternative A – No Action Alternative

Direct and Indirect Effects

There would not be any direct effects to any of the forest landbird species with the No Action alternative. Many forest birds, particularly during the breeding periods, are associated with hardwood and mixed conifer-hardwood forests. The no-action alternative would maintain these habitats in the current condition and would result in no negative effects to those particular species.

Cumulative Effects

Previous habitat removal, road building, and human disturbance have had the greatest impact on forest landbirds. A “No Action” alternative would not add to the historic impacts. There would be no additional impacts, beyond what has occurred previously.

Alternative B – Proposed Action

Direct and Indirect Effects

Responses of birds to thinning would vary with species of bird, thinning type and intensity, season, and the timescale over which the effects were examined. Wilson et al. (2004) suggested that second-growth management activities may create trade-offs for some species in terms of the disturbance effects to the understory versus the value of opening the canopy, along with longer term benefits as both the understory and overstory respond to silvicultural treatment. Previous studies in thinning areas have shown that some species will increase in numbers, some will decrease, and some will have negligible changes in numbers. For example, Hagar and

Howlin (2001) and Hayes (2001) both noted positive responses in species such as the western tanager (*Piranga ludoviciana*) and dark-eyed junco (*Junco hyemalis*), among others, whereas negative responses were noted for pacific slope flycatcher (*Empidonax difficilis*), hermit warbler, and Swainson's thrush (*Catharus ustulatus*), all of which are known or presumed (based on range and habitat preference) to occur in the project area. For species such as the pacific-slope flycatcher or brown creeper (*Certhia americana*) that are associated with old-growth or late-successional forest, the net benefit over time would be expected to be positive. Additionally, Haveri and Carey (2000) found that thinning produced stands that supported more winter birds than legacy retention alone (in second-growth stands) and that variable density thinning was a valuable adjunct to legacy retention, both of which are proposed under this alternative. It should be noted though that Hagar et al. (1996) found no statistically significant differences in winter bird densities between thinned and unthinned stands and only marginally greater species richness in thinned stands. All such changes would be indirect effects from the habitat manipulation. There may be some direct effects in terms of mortality of nests or chicks and possibly adults from harvest operations. Approximately 138 acres of project stands are proposed to be thinned during the owl and murrelet early breeding seasons, which also largely correspond to songbird breeding seasons. It is likely this mortality would be minimal (particularly compared to how much habitat is not being impacted in the watershed), except perhaps around temporary road construction due to impacts to ground nesters such as the dark-eyed junco. Indirect effects of temporary road construction in riparian reserves (0.76 miles) would likely have greater effects on this group due to the overall importance of riparian habitats for migratory birds. Likewise, increases in predator numbers or hunting efficiency can potentially offset positive impacts of thinning.

Hardwood clumps and individual trees would be protected under this alternative, except for individual trees needing to be removed for roads, yarding corridors, or other safety or operational concerns. It is expected that number would be relatively small. The planting of hardwoods along decommissioned temporary roads and landings would be of benefit to these species. The overall retention or enhancement of hardwood species would be particularly relevant and positive for neotropical migrants. For example, species such as western tanager may respond well to thinning, but are also influenced by hardwood and snag components (Hagar et al. 1996). Hardwood retention or enhancement is consistent with the information and emphasis given in both watershed analyses. As mentioned previously in various sections, effects to snags and down wood from any of the alternatives would likely be minimal, with longer term benefits expected through the growth and eventual recruitment of larger size-classes.

Hagar et al. (1996) suggested that some patches be left unthinned to provide for competition-related (self-thinning) mortality of trees for certain species, and also to provide for species such as the pacific-slope flycatcher and golden-crowned kinglet. The unthinned "skip" areas proposed in all project units is consistent with this recommendation.

In summary, direct and indirect impacts of the proposed action to neotropical migratory birds would vary across species, but are expected to be very minor. The potential exists for damage to nests and/or the mortality of individual birds as a direct result of project activities during the

breeding season. However, no habitat would be lost, and all species would benefit from the increase in structural diversity that is the objective of the thinning.

Cumulative Effects

In recent history, through the mid-1990s, road-building and timber harvest were the dominant management activities on National Forest System (NFS) Lands in the planning area. These activities removed forested habitat, fragmented the remaining habitat patches, and resulted in relatively homogenous second-growth stands, particularly in the lower portions of the planning area, where many of the proposed thinning stands are located. With the cessation of clearcut harvest on NFS lands, and current practices associated with thinning prescriptions such as hardwood retention, skips, gaps, and protection of riparian areas and wetlands, the quality and diversity of forested habitat in the watershed are recovering. The cumulative effect of the proposed action with these past actions would be to contribute to this recovery.

It is likely that conifer and hardwood habitat will continue to be harvested on non-federal ownerships within and south of the project boundary, limiting the potential of neotropical migrant bird species requiring older forests to occur on private lands, and placing more importance on federal lands. Species requiring younger or more fragmented forest would likely continue to occur on state and private lands.

Neotropical Migratory Birds Determination

For the various species of neotropical migratory birds inhabiting the project area, effects would be variable, that is, some species may increase in numbers, some may decrease, and some would exhibit no change. For those negatively affected by thinning activities, the amount of impact across the watershed would be minimal (880 acres, or 2 percent of the 38,500-acre watershed). Implementation of the proposed action would not contribute toward a need for conservation action for any of these species.

Environmental Consequences for U.S. Fish & Wildlife Species of Concern

Alternative A – No Action Alternative

Direct and Indirect Effects

There would be no direct effects to any of the Species of Concern for which there is suitable habitat in the project area. Accelerated development of late-successional characteristics, including large trees for goshawk nesting along with roosting habitat for bat species such as the long-eared myotis and long-legged myotis, would not occur and would comprise the indirect impact of no action. Indirect effects, in terms of delayed development of habitat, would possibly affect the flycatcher, with its preference for uneven canopies, interspersed openings, and dead/partially dead trees and overall habitat heterogeneity compared to what are relatively more homogenous stands in their present state. Most goshawk nests have been found in mature or late-seral forests. For goshawks, a species that prefer forest floors with little cover for hunting, the current conditions in many of these stands – dense canopies with largely open understories – are more suitable for foraging than nesting. There would be no direct effects on the Cascades frog, tailed frog or western toad with the No Action Alternative. However, ongoing effects to aquatic habitat in terms of chronic sediment delivery associated

with roads (discussed in the Aquatic Habitat and Fisheries section), could still potentially negatively impact amphibians during their time spent in aquatic environments.

Cumulative Effects

The effects of previous harvest, road building, and human disturbance – creating large tracts of homogenous habitat with few nesting/roosting structures – have had the greatest impact on the species of concern, with water quality effects to amphibians as well. A "No Action" alternative would not add to the historic impacts.

Alternative B – Proposed Action

Direct and Indirect Effects

The silvicultural prescription across 880 acres of late-successional habitat development and project design criteria for this project would protect and retain the larger trees and legacy snags preferred for potential roosting by bats, nesting by goshawks, perching by olive-sided flycatchers, and nesting and foraging by potential goshawk prey species. The prescription also requires protection of vine maple unless cutting it is necessary for yarding. This would serve to minimize effects to insects that many bat species prey upon due to the importance of vine maple to the forest lepidopteran communities. Thinning would likely benefit bats in the long term as vine maple and other understory shrubs that support lepidopteran species respond to more open understory conditions post-treatment. The vine maple provisions would also serve to reduce effects to and eventually benefit small mammal prey (goshawk) that feed on vine maple seeds.

The trees harvested probably do not currently provide roosting potential for the long-eared myotis and long-legged myotis bat species. The most likely roosts used by these species (old-growth trees) would not be affected with this project, and legacy trees in the units would be protected. There could be minor, short-term disturbance effects to any bats roosting in residual trees or legacy snags in stands to be thinned (or in adjacent old-growth), due to harvest activities, particularly in the stands that may be harvested during the owl and murrelet breeding seasons, which is also the breeding and rearing time for the bats. Longer-term effects would more likely be positive given that thinning would promote the growth of larger trees for roosting. Implementing project activities would not contribute toward a need for conservation action for the long-eared myotis and long-legged myotis.

Project design criteria would protect any active goshawk nests located in the project area. Goshawks would not likely be actively nesting within areas to be thinned (except possibly in remnant old-growth trees, which would be protected by buffers). They would most likely be nesting in adjacent late-successional "suitable habitat." Seasonal restrictions designed to prevent disturbance to nesting spotted owls and murrelets in suitable habitat on the majority of the proposed thinning stands would overlap with most of the March 1 through 30 September nesting season restrictions on activities that are recommended for nesting goshawks (Desimone and Hays 2004).

Recruitment and retention of large trees, along with overall development of structural diversity would benefit goshawks at the landscape scale and is generally consistent with management

recommendations (Desimone and Hays 2004, Finn et al 2002). In the short term, reductions in canopy cover and resulting development of understory may not be in line with recommendations outlined by Desimone and Hays (2004) and Finn et al. (2002) which are intended to ensure foraging access to goshawk prey. Wiens et al. (2006) also stressed the importance of forest management prescriptions that support an abundant prey population, while maintaining access to that prey in nesting areas, in order to increase juvenile goshawk survival. Retention of dominant overstory trees and thinning from below to maintain and develop deep canopies; protection of coarse woody debris and snags; and development of mature and late-successional forest characteristics at the large scale are aspects of the project that are consistent with recommendations by these same authors. Overall, enhancement of structural diversity would benefit goshawk prey population abundance. The availability of prey in thinned units would likely improve over time as canopy closure exceeds 70% and understory cover levels off. Availability in adjacent unthinned forest would not likely change. In short, while there might be minor short-term effects, overall long-term term effects to goshawks would be beneficial. Implementing any of these alternatives would not contribute toward a need for conservation action for the northern goshawk.

Variable density thinning would be expected to benefit olive-sided flycatchers in proposed units by improving overall heterogeneity and accelerating the development of late-successional forest conditions. Snag retention practices would help to retain these structural features valuable for perching and singing. Altman and Hagar (2007) recommend open and patchy areas with scattered trees areas within thinned stands to benefit olive-sided flycatchers. This would be emulated, though likely at a much smaller scale, by the gaps and heavy thin areas prescribed under this alternative. Development of late-successional habitat adjacent to openings, in contrast to many other species, would likely benefit olive-sided flycatchers, though they still could be susceptible to nest predation concerns mentioned for other avian species. The limited potential for direct mortality from thinning activities would be similar to what was described under the section on Neotropical Migratory Birds. Implementing this alternative would not contribute toward a need for conservation action for the olive-sided flycatcher.

Thinning the proposed stands, as well as the construction of temporary roads, may have a short-term, negative effect on western toads, if individuals are in the forested areas. This effect could include some direct mortality due to road traffic but would be minimal in terms of effects upon the entire population. Terrestrial (adult) Cascades frogs and tailed frogs would be unlikely to be found outside of areas immediately adjacent to waterbodies, which would be protected by no-cut riparian buffers. There would be a small potential for impact to these adults from proposed road building through riparian areas. With all three of these amphibian species, effects to aquatic environments are generally viewed as the greater threat. As mentioned previously, effects to aquatic habitat through sediment delivery are expected to be minimal under this alternative (See Aquatic Habitat and Fisheries section). Amphibians in the aquatic environment may experience minimal, short-term effects due to changes in water quality. Additionally, the mobility of these species could be impacted by culverts at temporary road crossings during project implementation. This impact would cease, and pre-project conditions would return after the roads are decommissioned. Implementing this alternative would not

contribute toward a need for conservation action for the Cascades frog, tailed frog, or Western toad.

Cumulative Effects

Continued harvest on state and private lands east of the project area can be reasonably expected, and would mean continued lack of more diverse mature or old-growth forest for nesting and roosting by northern goshawk, long-legged myotis and long-eared myotis, and less heterogeneity than preferred by the olive-sided flycatcher, though it would entail the edge components that olive-sided flycatchers utilize. Thinning approximately 880 acres, however, would add to the acres previously thinned within the project area boundary (See Silviculture and Forest Stand Development section) and would promote the growth of large trees suitable for nesting and roosting by these species. According to the Aquatic Habitat and Fisheries section, Aquatic Conservation Strategy objectives would still be achieved, therefore effects to amphibians are expected to be minimal. Previous aerial fertilization on private lands may have affected amphibian species, though to what degree is not known. The cumulative effect of this project would be some improvement in habitat conditions compared to current conditions.

Species of Concern Determination

Due to a lack of required habitat, the proposed project activities would have no effect on the Makah copper butterfly.

For the other species of concern discussed above, implementation of the proposed action would not contribute toward a need for conservation action.

WATER QUALITY AND HYDROLOGIC CHANGE

Introduction

This section summarizes key water quality and hydrologic change factors likely to be impacted by thinning and road activities proposed for the Upper South Fork Skokomish Vegetation Management Project. The water quality assessment focuses on sedimentation and turbidity associated with erosion generated from project activities, and on stream temperatures related to harvest effects on riparian shade. The hydrologic change assessment addresses the changes in hydrologic processes related to thinning and road activities.

Analysis Methods

Information from multiple sources was used to characterize the affected environment and to analyze potential project effects. In addition to a review of current scientific literature, some of the resources for this analysis include:

- 1995 South Fork Skokomish Watershed Analysis (USDA 1995)
- 1997 South Fork Skokomish Watershed Analysis (Simpson Timber Company and Washington Department of Natural Resources 1997)
- 2004 South Fork Skokomish Watershed Restoration Summary (USDA 2004)
- 2012 Memorandum of Understanding (MOU) between Washington State Department of Fish and Wildlife and USDA Forest Service Pacific Northwest Region: Hydraulic Projects Conducted by the US Forest Service
- 2000 Memorandum of Agreement (MOA) between USDA Forest Service Region 6 and Washington State Department of Ecology for Meeting Responsibilities under Federal and State Water Quality Laws
- Washington State water quality standards (WAC 173-201A)
- Washington Forest Practices Board forest practices (WAC 224-22 and WAC 224-30)
- Olympic National Forest stream temperature data (1999-2001)

This analysis relies heavily on Geographic Information System (GIS) data and analysis. GIS data was used to guide field reconnaissance, summarize the elements of the affected environment, and to summarize metrics used in the environmental effects analysis. Field reconnaissance revealed that some aquatic features were not represented in available data layers. Those data layers were updated with field survey information about the location and extent of perennial and intermittent streams and other aquatic features, including seeps, springs and wet areas.

Field visits were made to several proposed project units and existing or proposed roads, with emphasis on areas likely to have the greatest impact to aquatic resources. Field reconnaissance was intended to verify the location and condition of aquatic resources within the proposed commercial thin stands, document aquatic features not identified on existing project maps, review the proposed or existing roads to be used to implement project activities, and make observations about effects of historic management actions on aquatic resources. Field visits also included interdisciplinary team review of selected units with specific aquatic resource concerns.

Affected Environment

The project planning area encompasses all 36,750 acres of National Forest System lands in the Upper South Fork Skokomish River subwatershed. This subwatershed is partitioned into nine smaller catchments: Brown Creek, Cedar Creek, Church Creek, Lebar Creek, Middle Fork Skokomish River, Pine Creek, Rule Creek, Steel Creek and Upper South Fork Skokomish River. These drainage areas range in size from 1.8 to 14.4 square miles, as summarized in table Hydro-1 below.

Table Hydro-1. Summary of planning area by subwatershed

HUC ID (Historical HUC7 ID)	Subwatershed Name (Historical HUC7 Name)	Acres	Square Miles
17110017010409	Brown Creek	5,106	8.0
17110017010407	Cedar Creek	3,607	5.6
17110017010404	Church Creek	2,502	3.9
17110017010408	Lebar Creek	6,278	9.8
17110017010401	Upper South Fork Skokomish River	9,246	14.4
17110017010406	Middle South Fork Skokomish River	6,859	10.7
17110017010405	Pine Creek	2,413	3.8
17110017010402	Rule Creek	1,407	2.2
17110017010403	Steel Creek	1,126	1.8

Aquatic Resources

This planning area includes roughly 316 miles of perennial, intermittent and ephemeral streams, and numerous seeps, springs, and wet areas that may be potentially affected by project activities. Stream reaches include: the South Fork Skokomish River mainstem from Rivermile (RM) 14.2 to 23.5; major tributaries segments including Brown Creek from RM 0 to 2.7, LeBar Creek from RM 0 to 1.5, Cedar Creek from RM 0 to 3, Pine Creek from RM 0 to 0.8, and Church Creek from RM 0 to 0.7. In addition, several smaller perennial, intermittent and ephemeral are tributaries to the mainstem and the major tributaries have the potential to be affected. Seeps, springs, and wet areas have varied distribution throughout the proposed planning area.

Climate

The maritime climate of the South Fork Skokomish Watershed is characterized by relatively dry cool summers and wet mild winters. The proximity of this watershed to the Pacific Coast subjects it to strong maritime influences. Seasonal changes in weather result from shifts in the pathways of dominant westerly trade winds. During the summer, fewer wet fronts off the Pacific move across the land resulting in more solar radiation reaching the forests and higher air temperatures during July and August. The wet season begins in the fall and reaches a peak during the winter months of November, December, and January. Major storms that occur in the fall and winter most often approach the Olympic Peninsula from the Pacific Ocean following a southwesterly to northeasterly pattern.

Average annual precipitation varies from about 90 inches in the southern portion of the watershed to over 200 inches at higher elevations. Almost 90 percent of the average annual precipitation falls between mid-September and May 1 (Harr 1981).

Snowfall in the watershed typically occurs during the months of November through March, with the greatest amounts falling in January and February. Snow accumulation is uncommon in most years below the 1,000 foot elevation. In general, snow accumulates above the 2,500 foot elevation, and a snow pack persists above this elevation through late spring. There is rarely any snow pack remaining in the watershed by August. Snow and rain are common between 1,000 and 2,500 feet. Generally shallow snow packs (less than 15 inches deep) accumulate and melt quickly several times each winter as alternating cold fronts and warm fronts transit the area (Harr 1981).

Streamflows and Floods

Stream flow runoff in the South Fork Skokomish watershed closely mimics seasonal precipitation patterns, dependent in part upon elevation of the basin and the degree of snow pack influence. Stream levels begin to decrease in late spring or early summer as precipitation and snowmelt subside, with lowest streamflow levels occurring in August or September. Highest flows occur in December through February corresponding to peak in precipitation patterns.

Floods are a common natural disturbance within the South Fork Skokomish watershed and generally occur in the fall and winter as the result of prolonged rainstorms. These floods may be augmented by water from snowmelt if rain falls on snow. Rain-on-snow storm events can be a predominant source of peak flows and typically occur during the months of October through May.

Records for the United States Geological Survey gauge Skokomish River at US Highway 101 for Water Years 1934, and 1944 through 2002, show a high distribution of peak annual flows in recent years. Data indicate that 7 of the 10 largest events during this 60-year record occurred between 1991 and 2002 (USDA 2004).

Past Management

Timber harvest activities associated with commercial timber production became the dominant land use within the entire South Fork Skokomish watershed in the late 1920s. Between the late 1920s and early 1980s, approximately 60 percent of the entire South Fork Skokomish watershed (Lower and Upper subwatersheds combined) was logged by clearcut harvest methods. Approximately 41 percent (15,089 acres) of the Upper South Fork Skokomish subwatershed, the planning area for the Upper South Fork Skokomish Vegetation Management Project, was clearcut harvested.

Road development in the watershed related closely to the technology used to yard and haul logs during timber harvest activities. By the mid-1990s, Forest Service system roads within the entire South Fork Skokomish watershed totaled over 325 miles, and overall road density was around 3.6 miles per square mile (USDA 2004). Within the Upper South Fork Skokomish

subwatershed, the historic level of Forest Service system roads totaled around 188 miles with a road density of 3.3 miles per square mile.

Sedimentation

Background

According to Burroughs (1991), observations and experience of forest land managers and technical specialists nationwide indicate that forest roads are the greatest single source of sediment delivered to receiving streams. Probably the greatest volume of sediment produced from Alaska to California and the northern and central Rocky Mountains comes from mass erosion associated with forest road construction and maintenance. A lesser volume comes from surface erosion on the forest road prism, and a much smaller volume from landslides and surface erosion on timber harvest areas.

The effects of forest roads on geomorphic and hydrologic processes range from chronic and long-term contribution of fine sediment into streams to catastrophic effects associated with mass failures of road fill material during large storms. Primary mechanisms by which roads affect geomorphic processes include accelerating erosion from the road surface and prism itself by both mass wasting and surface erosion processes; directly affecting channel structure and geometry; altering surface flow paths, leading to diversion or extension of channels onto previously unchannelized portions of the landscape; and causing interactions among water, sediment, and woody debris at engineered road-stream crossings (USDA 2001).

The greatest effects of roads on erosion rates in steep forest lands prone to land sliding are from increased rates of mass soil movement following road building. Mass soil movements influenced by roads include debris slides, deep-seated slumps and earth flows, and debris flows. Studies, including one conducted on Washington (Reid 1981), show that areas with roads have accelerated erosion rates due to landslides compared to unmanaged forest areas. Swanson and Dryness (1975) documented increased frequency of landslides in roaded and clearcut areas in the western Cascades – up to 30 times the rates in unmanaged forests in the Pacific Northwest following the major flood of 1964.

Stream crossings are frequent locations of road-related failures during storm events. Failures of road stream crossings can cause large inputs of sediment to streams when culvert hydraulic capacity is exceeded or the culvert inlet is plugged and water overtops the road fill. This often results in erosion of the crossing fill, diversion of streamflow onto the road surface or inboard ditch, or both.

Surface erosion from road surfaces, cut banks, and ditches represent a substantial source of sediment input to streams. Surface erosion typically occurs on forest roads because their surfaces, cutslopes, fillslopes and associated drainage structures are often composed of erodible material, and are exposed to rainfall and concentrated runoff. Surface erosion varies greatly influenced in part by the erodibility of the exposed surface; the slope of the exposed surface, and the area of exposed surface that generates and concentrates runoff (USDA 2001).

Road Construction, Maintenance, and Haul

Surface erosion and associated sedimentation are sensitive to road construction and maintenance practices. Increased sediment delivery to streams following road construction is well documented in research literature for the Pacific Northwest (Bilby et al. 1989, Anderson and Potts 1987, Sullivan and Duncan 1981). Sediment delivery rates are highest in the first years after building and are closely correlated to traffic volume on unpaved roads (Reid and Dunne 1984, Sullivan and Duncan 1981). Clinton and Vose (2003) assessed sediment movement from four different road surface types and concluded the variability in results within and among surface types is related to levels of maintenance and drainage type. Results for movement of total suspended solids for surface types showed paved roads had the least amount of movement, followed in order by improved gravel, routine gravel, and unimproved gravel.

Clinton and Vose (2003) found that properly installed structures and maintenance practices substantially reduced sediment movement downslope of the road. The distance sediment traveled below a road surface was related to the type of drainage system provided. Road drainage presents the least amount of risk for sedimentation when runoff outlets are located at the maximum distance from perennial or ephemeral streams. Ensuring that drainage occurs at locations not adjacent to perennial or ephemeral water courses, and that the interval of drainage features is frequent enough to keep water volumes to a minimum, is critical to reducing sedimentation risk.

Road Density

Road density is commonly used as an indicator of potential sedimentation from surface erosion in a watershed. Landscape scale environmental assessment results for the Interior Columbia River Basin (USDA 2001) showed strong fish populations were more frequently found in areas with low rather than high road densities. Lee et al. (1997) concluded that increased road densities and their attendant effects were associated with declines in the status of four non-anadromous salmonid species.

Drainage Density

Highly dissected landscapes can naturally contribute large amounts of sediment to streams. Road networks that transect highly dissected landscapes contribute to altered hydrologic processes. Drainage density can be an indicator for considering the potential for road effects on hydrologic processes. Hydrologic and geomorphic consequences of roads result from one or more of the following primary effects roads have on water: they intercept rainfall directly on the roads surface and road cut banks and intercept subsurface water moving down the hillslope; they concentrate flow, either on the surface or in an adjacent ditch or channel; they divert or reroute water from flow paths that it would take were the road not present (USDA 2001).

Conditions in the Upper South Fork Skokomish

Surface Erosion, Mass Wasting, and Road Failures

Management activities in the South Fork Skokomish watershed have resulted in substantial contribution of sediment into aquatic habitats from surface erosion, mass wasting, and road

failures – including those at stream crossings. The quantity of sediment delivered to aquatic habitats is not quantified.

Intensive timber harvest and road construction in the decades leading up to the 1990's, within the South Fork Skokomish watershed led to extensive management related surface erosion and mass wasting incidents. Inventories conducted in the 1990s provide information on historic erosion and mass wasting activities. Watershed Improvement Needs inventory results summarized in the 1995 South Fork Skokomish Watershed Analysis determined approximately 2,500 erosion sites existed within the watershed, ranging in size from one quarter to five acres. Approximately 95 percent were associated surface erosion sites and the remaining five percent were mass wasting features. Of the total, ninety percent were associated with roads and the other ten percent were either stream bank or in-unit (harvest unit) slope failures (USDA 1995).

Major flood events over the last few decades have caused extensive damage to Forest Service roads within the South Fork Skokomish watershed, including numerous road-stream crossing and fillslope failures (USDA 2004). Some of the most recent resulted from an intense winter rainstorm in 2007. Typical mechanisms associated with crossing failures include debris flow and plugging of culvert inlets by sediment or woody debris, and often both. At several stream crossings, loss of road fill resulted from dam break flood processes, saturation of the fill, or progressive headward cutting of the downstream fillslope. At some plugged crossings, stream flow was diverted out of the natural channel and rerouted down the ditch or road prism, resulting in a series of cascading fillslope or ditch relief culvert failures. Channel scour associated with many of these events undercut the toe of channel sideslopes and contributed substantial sediment to the channel network.

Road Density

Road decommissioning within the upper South Fork Skokomish watershed over the last two decades has reduced historic road densities by over 40 percent. Historic road density on National Forest System lands in the Upper South Fork Skokomish subwatershed was 3.3 miles per square mile (188 road miles within the 57.4 square mile subwatershed) prior to decommissioning efforts that began in the early 1990s. Current road density within the planning area is 1.25 miles per square mile. Road densities will be further reduced to approximately 1.21 miles per square mile by the end of 2012.

Road information for the nine subwatersheds within the Upper South Fork Skokomish planning area is displayed in table Hydro-2. Current road densities for the subwatersheds range from 0 to 2.7 miles per square mile. Subwatersheds with the highest densities include Cedar Creek, Middle South Fork Skokomish River, and Lebar Creek. This table takes into account planned road decommissioning scheduled through 2012.

Table Hydro-2. Road density summary by drainage (using historical HUC7 ID)

HUC ID (Historical HUC7)	Drainage name (Historical HUC7 name)	Acres[1]	Square miles[1]	Road miles	Road density (miles per square mile)
17110017010409	Brown Creek	5,106	8.0	6.8	0.85

Table Hydro-2. Road density summary by drainage (using historical HUC7 ID)					
HUC ID (Historical HUC7)	**Drainage name (Historical HUC7 name)**	**Acres[1]**	**Square miles[1]**	**Road miles**	**Road density (miles per square mile)**
17110017010407	Cedar Creek	3,607	5.6	15.2	2.70
17110017010404	Church Creek	2,502	3.9	2.3	0.59
17110017010408	Lebar Creek	6,278	9.8	14.3	1.46
17110017010401	Upper South Fork Skokomish River	9,246	14.4	7.3	0.51
17110017010406	Middle South Fork Skokomish River	6,859	10.7	22.2	2.07
17110017010405	Pine Creek	2,413	3.8	1.2	0.32
17110017010402	Rule Creek	1,407	2.2	0.0	0.00
17110017010403	Steel Creek	1,126	1.8	0.3	0.17

1 *Note – values are GIS-derived estimates. Rounding errors make these drainage values total more than the 36,750 acres (57.4 square miles) represented by the planning area. This does not appreciably affect the road density values in the left-hand column.*

Stream Density

The Upper South Fork Skokomish subwatershed is a relatively highly dissected landscape, with overall stream density measuring around 5.8 miles per square mile. This figure is based on stream miles derived from Forest Service GIS layers that show a total of 315.9 miles of stream for the 57.4 square mile area, and includes both perennial and intermittent streams and artificial flow paths. Intermittent streams total 172.2 miles and represent 55 percent of the stream network. Perennial streams total 134.7 miles and represent 43 percent of the network. Table Hydro-3 provides stream density summary information.

Table Hydro-3. Stream density summary for Upper South Fork Skokomish planning area		
Stream type	**Miles**	**Miles per square mile**
Intermittent	172.2	3.1
Perennial	134.7	2.5
Artificial Path	9.0	0.2
Total for Analysis Area	*315.9*	*5.8*

Stream length and density information for the nine drainage areas within the Upper South Fork Skokomish planning area is displayed in Table Hydro-4. Stream densities for the drainages range from 4.5 to 6.5 miles per square mile. Drainages with the highest densities include Brown Creek, Lebar Creek and Middle South Fork Skokomish River.

Table Hydro-4. Stream density by drainage				
HUC ID (Historical HUC7 ID)	**Drainage name (Historical HUC7 name)**	**Square miles**	**Stream miles**	**Stream density (miles per square mile)**
17110017010409	Brown Creek	8.0	52.2	6.5
17110017010407	Cedar Creek	5.6	27.8	4.9
17110017010404	Church Creek	3.9	16.5	4.2
17110017010408	Lebar Creek	9.8	54.2	5.5

Table Hydro-4. Stream density by drainage				
HUC ID (Historical HUC7 ID)	**Drainage name (Historical HUC7 name)**	**Square miles**	**Stream miles**	**Stream density (miles per square mile)**
17110017010401	Upper South Fork Skokomish River	14.4	70.6	4.9
17110017010406	Middle South Fork Skokomish River	10.7	58.5	5.5
17110017010405	Pine Creek	3.8	17.0	4.5
17110017010402	Rule Creek	2.2	10.2	4.6
17110017010403	Steel Creek	1.8	8.9	5.1

Washington State water quality standard requirements

The water quality parameters most likely to be affected by this project are temperature and turbidity. The information below summarizes designated water uses for waters within the planning area.

WAC 173-201A-200 through 173-201A-260 describes the designated water uses and criteria. Where multiple criteria for the same water quality parameter area assigned to a water body to protect different uses, the most stringent criteria for each parameter is to be applied. Use designations for water bodies are listed in WAC 173-201A-600 and 173-201A-602. According to Table 602 in WAC 173-201A-602, all surface waters within the South Fork Skokomish River from confluence of Brown Creek are to be protected for the designated uses of: char spawning and rearing; extraordinary primary contact recreation; domestic, industrial, and agricultural water supply; stock watering; wildlife habitat; fish harvesting; commerce and navigation; boating and aesthetic values.

According to WAC 173-201A-200, aquatic life uses are designated based on the presence of, or intent to provide protection for, key uses. It is required that all indigenous fish species and non-fish aquatic species be protected in water of the state in addition to the key species described. The category for aquatic life uses pertaining to the South Fork Skokomish River and tributaries within the planning area is:

> *(i) Char spawning and rearing. The key identifying characteristics of this use are spawning or early juvenile rearing by native char (bull trout and Dolly Varden), or use by other aquatic species similarly dependent on such cold water. Other common characteristic aquatic life uses for waters in this category include summer foraging and migration of native char; and spawning, rearing, and migration by other salmonid species.*

Water quality criteria for aquatic life uses include: toxic, radioactive, and deleterious materials; aesthetic values; temperature; dissolved oxygen; turbidity; total dissolved gas; and pH. WAC 173-201A-300 through 173-201A-330 covers the antidegradation policy. This policy applies three levels of protection for surface waters of the state.

Turbidity

Background

It is reasonable to assume that activities that that generate suspended sediment within this project would likely result in similar trends of increased turbidity. Turbidity refers to the amount of light scattered or absorbed by a fluid, an optical property of the fluid, and is measured in nephelometric turbidity units or NTUs. In streams, turbidity is typically influenced by the presence of suspended particles of silt and clay, but other contributions can include finely divided organic matter, colored organic compounds, plankton and microorganisms. The relative proportion of size, weight, and refractive properties of these materials varies and therefore, a correlation of turbidity with weight concentration of suspended matter cannot be assumed (MacDonald et al. 1991).

Washington State water quality critera for turbidity

Washington State water quality standards (WAC 173-201A-200) set maximum turbidity criteria for beneficial uses based on each aquatic life use categories. Turbidity for Char Spawning and Rearing designated waters shall not exceed 5 NTU over background when the background is 50 NTU or less, or a 10 percent increase in turbidity when the background is more than 50 NTU. These turbidity criteria can be modified without specific written authorization from Ecology to allow a temporary area of mixing, subject to certain constraints, during and immediately after necessary in-water construction activities that result in disturbance of in-place sediments.

Stream Temperature

Background

The amount of heat from solar radiation that reaches a stream is controlled in part by streamside riparian vegetation which provides shade, and is the focus of this analysis. Several other factors that influence temperature include those that affect the physical stream course or quantity of flow, and will not be discussed here. A number of Total Maximum Daily Loads (TMDL) developed for temperature impaired waters for watersheds in Western Washington determined shading a stream from direct sunlight was the most influential factor on stream temperature. Two such studies include the Upper Humptulips and Wind River areas (Peredney et al. 2001; Pelletier 2002).

Riparian Conditions

Previous management activities within riparian areas in parts of the Upper South Fork Skokomish subwatershed have reduced stream shade. It is assumed this decrease in shade led to an increased the amount of solar radiation reaching the stream, and elevated stream temperatures. The degree to which stream temperature has been affected by reduced stream shade in the subwatershed is not quantified. An assessment done in 1997 reflects the impacts of past forest practices. Though it does not reflect current conditions, it is brought forward to show historic characteristics of riparian stand conditions. Given the growth in vegetation and cessation of clearcut harvest practices, it is reasonable to assume that recovery of riparian stands has occurred in the 14 year period since following the 1997 assessment on NFS lands.

Assessment results within the Riparian Function Module of the 1997 South Fork Skokomish Watershed Analysis, which covered both the Upper and Lower subwatersheds, determined shade problems related to riparian stand conditions, following the 1995 state manual watershed analysis procedures (Washington Forest Practices Board 1995). Existing (mid-1990s) stream canopy was determined through aerial photograph interpretation. Shade values established for applicable areas for applicable areas within the entire South Fork Skokomish watershed, totaling 132.8 miles of channel. Map units were numbered and target shade levels were listed as "At" or "Below" target.

The Riparian Function Module analyst concluded that, based on review of 1929 aerial photographs, historically 90 to 95 percent of the riparian areas examined were composed of old, dense conifer stands with high canopy cover. Only the mainstem South Fork Skokomish River segments were rated below 90 percent shade. Results for the conditions at the time of the assessment (mid-1990s) showed that, of 132.8 miles of channel assessed, 84.7 miles (64 percent) rated as below target. It was further determined that 6.8 miles was primarily impacted by agriculture development, 43.7 miles was impacted by forest practices, and 43.2 miles were related to natural mechanisms. Riparian areas within the Upper South Fork Skokomish River, Cedar Creek, Pine Creek, Rule Creek, and Steel Creek drainage areas were characterized as having alternating stands of mature old growth and wide swaths of clear cut with good riparian leave areas. The clearcut areas with riparian buffers show reduced riparian areas. The lower portions of the Lebar Creek and Brown Creek drainages were intensively harvested as part of the abandoned dam project, and the upper portions were harvested in more recent years. Therefore, these two drainages showed varied riparian classification (Simpson Timber Company and Washington Department of Natural Resources, 1997).

Washington State water quality standards for temperature

Waters within the project area in the vicinity of thinning units are designated as Char Spawning and Rearing. Water temperature is measured by the 7-day average of the daily maximum temperatures (7-DADMax). The highest 7-DADMax for char spawning is 9°C (48.2°F) and for spawning and rearing is 12°C (53.6°F). For water bodies with temperatures that are warmer than the criteria due to natural conditions, human actions considered cumulatively may not cause the 7-DADMax temperature of that water body to increase more than 0.3˚C (0.54˚F).

Olympic National Forest stream temperature data for period 1999 – 2001

Data were collected to characterize water temperature conditions during the summertime low flow period within the mainstem South Fork Skokomish River and major tributaries for years 1999 through 2001. Results for the period of record indicate exceedences of current state water quality standard of for 12°C for 7-DADMax for the three years of record. Records indicating exceedences in the planning area are summarized in Table Hydro-5.

Table Hydro-5. Summary of stream temperature monitoring data for years 1999 - 2001

Stream name	Year	River mile (RM)	Monitoring period begin date	Monitoring period end date	Maximum temperature (°C)	7-DADmax (°C)
South Fork Skokomish	1999	17.13	7/21/1999	9/21/1999	14.5	14.0

Table Hydro-5. Summary of stream temperature monitoring data for years 1999 - 2001						
Stream name	**Year**	**River mile (RM)**	**Monitoring period begin date**	**Monitoring period end date**	**Maximum temperature (°C)**	**7-DADmax (°C)**
Brown Creek	1999	0.13	3/19/1999	10/25/1999	11.8	11.6
LeBar Creek	1999	1.0	4/1/1999	10/26/1999	13.9	13.7
Cedar Creek	1999	0.5	5/3/1999	12/13/1999	15.6	15.0
Pine Creek	1999	0.09	2/2/1999	11/22/1999	10.9	10.2
Church Creek	1999	0.1	5/4/1999	10/19/1999	13.5	12.1
South Fork Skokomish	2000	11.72	4/17/2000	10/12/2000	18.5	18.0
South Fork Skokomish	2000	20.84	4/28/2000	12/31/2000	15.1	14.9
South Fork Skokomish	2000	25.94	4/19/2000	9/25/2000	9.7	9.6
South Fork Skokomish	2001	25.94	5/10/2001	8/19/2001	9.4	9.0
South Fork Skokomish	2001	24.12	3/27/2001	7/10/2001	13.7	10.5
South Fork Skokomish	2001	23.78	5/10/2001	10/3/2001	12.9	12.7
South Fork Skokomish	2001	22.46	7/10/2001	8/23/2001	16.4	14.0
South Fork Skokomish	2001	20.84	5/31/2001	10/23/2001	15.2	15.0
South Fork Skokomish	2001	19.31	6/5/2001	10/18/2001	15.6	15.3
South Fork Skokomish	2001	17.13	5/31/2001	7/4/2001	14.5	13.1
South Fork Skokomish	2001	15.58	5/25/2001	7/8/2001	16.4	15.5
Church Creek	2001	0.49	1/1/2001	8/19/2001	11.4	11.3
Lebar Creek	2001	0.1	5/11/2001	10/10/2001	17.1	16.9
Brown Creek	2001	0.13	5/11/2001	10/18/2001	13.3	12.4

Washington Water Quality Assessment

Section 303(d) of the 1972 Clean Water Act as amended requires identification and placement of water bodies on the 303(d) list for those waters that do not meet state water quality standards. Water quality limited water bodies must be identified by the United States Environmental Protection Agency (EPA) or by the state agency delegated this responsibility. In Washington, EPA has delegated this responsibility to the Washington State Department of Ecology.

Washington 2006/2008 Water Quality Assessment and Federal Clean Water Act 303(d) Listed Water Bodies

Ecology completed Washington State's Water Quality Assessment for 2006/2008 and submitted it to EPA in 2008. The document entitled Assessment of Water Quality for the Sections 303(d) and 305(b) Integrated Report describes assessment policy (WDOE 2006). Ecology used the water quality standards under the 2006 formal rule to conduct this assessment. The water quality policy decision set temperature assessment criteria for both continuous monitoring data or single "grab sample" data, depending on what sampling regime is used. It assigned all waters in the state to one of five categories: Category 1 - Meets Tested Standards; Category 2 - Waters of Concern; Category 3 - No Data; Category 4 - Impaired but Does Not Require a TMDL (4a. Has a TMDL, 4b. Has a Pollution Control Plan, and 4c. Impaired by a Non-Pollutant), and Category 5 - 303(d) List.

Under Section 303(d) of the federal Clean Water Act and EPA's implementing regulation (40 CFR 130.7),the State of Washington is required to prepare a list of waters for which beneficial uses are impaired, as determined through use of Washington State water quality standards.

EPA approved the 2008 Clean Water Act 303(d) List of degraded waters in January 2009. Category 5 is the only category that constitutes the 303(d) list of impaired waters, and thus requires preparation of a of a Water Quality Cleanup Plan, otherwise referred to as Total Maximum Daily Load (TMDL). The 2008 federal CWA 303(d) list includes two water bodies listed for temperature within the South Fork Skokomish watershed – one within the mainstem South Fork Skokomish River, and one within LeBar Creek. The LeBar Creek water body is within the Upper South Fork Skokomish Vegetation Management project planning area, and the South Fork Skokomish River water body is downstream, outside of the planning area. The Lebar Creek listing, identified as List ID 35623, includes the entire lower segment of within T22N R05W Section 40. The South Fork Skokomish River listing, identified as List ID 35267, includes the mainstem river segment within T22N R05W Section 15 (Washington State Department of Ecology 2009). Currently no TMDL is in place to address the two 303(d) listed water bodies within the South Fork Skokomish watershed.

Hydrologic Change

Hydrologic change - timber management

Background

Timber harvest can alter hydrologic processes though increased evapotranspiration due to tree removal and increased snow accumulation and melt rates associated with changes in canopy closure. The changes in hydrologic processes can affect the amount and rate of water available for runoff, which can influence streamflows, including peak flows.

Removal or thinning of the forest canopy affects snow accumulation and melt processes. Closed forest canopies intercept substantial amounts of snow that sublimates back to the atmosphere before reaching the ground. Snowpacks in cleared areas tend to be deeper and hold more water than those under forest canopies. During windy and humid rainstorms, or rain-on-snow events, snow melts faster in clearings than under a forest canopy, due in large part to air temperature and wind speed over the snowpack. Forest canopies protect the forest floor from wind and inhibit snowmelt during a rain-on-snow event. Forest canopy thinning or removal tends to increase the water available for runoff during rain-on-snow events (Washington Forest Practices Board 1995).

Rain-on-snow events occur as the result of high rates of snowmelt during rain storms. These events can result in substantially increased rates of water delivery to soils and streams – above that of rain alone. A 1992 study measured an average of 40 percent increase in the total of rainfall and snowmelt in clearcuts compared with closed canopies in northern Cascades test plots (Coffin and Harr 1992).

Rain-on-snow events can occur at any elevation. They are uncommon in low elevations where snow pack is limited during rainstorms, and at higher elevations with persistent snowpack and

air temperatures that stay low enough to keep snow from melting. Within the South Fork Skokomish watershed, rain-on-snow events typically occur between approximately 1,400 and 3,600 feet in elevation, in the rain-on-snow transition zone. The combination of existing snow packs and warm rainstorms is most common in the rain-on-snow zone and therefore it is expected that timber management in the rain-on-snow zone would have more effect on water available for runoff and peak flows than management at other elevations (Simpson Timber Company and Washington Department of Natural Resources 1997).

Jackson (cited in Washington Forest Practices Board 1995) modeled water available for runoff and peak flows for the South Fork Skokomish watershed based on 1995 Washington State watershed analysis methodology. The watershed was delineated in to precipitation zones, distributed as follows: 49 percent rain-on-snow zone. 36 percent rain dominated, 11 percent lowlands and 4 percent snow dominated zone. Vegetation was categorized for "hydrologic maturity" based on canopy crown closure. Hydrologic maturity represents forest stands with greater than 70 percent canopy crown closure; intermediate hydrologic maturity represents stands with 10 to 70 percent canopy crown closure, and immature stands represent stands with less than 10 percent canopy crown closure. The distribution of vegetation into these three canopy closure was not disclosed in Jackson's analysis document (Simpson Timber Company and Washington Department of Natural Resources 1997).

Jackson modeled water available for runoff and peak flows for three vegetative states: full mature canopy, current conditions canopy, and fully immature (clearcut) canopy. A ten percent increase in peak flows over full mature vegetative conditions was used as a threshold of concern based on recommendations within the watershed analysis manual (Washington Forest Practices Board 1995). The model results for water available for runoff showed no notable increases in peak flows under current (then 1997) vegetative conditions relative to flows under fully mature canopy conditions. Under hypothetical clearcut conditions, flow increases of greater than 10 percent were predicted for all drainages except Steel Creek and the Upper South Fork Skokomish. Typical flow increases under fully clearcut conditions ranged from 20 to 35 percent (Simpson Timber Company and Washington Department of Natural Resources 1997).

The Upper South Fork Skokomish Vegetation Management project proposes only thinning, no clearcut harvest. Based on Jackson's modeling, the project would not be expected to increase water available for runoff or peak flows.

Conditions in the Upper South Fork Skokomish subwatershed

Review of the 1995 and 1997 watershed analyses determined the majority of the planning lies within rain-on-snow or rain-dominated zones. According to Grant et al. (2008) watershed in rain dominated zones are less sensitive to changes in peak flows compared to those in rain-on-snow zones. Several of the drainages have greater than 50 percent of their area in the transition zone and these are: South Fork Skokomish – Pine Creek to Headwaters, Steel Creek, Lebar Creek, Brown Creek, Rule Creek, Church Creek, Pine Creek, and Cedar Creek. It is assumed these drainages are more sensitive to changes in peak flows during rain-on-snow events.

On Forest Service lands where no clear cutting has occurred and commercial thinning practices retain crown closure, it would be expected that areas considered hydrologically immature in 1995 would have now grown, and have crown closures measuring greater than 10 percent. Observations during field reconnaissance of the planning area in 2010 and 2011 confirm this assumption. Some previously clearcut stands, especially in upper Lebar Creek and Brown Creek, have not grown at the rate that would have been expected, and canopy closure is also occurring at a slower rated. These areas are generally south facing slopes with visible exposed area of bedrock, and would be expected to have naturally poor site conditions for tree growth. No stands having these conditions are proposed for thinning in the current project.

Hydrologic change - roads

Roads can affect the routing of water through a watershed by intercepting, concentrating, and diverting flows from their natural pathways. These changes in routing can cause increases in peak flows by both volumetric increases of rapid surface runoff and changes in timing of runoff to streams (Wemple et al. 1996). The road drainage system can act as an extension of the drainage network. Roads can intercept groundwater flow, and thus increase the amount of water delivered to streams more rapidly than through natural processes (Jones and Grant 1996). Areas likely to be sensitive to increases in both volume and rate due to roads are those with there is both high drainage density and high road densities.

Different parts of a road system behave differently, and even a single road segment will perform differently given storms of different magnitudes. As storms become larger or soils become wetter, more of the road system contributes water directly to streams. A road's position on a slope (upper, mid-slope, lower) has a strong effect on the magnitudes of hydrologic change caused by roads. Discharge from hill slopes, height of cut bank, density of stream crossings, soil properties, and response to storms all differ with slope position.

Road density and drainage density

Road remediation efforts implemented since the early 1990s have focused on treatments that restore or improve hydrologic processes and function, including road decommissioning. Road density in the planning area has been decreased from 3.3 to 1.25 miles per square mile, and additional work scheduled for 2012 will decrease it to less than 1.21 miles per square mile. Storm damage risk reduction work on some roads has further reduced the extension of the stream network from roads. Research monitoring conducted by Black et al. (2009) on four miles of road in the South Fork Skokomish watershed found that, when taken collectively, decommissioning treatments should be effective in reducing most hydrogeomorphic impacts and risks to aquatic ecosystems. The monitoring found stream connectivity was reduced by 70 percent, delivery of fine sediment was reduced by 81 percent, and the risk of stream crossings becoming plugged was completely eliminated by excavation and removal of culverts and associated fills.

The Upper South Fork Vegetation Management project does not propose new permanent roads, and would not increase road density in the planning area.

Environmental Effects

The no-cut riparian buffers (table 2.10) were designed to minimize or eliminate potential effects to stream temperature and turbidity (sedimentation). This assessment of potential environmental effects associated with the project's alternatives assumes that all of the project design criteria, mitigation measures, and best management practices described in chapter 2 are implemented.

Alternative A – the No Action Alternative

Alternative A, the No Action alternative, is provided to serve as a baseline of the existing condition for comparison with the Proposed Action. Under the No Action alternative, no thinning treatments or associated project activities would take place. Forest stands in the project area would remain untreated. All existing roads – authorized system roads, decommissioned roads, and existing unclassified roads – would remain in their current condition. No commercial thinning or related economic activity would take place. No timber sale revenues would be available for additional restoration activities in the project area.

Direct Effects

Because there would be no management action, the No Action Alternative would have no direct effects on water quality and hydrology.

Indirect Effects

Stream Temperature

There would be no indirect effects to water temperatures, because no thinning within shading proximity to streams would occur. Natural changes in riparian vegetation due to disturbances such as floods, windthrow, bank erosion, mass wasting and disease would continue to occur, and may reduce riparian shade. It is assumed that ongoing maturation of riparian vegetation would maintain or improve riparian shade conditions and as a result, shade would be maintained and likely increase over time. Stream temperatures would be maintained or possibly reduced under these conditions.

Sedimentation and Turbidity

Sedimentation and turbidity associated with erosion generated from roads would generally remain the same as current conditions. Improvements to system and non-system roads associated with this planning effort would not occur. In addition, no funds would be generated from timber sale receipts for potential expenditure on sale area improvement or other projects that target additional road remediation work such as road decommission, culvert upgrades, and storm damage risk reduction.

Hydrologic Change – Thinning

Forest canopy would remain at current levels in the short term. In the absence of other disturbances), altered hydrologic processes currently existing in previously managed stands would progress toward more natural conditions as the stands continue to grow and mature. Evapotransporation rates would increase, and forest canopy would trend toward closure, toward hydrologically mature conditions. Snow accumulation and melt rates within stands would be reduced. The recovery of hydrologic processes would result in a decrease in amount

of water available for runoff. Streamflows would respond correspondingly. Stands with diminished rates of tree growth and canopy closure, such as the upper areas of Lebar Creek and Brown Creek, would likely take longer to progress toward more natural conditions.

Hydrologic Change – Roads

Under the No Action Alternative, no road work would occur. In addition, no road decommissioning or improvement projects associated with this vegetation management project would occur (see tables 2.7 and 2.8 in chapter 2). The density and extension of the drainage network associated with the existing road network would remain the same as current levels.

Cumulative Effects

Because no management action would be taken under this alternative, there would be no cumulative effects when combined with previous, current, or reasonably foreseeable future actions.

Alternative B – the Proposed Action

Below is a summary of proposed project activities that have the potential to affect water quality and hydrology:

- Of the 880 acres proposed for thinning treatment, 224 acres are within Riparian Reserves, although no-cut buffers would notably reduce this area;
- 3.52 miles of temporary road development, of which 0.76 miles are in Riparian Reserve;
- 27.4 miles of system roads used as haul routes in the planning area. One mile of this consists of closed, ML1 road (see table 2.3). Project-related road maintenance and upgrading would need to occur on some of these roads to bring them up to a standard suitable for haul;
- 25.6 miles of system roads used as haul routes that pass through the Lower North Fork Skokomish and Lower South Fork Skokomish subwatersheds. Project related road maintenance may need to occur on some of these roads to bring them up to a standard suitable for haul.

Direct and Indirect Effects

Sediment and Turbidity

Project activities with the potential to generate sediment and deliver it to streams include timber harvest operations, road and helicopter landing development, road maintenance and upgrading, and log haul. Seasonal operating restrictions that address resource concerns other than aquatics for this project often result in occurrence of timber harvest operations during the winter months – the wettest time of the year. Ground disturbance from harvest activities and roads, when combined with intense and sometimes long duration rainfall events, can present conditions that generate and transport sediment to aquatic habitats.

Sediment delivery to aquatic resources generated from temporary road construction, reconstruction and decommissioning is expected to occur under some conditions, but would be minimal. Collectively, project design criteria, best management practices, and mitigation

measures for this project would substantially reduce the likelihood of sediment transport to aquatic habitats. Turbidity associated with sediment delivered to these water resources is likewise expected to be minimal.

Ground disturbance during thinning operations in riparian reserves

Thinning activities would occur to a limited degree within Riparian Reserves. The 224 acres within Riparian Reserves represent approximately 0.6 percent of the total 36,750 acre planning area and 1.1 percent of the total 20,860 the Riparian Reserve acres within this planning area.

Ground disturbance from thinning activities inside the riparian reserves would occur primarily from yarding activities. Ground-based logging involves using skid trails to drag trees to the nearest landing, and would expose bare soil at the time of harvest. There are 53 acres of ground-based logging proposed within riparian reserves. Cable (skyline) logging would disturb soils along the skyline paths as trees are yarded. There are 82.5 acres of cable logging proposed within riparian reserves.

Sedimentation and elevated turbidity levels associated with ground-disturbing thinning activities are expected to be negligible in both the short and long term. Harvest operations and practices specified for this project were designed to minimize adverse impacts to soils and water quality. They include limitations of where different logging methods can be used based on slope steepness; timing of ground based skidding and yarding operations when soils are dry, frozen or covered with adequate snow depth or logging slash; and limiting the width and distance between skid trails and cable corridors. A recent study found that proper use and post-harvest treatments of skid trails, and the presence of organic matter and surface roughness features such as woody debris and logging slash (Litschert and MacDonald 2009), were effective in preventing downslope sediment delivery. Riparian no-cut buffers for this project were designed to prevent sediment delivery to streams, and they all exceed the 10-meter streamside buffer widths found by Rashin et al. (2006) to effectively minimize sediment contributions.

Temporary Road Construction

The Proposed Action includes a total of approximately 3.52 miles of temporary road development to provide access to project treatment units. One new stream crossing would be constructed as part of the new temporary road construction. Of the 3.52 mile total, 0.76 miles are within Riparian Reserves.

Temporary opening of existing unclassified roads and decommissioned roads would utilize existing road grades and reduce disturbance associated with constructing new access roads. Unclassified roads are not considered Forest system roads, and therefore probably have not received maintenance since they were last used. Typically road profiles still exist on these roads, but their surfaces are covered with vegetative growth including shrubs and trees of varying size. Use of these roads would involve clearing of vegetative growth within the road profile, use of existing drainage structures that function adequately, and reconstruction to address areas with drainage and stability concerns.

The existing decommissioned roads proposed for opening within this project are similar to temporary roads within the planning area in that they not received maintenance for several years. Road profiles exist, but are typically covered with shrub and tree growth. Use of these roads would require treatments similar to those described above for existing unclassified roads.

New temporary road construction totaling 0.91 miles would occur for 13 relatively short segments ranging in length from 0.1 to 0.27 miles, distributed within multiple units throughout the planning area. Road construction activities within Riparian Reserves would be potential sources of sediment and elevated turbidity in nearby waters, given their proximity to riparian habitats. However, newly constructed temporary roads within Riparian Reserves would total only 0.02 miles, so this potential is minimal. New road construction would cause localized disturbance of soils at the individual sites. Road location, no-cut buffers riparian buffers, timing of construction in the drier months, and practices that prevent surface erosion of disturbed areas would substantially reduce water quality impacts associated with sediment delivery to streams. Only minor (if any) impact to aquatic resources would occur, and would be limited to the immediate vicinity of the construction site at the time of construction and for the duration of use. No detectable effects would be at the subwatershed or watershed scale.

All 3.52 miles of temporary roads would be decommissioned following project use. It is expected that the type and intensity of decommissioning treatments would adequately address aquatic resource concerns. Typical treatments would include: removal of culverts and associated road fill; construction of drainage features to restore hillslope processes; removal of unstable roadfill; scarification of road surfaces; placement of clearing debris and application of weed free mulch and seed to prevent surface erosion and promote revegetation at select sites; and construction of non-driveable berms at the road entrance to prevent vehicle access. Any impacts to aquatic resources would be localized. Decommissioned road segments could deliver sediment for some years following treatment as vegetation recovers, but impacts to aquatic resources would be localized. No detectable effects would be expected at the drainage or subwatershed scale.

Helicopter Landing Development

The Proposed Action would involve development of thirteen helicopter landings, with preference given to existing openings in order to avoid disturbance caused by development of new landings. Activities involving reconstruction of existing landings or construction of new landings would be designed to limit movement of sediment to channels that result from soil disturbance. Proposed landings are primarily located on ridgetops, stable sideslopes, or relatively gentle terrains. Any landings within Riparian Reserves would be located on existing roadways that require minimal reconstruction. Project design criteria restrict construction of new landings within riparian no-cut buffers.

Following project use, all landings would be rehabilitated with treatments designed to provide adequate drainage and stability and promote establishment of ground cover to prevent erosion, sedimentation, and elevated levels of turbidity.

Sediment delivery to waters and elevated turbidity levels associated with landing development and rehabilitation would be likely be minimal and would be localized. No detectable impacts to water quality are expected from these activities in both the short or long term at the subwatershed scale or watershed scale.

Culvert Installation

All road construction and improvement projects involving stream crossings would occur in the summer season when stream water levels are low. All new culvert installations at stream crossings to remain in place for more than one summer season would be designed to accommodate 100-year flood flows. All work at stream crossings would be conducted in accordance with provisions of the set forth in the MOU between the Forest Service and Washington Department of Fish and Wildlife Service for hydraulic projects. These requirements should be sufficient to minimize sedimentation potential caused by the culvert replacement. Only one new stream crossing is proposed for temporary roads in the project. The project is also likely to include replacement of some existing culverts, as well as removal of culverts after thinning is complete.

Dewatering streams during in-channel operations such as culvert installation or removal is a required practice that reduces potential effects of sedimentation to downstream resources. Short-term sediment inputs during culvert installation and removal operations are expected. Water directed back into the channel following these activities flows on channel surfaces that have been disturbed by equipment operations within the channel, and which usually entrain and transport sediment. Typically the transport of this sediment is localized, and turbid waters usually return to background levels with a few hours. Duncan et al. (1987) demonstrated that sediments, including fines, settled out rapidly in small mountain stream channels. The study found less than 50 percent of sediments traveled farther than 410 feet.

Longer-term impacts from sedimentation may result at culvert installation and removal projects due to from erosion of newly excavated stream channel side slopes. Erosion control treatments would minimize these impacts. In the case of culvert removals, sedimentation resulting from channel adjustments due to the scour during higher flow events would occur until the channel stabilizes, but proper design and excavation of the channel would minimize these impacts as well.

Maintenance Level 1 Roads

A total of 1.0 miles of Maintenance Level 1 (ML1) roads, comprised of five short road segments ranging in length of 0.12 to 0.41 miles, would be reopened for log haul. Opening and re-closure following project activities of ML1 roads would result in minimal impact to aquatic resources. Reconstruction would adhere to seasonal restrictions and other practices designed to minimize delivery of sediment to waters. Post-project closure would consider potential risk to aquatic resources associated with presence of the road until it would be reopened or fully decommissioned. Potential for sedimentation and elevated turbidity levels exists due to the absence of maintenance following closure, but is expected to be minimal.

Road Repairs, Maintenance, and Log Haul

Sediment delivery to channels would be expected, but road treatments that bring roads up to standard for their intended season of haul and management of haul activity during periods of high rainfall would substantially reduce the likelihood of this occurrence. Haul routes within the planning area total 27.4 miles and are listed in Table A-3 in Appendix A. These haul routes intersect with approximately 82 stream crossings and an unknown number of ditch relief culverts, some of which have connectivity with streams during periods of runoff.

The majority of haul roads associated with this project are unpaved gravel roads. All proposed haul routes would receive treatments to bring them up to a standard suitable for log haul (see table A.5 in Appendix A). Treatments needed would vary based in part on the existing condition of the road, requirements for different operational maintenance levels, and time of year haul would occur. It is assumed that gravel roads to be used during the wet months of the year would involve more extensive treatments to prevent or minimize resource damage during their use.

The Proposed Action would generate around four loaded log trucks per day associated with ground based and cable operations, concentrated in the dry months (summer, early fall). Haul traffic volume associated with for helicopter and pre-bunching would be somewhat greater, concentrated in late fall, winter and spring seasons. Intensity of haul activities would vary during all months of the year. Haul activities associated with this project would likely be intermittent and span the course of an estimated 5 to 10-year period.

In addition to being brought up to suitable condition for haul, management of haul activity would be adjusted to account for existing or predicted weather conditions that could limit the effectiveness of practices that control sedimentation. This would likely occur with log haul during the wet months of the year when rainstorms are frequent. In some cases, haul activity would be curtailed to prevent resource damage or avoid levels of turbidity that exceed State water quality standards. Given the anticipated haul traffic volume and management of haul activity, any haul-related sedimentation and turbidity effects are anticipated to be minor and of short duration.

Stream Temperature

Water temperatures would not be affected under this alternative because no thinning would occur that would have the potential to reduce existing stream shade. No thinning would occur within the designated minimum riparian no-cut buffers. Thinning in riparian reserves outside of the no-cut buffers would retain the dominant shade producing trees, with post-treatment canopy closure ranging from 60 to 90 percent. Stream temperatures would be maintained or improved as the result of thinning practices. The project would not cause increases to instream temperatures in either of the two 303d-listed waterbodies mentioned above.

Hydrologic Change

Hydrologic Change – Thinning

Thinning treatments under this alternative have the potential to alter hydrologic processes by decreasing evapotransporation and increasing snow accumulation and rate of snow melt. Changes to these hydrologic processes could affect stream flows by altering the volume and rate of water available for runoff, including peak flows. The planning area resides predominantly in rain-on-snow and rain-dominated zones. Rain-on-snow watersheds are most susceptible to changes in peak flows during rain-on-snow events. GIS analysis of the 880 proposed treatment acres indicates that approximately 123 acres lie within the mapped rain-on-snow zone. The remaining 757 acres are within the lower elevation rain-dominated zone, although rain-on-snow events do occasionally occur within this zone.

Skips within the thinned areas would total at least 10 percent of the treated stand area. No thinning would occur in skips and therefore no thinning-related hydrologic changes would occur within skips.

Up to 10 percent of the treated stand area would be a combination of heavy thinning and gaps (small openings). Gap openings would vary in size from 0.1 to 0.25 acres. Areas of heavy thinning would range from 0.5 to 1.5 acre in size. Increased snow accumulation on the ground would occur within gap openings and heavily thinned areas, and snowmelt would be more rapid due to the greater exposure of these areas to wind and rain. Based on the silvicultural prescription, these openings would total no more than 10 percent of the 880 treatment acres, or at most 88 acres acres, which equates to less than 0.25 percent of the 36,750-acre planning area. Some increased snow accumulation would be expected in areas of stands receiving the regular thinning treatment, but this would be quite minor given post-treatment canopy closures of 60 to 90 percent, and would diminish as canopy growth increases in response to the thinning treatment. Given the very small increase in forested subwatershed area in an immature hydrologic condition, hydrologic changes from thinning would be undetectable on a subwatershed scale.

Removal of trees by thinning would also decrease the amount of evapotranspiration that occurs, and allow increased soil moisture in stands treated. This would be expected to increase water available for runoff at the site scale for several years, until growth of understory vegetation and tree canopy growth return evapotranspiration rates to pre-project levels.

The increase in water available for runoff from altered hydrologic processes and corresponding increases in peak flow would be minimal at the site scale given the limited extent of thinning and its distribution throughout the watershed. Under this alternative only 2.8 percent of total watershed area is proposed for thinning, and this percentage would decrease considerably when exclusion of acres thinned in skips and protection buffers is accounted for. Rough estimates show that the thinning would result in a minor and temporary reduction in canopy cover over at most 1.1 percent of the total watershed area.

It is assumed that increases in both water available for runoff and increases in peak flows would be undetectable at the subwatershed and watershed scale. This interpretation is supported by the work of Grant et al. (2008), who conclude that if peak flow increases do occur from forest practices, they are only detectible at flows with return period of 6 years or less.

Hydrologic Change – Roads

Change in road density is used here to assess potential project-related change in hydrologic processes due to extension of the drainage network. A comparison of road density for current, during, and post project is provided in table Hydro-6. Current road density includes all Forest Service system roads (Maintenance Levels 1 -4) within the planning area, and takes into account planned decommissioning scheduled for 2012. During-project road density includes Forest system roads plus the 3.52 miles of temporary road construction proposed under Alternative B. In order to assess maximum potential effects to hydrologic processes, the calculation for during-project maximum density assumes all proposed temporary roads are in place at one time. This is a very conservative assumption given that project implementation would span the course of 5 to 10 years, and only a subset of the proposed roads is likely to be in use at any one time.

Table Hydro-6. Alternative B: pre-, during-, and post-project road densities

Current road density	During-project (maximum)	Post-project
1.25 mi/sq.mi	1.31 mi/sq.mi	1.25 mi/sq.mi

Road development under Alternative B would result in a very minor temporary increase in road density (0.06 miles per square mile) in the planning area during project implementation. Because no new permanent roads would be constructed, no change in road density would occur over the long term. This alternative involves construction of 3.52 miles of temporary road distributed throughout the project area, all of which would be decommissioned after use. Any temporary roads used for thinning operations that are not decommissioned prior to the wet season would have stream crossings removed and be winterized prior to the wet season. Only one new stream crossing is identified within the temporary road set, and most segments are on relatively flat ground. The total of 1.0 mile of closed ML1 road segments that would be opened for the project and re-closed after project operations is part of the existing authorized road system, and would not reflect a change in road density. At project completion, there would be a no net gain of road miles, and no change in road density or number of stream crossings.

Increase in road length during project activity due to temporary roads would likely result in only a slight increase in connectivity between roads and streams through capture of water in ditches and from the road surface. This is due in part because temporary road segments would be located on relatively flat ground with construction of only one new stream crossing. Any changes to hydrologic processes, including the volume and timing of runoff due to this increased connectivity between roads and streams, would be slight, localized, and of short duration. Changes to stream flows would be undetectable at the subwatershed and watershed scale.

There are 6.8 miles of system roads recommended for decommissioning in association with this project (table 2.7), if project-generated funds are available. Decommissioning these roads would further reduce any existing hydrologic effects from extension of the drainage network represented by these roads.

Alternative B – Summary of direct and indirect environmental effects

Alternative B is expected to have no impacts on stream temperatures. Impact due to sediment and turbidity would at most be minor and localized and not detectable at the subwatershed or watershed scale, and would occur intermittently during the 5-10 year project implementation period and for several years beyond that as disturbed sites recover (decommissioned roads). Changes in hydrologic processes from thinning and road activities would also be minimal, localized and not detectible at the subwatershed or watershed scale. Implementation of Alternative B would result in improved conditions within the subwatershed. Implementation of project work identified as part of the timber sale area improvement on system and non-system roads identified as part of this project would also result in improved subwatershed condition.

Cumulative Effects

Overall impacts associated with Alternative B for the elements and metrics assessed would be minimal at the site scale and not detectable at the subwatershed or watershed scale. In consideration of the past, present and future actions on federal and non-federal lands within, no negative cumulative effects are anticipated within the Upper South Fork Skokomish subwatershed. Relative to desired conditions in the watershed, the project would be likely to result in a beneficial cumulative effect.

Past management that involved intensive timber harvest, broadcast burning, and road construction have been the major contributors to impacts on aquatic resources in the Upper South Fork Skokomish subwatershed. Beginning in the early 1990s, implementation of the Forest Plan as amended by the 1994 ROD (the “Northwest Forest Plan”) has emphasized restoration aimed at recovery of terrestrial and aquatic species and their habitats.

Overall watershed conditions are expected to improve over time as the result of result of an extensive restoration program of work implemented on National Forest System lands in the watershed since the early 1990s. Substantial work has been implemented to improve ecological health of watershed through implementation of projects aimed at recovery of aquatic and terrestrial habitats. It is recognized that it may take decades to realize the benefits of this work. Restoration efforts to date have involved the following types of projects: commercial thinning; pre-commercial thinning; riparian nutrient enhancement (fish carcass placement); floodplain restoration; road projects including decommissioning, closure, conversion to trail, storm damage risk reduction, and maintenance; fish passage barrier correction; elk and deer forage enhancement; invasive plant species (weed) control; and revegetation of disturbed sites with native plant species.

Federal projects likely to occur within the reasonably foreseeable future within the Upper South Fork Skokomish subwatershed include additional road restoration work. This is either currently being implemented or is planned, but awaiting availability of funding. Activities referred to here are separate from this planning effort. Road activities planned include decommissioning, closure, trail conversion, storm damage risk reduction, and maintenance. These activities target improvement of drainage associated with the road network. They are intended to prevent or reduce road related sediment delivery to aquatic systems. Road density is expected to decrease as the result of planned decommission work.

SOIL PRODUCTIVITY, EROSION, AND LANDSLIDE RISK

Introduction

This section summarizes the potential effects to soil productivity and landslide risk associated with the proposed and connected actions within the Upper South Fork Skokomish Vegetation Management project and planning areas. The following is a discussion of the relevant information pertaining to past and predicted soil disturbances; past and potential erosion from timber management and connected activities; organic matter and soil organisms; and landslide risk.

The effects analysis section assumes that the project design criteria, mitigations, best management practices, and seasonal operating restrictions specified in chapter 2 of this Environmental Analysis are applied to the project implementation. These measures were designed to minimize or mitigate potential impacts, and to ensure that the project would comply with all pertinent laws, regulations, and policies.

Analysis Area and Scale

There are three geographic scales of analysis for this project. From largest to smallest, they are:

- Planning Area – The 38,500 acre Upper South Fork Skokomish River subwatershed (6th field subwatershed delineation).
- Project Area – The area in which project analysis occurs for proposed specific activities, including actions associated with designated treatment units as well as other connected actions outside of those units such as helicopter landing construction, rock pit development, log haul, and sale area improvement projects.
- Activity Area – The proposed treatment units (880 acres of active thinning and 157 acres of designated skips) consisting of the smaller, forest stand-scale units delineated in the proposed action, either individually or collectively. Also included are the proposed 3.52 miles of road development, thirteen 1-acre helicopter landings, and additional minor short temporary road safety spurs to get equipment and landings off the main existing open system roads. The analysis areas for soil resources for direct, indirect and cumulative effects are the outer boundaries of the stands (units) proposed for thinning. These are appropriate boundaries because actions outside the unit boundaries would have little or no affect to soil productivity within the units, and actions within the unit boundaries would have little or no affect to soil productivity elsewhere.

Analysis Methods

Soil distribution is complex within the planning area. All soil mapping units (SMU), soil resource inventory (SRI), Ecological Unit Inventory (EUI) landforms, and other features delineated and mapped have been assessed for several potential risks and hazards, and are summarized in this report through GIS analysis. These are most useful as an initial broad-scale planning tool to identify and display maps of possible soil concerns and sensitive areas. Interpretations are based on observations of soil characteristics at sites thought to best represent the entire soil mapping unit. Soil properties can vary widely within a mapping unit, and on-site investigations are often required to refine or modify interpretations. The project Soil Scientist has adjusted

the management interpretations to reflect on the existing and likely ground conditions at the time of activities. These interpretations have also been adjusted based on the anticipated types of disturbances to the soils from the proposed activities, and provide resolution to the soil map units at a site-specific scale.

This analysis utilized the surveys and sources of information listed below to evaluate and interpret potential effects associated with the proposed action. In addition, previous field experience, personal observation, and knowledge of how soils respond to the proposed types of management actions were used to predict impacts.

- Olympic National Forest Ecological Unit Inventory, or EUI (USDAFS, unpublished 2000)
- Olympic National Forest Soil Resource Inventory Update (USDAFS 1982)
- Natural Resource Conservation Service (NRCS) Web Soil Survey of the Olympic National Forest (http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm)
- South Fork Skokomish Watershed Analysis (USDA FS 1995)
- State of Washington Department of Natural Resources Landslide Mapping Inventory
- National Agriculture Imagery Program (NAIP) 2009 aerial digital imagery
- historic aerial photos
- Resource information in Olympic National Forest GIS data sets, including
    - slope
    - geology
    - landforms
    - hydrology and wetlands
    - topography
    - documented mass wasting features and erosion sites

A three-step methodology was used to gather data needed for this effects analysis. Priority stands were chosen for field evaluation and validation of soil mapping units, slopes, hydrology, and other features. Appropriate map changes were made to reflect field observations. Stands selected for field estimates and study of existing soil disturbance conditions were also chosen based on logging method (with emphasis on ground-based systems because of their greater soil disturbance). Skyline and helicopter stands were included in the detrimental soil condition study, but stands where slopes averaged greater than 40 percent were not surveyed as intensively because skyline and helicopter logging systems create less ground disturbance than ground-based logging. Soil disturbance condition was based on Howes Disturbance Classes (Howes, 2000). Initial transects were developed from old aerial photos (from the earliest flight flown after the stand was originally clearcut) to provide for the best coverage of past treatment unit activities. Stands surveyed included each of the primary soil types in the planning area. The surveyed stands provided feedback for calibrating aerial photo estimates, and ultimately were used in the prediction of percentage of detrimental soil condition following logging.

All stands were visited in 2010 and 2011. A total of eight days was spent primarily in the activity areas, but also the planning area, investigating the following: soils; slope steepness; landslide risk; existing road conditions and proposed road development; streams, wetlands and riparian areas; and restoration opportunities. Specific logging systems and road development concerns

associated with the proposed action were examined, including proximity to riparian areas; soils with seasonal high water table and wet areas; existing and potentially unstable areas; and unique features such as rock outcrops, seeps, and springs.

Measures Used to Assess the Effects of the Proposed Action

Soil Productivity

Activities associated with the proposed action and connected actions have the potential to adversely affect soil productivity and may result in the following types of detrimental soil conditions: compaction, puddling, displacement, erosion and severe burning. Detrimental soil conditions may also alter hydrologic function. These conditions, if severe enough, can result in soils that have low levels of porosity, reduced root penetration, increased runoff, reduced infiltration, reduced soil water storage capacity, reduced soil water availability, reduced nutrient availability, and reduced levels of mycorrizae and other soil organisms. Soil compaction and displacement; and lack of vegetation, coarse woody material, and plant litter covering the soil surface can reduce the number of soil arthropods (Soil Quality Institute 2002). The proposed activities may change soil habitats and the soil food web, and alter soil quality, or the capacity of soil to perform its functions (Tugel, A.Jl, 2002). Because information about fungal, bacterial, and arthropod populations is not available for this project, and effects to soil organisms are not considered independently from overall soil function, and this analysis considers soil disturbance and changes in organic matter as a surrogate for potential effects to soil organisms.

Other aspects of the proposed action such as road reconstruction or repair, road closures, log haul, snag creation would not have a meaningful or measureable effect on soil productivity because they do not alter soil conditions. Some actions are specifically designed to benefit soil productivity including the creation of down logs, road decommissioning, and obliteration of existing and new temporary roads and landings.

The extent and distribution of potential detrimental soil conditions are measured in percent of each activity area, meaning within and directly adjacent to proposed thinning units.

Erosion

Soil erosion can directly affect soil productivity by reducing soil depth and volume, resulting in a loss of nutrients and water holding capacity. An indirect affect from soil erosion is runoff from bare areas carrying soil particles to water bodies where it becomes sediment. Hazard ratings are based upon bare surface soil properties that affect detachability, such as soil texture and slope. Management ratings for erosion risk, for example, vary with the variability of the soils across the landscape, with some soils mapped with a severe erosion risk, others with slight, and many in between. Although ratings are a good preliminary analysis tool, almost any soil regardless of rating can become more erosive than rated under the right (or wrong) circumstances. Slight erosion risk soils that are exposed, compacted, rutted, and/or displaced can become erosive even on gentle slopes. Conversely, erosive soils occurring on very steep

slopes may be stable for decades because of sufficient protective cover (tree needles, leaves, wood, rocks, etc.).

Landslide Risk

The planning area has a history of slope instability, primarily shallow rapid mass movement (failures such as landslides or mass wasting, debris slides, and debris flows), and to a lesser extent deep-seated mass wasting. These features are often naturally occurring and generally slow moving. Slope instability has been an active agent in the downslope movement of soil, rock and vegetation in most of the planning area for at least the last one hundred years, and the deep seated mass movement is thousands of years old.

Road construction and timber harvest have the potential to increase the rate of landslides by changing slope configuration, strength and hydrologic processes. Some proposed harvest units are located on landforms that pose a landslide risk and have existing landslide features, some of which have delivered to nearby streamcourses.

Affected Environment

This section discusses the existing management-related and environmental characteristics of the Upper South Fork Skokomish River planning area that influence soil productivity and landslide risk conditions.

Soil Productivity

Standards for detrimental soil conditions have been set to meet the direction in the National Forest Management Act of 1976 and other legal mandates. Soil and water quality are maintained when soil compaction, displacement, severe burning, erosion, loss of organic matter, and altered soil moisture regimes are maintained within defined standards. The desired condition for soils in the planning area is to keep cumulative soil disturbance to less than 20 percent of the treatment areas, and maintain effective ground cover of surface organic material for soil productivity.

The majority of soils in the Planning Area have a moderate to high productivity due to soil development and a climatic regime which provides adequate moisture for plant growth. The major category of soil types in the area are Andisols. These soils hold a high amount of water that is available to plants, and have high infiltration rates, light bulk densities which are easily penetrated by roots, high aluminum contents, and low base (Ca, Mg, K) saturation. Soils in the area are generally moderate in fertility; however soil fertility does not seem to be a limiting factor in tree growth.

Soils in the planning area reflect a varied and complex history, but are generally quite young. The geologic and glacial history of the watershed has left a diversity of parent materials from which a variety of soils have been formed. The soils can be divided into two main types based on the parent materials they developed from: Deep Glacial Valley Soils (landforms L, N, M, and X), are derived from glacial parent material; Mountain Upland Soils, (landforms D and H) are derived from marine basalt from volcanic rocks. These two main soil types can be further subdivided into a total of eight general types based on slope steepness, landform stability, and

depth to compact till. Table Soils-1 below displays landform types, the major soil groupings, some key soil disturbance interpretations, landslides and landslide risk, and the extent (in acres) of the soil types in the planning area and the proposed thinning units (landforms that do not have any potential harvest units associated with them are not addressed in this report). Soils interpretations were evaluated for potential impacts associated with timber harvesting, road development, and other proposed project activities.

Table Soils-1. Landform groups, major soil types, and soil management risk ratings

Landform	Parent material	Slope range (%)	Landslide risk	No. of mapped historic landslides	Sediment delivery efficiency	Compaction hazard	Erosion risk	Puddling risk (depth to seasonal water table, inches)	Acres in planning area (by landform)	Acres in proposed thinning units
Glacial Outwash Plains (L)	Continental glacial outwash	2-15	Low	7	Low	Moderate	Low	Low	1,714	210
Glacial Valley (N)	Alpine compact and cemented till	5-30	Low	0	Low	Moderate	Low	High (12-36)	7,686	145
Glacial Valley (N)	Alpine cemented till	30-60	High	187	Low	Moderate	Moderate	Moderate (20-40)		119
Ground Moraine (M)	Cemented alpine glacial till	5-30	Low	0	Low	Moderate	Slight	Moderate (20-40)	173	15
Ground Moraine (M)	Cemented alpine glacial till	30-60	Moderately High	1	Moderate	Moderate	Moderate	High (20-40)		60
Escarpments (X)	Glacial outwash and till	50-90	High	12	High	Moderate	High	Moderate (36-48)	1,255	44
Mountain Slopes (D)	Colluvium from marine basalt	40-90	High	403	Moderately High	Low	Severe	N/A	268	265
Dissected Mountain Slopes (H)	Colluvium from marine basalt	40-90	Very High	19	Very High	Low	Severe	N/A	11	11

Deep Glacial Valley Soils

The landscape of the broad, U-shaped valleys and lowland moraines has been extensively altered by ice and water erosion consequent to glaciation that occurred during the Pleistocene

epoch. The glacial deposits consist primarily of compact till. Soils generally have a medium textured, weak to moderately well structured surface soil overlying deep till deposits composed of silts, sands, gravels, cobbles and stones. Soils are generally moderately deep (2 to 4 feet to cemented till), stratified, moderately compact, and formed in glacial deposits. Runoff is slow, with moderate permeability to the cemented till layer, and very slow through it. There is a seasonal zone of saturation between 2.5 and 4.5 feet from November through April.

This grouping is represented by the following landforms: Glacial Outwash Plains (L), Glacial Valleys (N), Ground Moraines (M), and Escarpments (X). The group has been further subdivided into six general landform and soil types based primarily on slope break – less than or greater than 30 percent. These landforms comprise a total of 10,828 acres, or 30 percent of the planning area.

Glacial outwash plains (L) are flat plains formed from large masses of continental or piedmont glacier outwash sediments. Slopes are 2 to 15 percent. Continental glacial outwash deposits are sorted deposits derived from the meltwaters of the Juan de Fuca lobe of the Cordilleran ice sheet. These deposits are characterized by rock clasts foreign to the Olympic Peninsula (i.e., granite, limestone, dolomite, etc.) that have their origins in the coast Mountains of British Columbia, Canada. Substratum is porous and gravelly. Major order streams cross these landforms. Stream spacing is very wide. Soils are very deep, with moderate permeability, and are well drained. No water table exists in these soils. These plains are very inefficient at delivering sediment.

Representative soil map unit (SMU) is SMU 563L8. A total of about 210 acres of proposed thinning units are found on L landforms. These units are the following: D15A, D15B, D15B1, L03A, L13B, L60, L65, S01A, S071, S072, S099B, S099C.

Glacial valleys (N) are long, narrow, gently sloping bottoms of U-shaped or other glaciated valleys. These landforms contain major order streams and are pocketed with springs. Landform slope phase 10 to 30 percent delivers sediment inefficiently except immediately adjacent to streams. Landform slope phase 30 to 60 percent delivers sediment more efficiently. Stream densities are often high and management activities tend to be close to perennial streams. Substratum materials are composed of glacial till with some inclusions of outwash and debris from adjacent valley walls. Glacial till often has a compacted layer which perches water, causing springs and overland flow when surface layers are also compacted. Slope instability is common upon removing vegetation at slope breaks and near drainageways.

Representative SMUs for 5 to 30 percent slope class are SMU 505N7 and SMU 536M7. A total of about 160 acres of proposed thinning units are found on these landforms: units L60, S010, S036, S036A, S052A, S052A, S052B, S052C, S053B, S053B1, S053C, S070A, S070C, S071, S074A, and S112 are located on SMU 505N7; units D24 and D25A are on SMU 536M7.

Representative soil map units for 30 to 60 percent slope class are 538M7, and 506N7. A total of about 130 acres of proposed thinning units are found on these landforms: units S010, S015, S016, S017, S036, S036A, S052A, S052B, S052C, S053C, S072, S084, S09, S099A, S099B, S099C are on SMU 538M7; units S026, S026A, S029, S036, and S053C are on SMU 506N7.

Ground moraines (M) are gently rolling, undulating, or bench-like slopes that occupy the valley floor and sideslopes. They occur below 3500 feet. Slope gradients are from 10 to 30 percent. Topography varies from a knoll and pothole topography, to nearly flat plains, to moderately steep "plastered" till on sideslopes. Stream patterns are irregular or deranged except on sideslopes where they are recessive. The substratum has a compacted layer that perches water tables and can create zones of instability when dissected by a stream. Till is inherently high in silt which is highly transportable by erosion. Sediment delivery is inefficient on 10 to 30 percent slopes and moderately efficient on 30 to 50 percent slopes.

Representative soil map units for 5 to 30 percent slope class is SMU 536M7. A total of about 16 acres of proposed thinning units are found this SMU: units D25A and D24.

Representative soil map units for 30 to 60 percent slope class is SMU 538M7. A total of about 60 acres of proposed thinning units are found this SMU: units L13B, L13A, D15B, D15B1, D24, D25A, and D25B.

Escarpments (X) are narrow but deeply incised break lands formed through downcutting through unconsolidated parent material such as glacial outwash and glacial till. Slopes are 50 to 90 percent, and are moderate relief averaging less than 500 feet in length. Major order perennial stream transects these landforms. Sediment delivery through surface erosion and mass movement is very efficient. These landforms are inherently active with natural landslides and treefall. Vegetation is an important stabilizing factor on these naturally oversteepened slopes. The substratum is variable and unpredictable with zones of incohesive materials.

Representative soil map units for X landforms is SMU 663X7. A total of about 45 acres of proposed thinning units are found this SMU: units L01A, L03A, L60, S052, S053B1, S053B2, S070C, S071, S072, S074, S099A, S099B.

Management Issues with Deep Glacial Valley Soils. Management concerns associated with Deep Glacial Soils in this planning area are related to their texture, drainage, and topographic position. All major SMUs have some degree of restricted drainage because of the soil properties (compact till) and topographic features. Restricted drainage generally has an adverse effect on management as soils with excessive moisture content are subject to damage from timber harvest, road development and other activities. These management activities affect the soils by causing muddiness, destroying soil structure, and causing compaction. This not only creates damage to the soil, causing possible reduction in productivity, but also increases the erodibility which subsequently increases stream sedimentation, thereby impacting water quality and aquatic habitat values. Damage is limited to the areas with direct ground disturbance.

In the absence of disturbance, water will percolate freely through the surface soils but is restricted by the compact subsoils. Surface soils become saturated and excess water is forced to move laterally. This causes a seasonal water table condition in which surface soil materials are easily removed, and can result in erosion and possibly sedimentation. Ground-based yarding operations that occur during winter months (November through April), when the seasonal water table is present and soil water content is high, may result in severe rutting and

puddling (deformation of soil structure). Displacement of topsoil and subsoil, loss of organic matter, and alteration of subsurface lateral water movement may also occur.

Overall sediment delivery is inefficient on 5 to 30 percent slopes due to gentle slopes and low stream density. Erosion may be severe on slopes greater than 30 percent, transporting lost topsoil downslope, degrading soil productivity, and altering long term physical, chemical and hydrologic conditions. Slopes greater than 30 percent are more efficient in delivering sediment to streamcourses.

Restricted drainage affects road construction as it necessitates frequent culvert installations. Proper road surface compaction on fills is difficult to attain, and a thick base course is often required, thereby increasing road development and maintenance costs. Relatively few problems are associated with road development other than those related to drainage. Map units are generally stable and are in good locations for roads. Raveling and sloughing of cutslopes does exist in some map units, resulting in plugging of ditchlines, erosion and fillslope erosion.

Mountain Upland Soils

This group is represented by Mountain Slopes (D) and Dissected Mountain Slopes (H) landforms, and comprises 19,265 acres, or 50 percent of the planning area. This category of landforms is generally found on slopes of 40 to 90 percent. Soils are derived predominantly from fluvial erosional processes, and formed in residuum and colluvium from marine basalt rocks. Marine basalt is a general term for a variety of extrusive peripheral volcanic rocks on the Olympic Peninsula commonly known as the Crescent Formation. These rock types are mainly basalt, massive flow, pillows, and breccia, with minor diabase, gabbro, and hydrothermally altered volcanic rocks. All of these peripheral rocks are folded and faulted, but they are in general stratigraphically contiguous. Slopes are primarily controlled by rock structure. Soils forming slope deposits over bedrock are shallow, rocky and generally non-plastic. Downslope transport occurs as rolling and falling of individual particles. Infrequent larger slides occur as flows, transporting slope deposit materials. Soils are generally found on ridgetop, upper and midslope topographic positions, and comprised of medium and moderately coarse-textured, moderately deep and shallow depths that are well drained, with moderately rapid permeability.

Mountain slopes (D) landforms are found on steep, complex slopes up to 2500 feet in relief. Drainage patterns are trellis. Drainage ways are somewhat broad. Slopes are relatively smooth, with slopes breaks or benches. Drainage spacings are from 1000 to 2500 feet and are first and second order. Sediment delivery efficiency of steep slopes is moderated by potential sediment storage on convex and complex slopes. Efficiency is rated moderately high as once sediment enters first order streams it can be delivered efficiently to major order streams.

Approximately 265 acres of thinning units are on Ecological Unit Inventory (EUI) map units 416D8 and 423D7: units D15B, D24, D25A, D25B, L13A, L13B, L60, S09, S015, S016, S017, S026, S029, S071, S071A, S072, S084, S099A, S099B, and S099C.

Dissected mountain slopes (H) are steep, straight to concave slopes up to 2500 feet in relief. Slopes are greater than 60 percent. Rock outcrop can comprise a substantial portion of the landform. First order drainages comprise more than 25 percent of the surface area. Sediment is delivered very efficiently because of steep slopes, potential for landslides, and number of perennial streams.

Approximately 11 acres of proposed thinning in one unit are on EUI 423H7: unit D25A.

Management Issues with Mountain Upland Soil. The management issues associated with the Mountain Upland soils is the potential for accelerated surface erosion from logging activities and road development. Existing steep cutslopes that are already exposed may potentially be further disturbed by logging and yarding activities. Shallow and moderately deep soils that occur on steep slopes have weak surface structural strength. Lack of ground cover and high annual rainfall may generate surface sheet erosion on exposed soils if preventative and corrective measures are not followed.

The potential for shallow rapid landsliding of soils and bedrock materials exists in this category of landforms and soils. Of the 629 historic mass wasting features mapped in the planning area, 422 (67 percent) are on landforms D and H. The slope instability is generally associated with slopes greater than 70 percent on dissected sideslopes and headwall areas, especially in shallow ridgetop and upper sideslope soils. Sediment delivery efficiency is moderately high. Road construction and maintenance are primary management concerns, due to cutslope and fillslope intability, stream crossing locations, and road drainage issues. Due to the high density of sideslope tributaries, unstable sidecast waste material can slide and reach major streamcourses.

Soil Productivity - Soil Disturbance and Logging Activities

Log yarding and road construction have the potential to cause soil compaction. Froehlich et al. (1985) and Wert and Thomas (1981) found slow rates of natural recovery of compacted soil, restricted primarily to the top six inches. They observed that heavy compaction persisted at the 8- and 10-inch depths. Bulk density of soil is often used to characterize compaction. Froelich (1985) has reported that most productive soils in the Pacific Northwest are characterized by relatively low bulk densities, ranging from about 0.5 g/cm3 to 0.9 g/cm3, and as a result have high macroporosity, high infiltration rates, and low soil strength. Heilman (1981) found that the roots of Douglas-fir seedlings could no longer penetrate soil when bulk density reached about 1.8 g/cm3. For reference, a road surfaced with igneous rock and then heavily compacted would exceed 2.0 g/cm3. Pure, igneous rock would be about 2.65 g/cm3.

Other research conducted on the Olympic Peninsula (Miller et. al. 1996), found that, seven to eight years after harvest, tree height and volume did not differ considerably between conifers planted in moderately-compacted skid trails and those outside of compacted areas. This is thought to be attributed to the low bulk densities, climatic factors, and ameliorating qualities of the soils. Minor detrimental soil conditions associated with skyline and helicopter yarding operations are reported in the literature, such as in Klock (1975), Aulerich et al. (1974) and Power (1974). These studies have shown that skyline-yarding systems cause little impact to soil.

Helicopter yarding lifts the logs vertically from the unit, thereby minimizing soil disturbance. Both skyline and helicopter yarding systems reduce the need for new roads within units.

Soil puddling, or rutting, is one of the most severe detrimental soil impacts. Ruts one to three feet deep may result when heavy ground-based skidding equipment travels across soils with finer textures, lower percentages of rock fragments in the surface soils, and high soil water content. Under these conditions the soil strength may not be sufficient to support the applied load from vehicle traffic. Rutting can affect the surface and subsurface hydrology of the site, as well as the rooting environment. The process of rutting can physically sever roots of trees located adjacent to heavily used skid trails, reducing the aeration and infiltration of the soil in the rut itself. Rutting can divert and concentrate surface water flows, creating accelerated surface erosion, especially on slopes greater 10 percent. Rutting results in deformation of the soils, loss or displacement of organic material and nutrients, and mixing of surface with subsurface soils, all of which negatively affect the long term productivity of the soil. Soil damage from rutting is limited to the rutted area itself. The damaged soils may eventually recover to historic conditions after 40 to 50 years (Froelich et al. 1985). Soil water content varies seasonally, and rutting can be avoided or minimized by conducting ground-based operations during the dry season.

Soil Productivity – Organic Matter

Duff, the surface layer of organic which includes both the duff and litter layers on the forest floor, minimizes nutrient loss and protects against surface erosion. These layers, with large woody material, also contribute to soil fauna, ectomycorrhizal formations, soil moisture retention, and the soil's contribution to the forest ecosystem. Past timber harvest and broadcast burning activities have removed a large amount of the historic duff, organic matter, and downed woody material in managed stands in the planning area. Duff layers are relatively thin in some proposed thinning units, ranging from ¼ to 1½ inches with an average of ½ inch in the proposed treatment units. Large woody debris of any size or decay class is scarce in the majority of managed stands throughout the planning area. Lack of large wood reduces both diversity and abundance of soil fauna and flora, which can in turn reduce organic matter turnover (decomposition rate) and nitrogen availability. Retention, recruitment, and replacement of coarse woody debris and soil organic matter are needed to restore soil productivity where it has declined or has been lost.

Soil Erosion and Sedimentation

Soil erosion can directly affect soil productivity by reducing soil depth and volume, resulting in a loss of nutrients and water holding capacity. Soil texture, slope and other surface soil properties affect detachability (a soil's potential to erode). An indirect affect from soil erosion is the transport of soil particles to waterbodies, where they become sediment.

Most forest soils have low potential for natural surface erosion. This is because they tend to have generally high natural porosity, high infiltration rates, high water storage potential, and they are usually fully occupied with vegetation and surface litter. Across the planning area, there are distinct features with greater potential for surface erosion and mass wasting, and

whose shape and origin are related primarily to erosion processes. These locations are similar to those prone to slope instability: steep inner gorges, dissected mountain headwalls, and other unstable terrains. These landforms were not considered for thinning. Skid trails associated with ground-based yarding operations conducted on slopes greater than five percent, and temporary road locations (both new construction and reconstruction of existing non-system roads) are also locations where the potential for erosion is high.

Overall, areas of active surface erosion observed in the project area were in the form of sheet, rill and gully erosion on several of the existing unclassified roads and ORV trails, most notably where they intersect stream crossings and other hillslope seeps and springs. Other erosion, mainly gully erosion and sheet erosion, were noted adjacent to system roads where unstable fillslopes has resulted in mass wasting, plugging of culverts, diversions and washouts. Minor gully erosion was also noted on several old skid trails in glacially-derived soils gullies and sheet/rill erosion on some of the historic landings.

"Sediment is the product of erosion, whether it occurred as surface, gully or soil mass erosion" (Brooks et al., 1991). Sediment can be both harmful and helpful to the proper functioning of streams. For instance, landslides are an important natural process that inputs sediment and wood for fish spawning habitat, but they can also be a chronic source of fine sediment that can damage young salmonids or foul water systems.

Soil surface erosion has been the subject of modeling developed by the Water Erosion Prediction Project, or WEPP (Elliott, 1997) of the US Forest Service Rocky Mountain Research Station, Moscow, Idaho. The WEPP model uses the characteristics of climate, soil texture, local topography, plant community, and surface residue cover to estimate soil erosion potential. Most erosion models are best used for predicting erosion rates for short segments of land slopes and when surface roughness is not highly variable. The WEPP model, like many others, has shortfalls when applied to large areas and when surface roughness of both streams and upland slopes are highly variable. An accurate quantitative analysis of sediment generated from a project such as the Upper South Fork Vegetation Management project would be extremely difficult to undertake because of the many variables associated with project activities. Uncertainties include the timing of activities; weather conditions (rainfall amount, duration, and intensity) during project implementation; the number of stream courses active when the work would be taking place; condition of the road surfaces; and the intensity, location, and timing of log haul. Although a quantitative analysis could provide a gross estimate of the amount of potential sediment generated, it would not correlate directly to impacts on fish or water quality because the model would be unable to determine how much sediment would be captured through mitigation measures and how much sediment would actually reach stream channels.

Surface erosion and subsequent sediment delivery to streams is possible only when storm events are large enough to saturate soils and cause overland surface water flow. If surface soils are not compacted, the probability of surface erosion is relatively low in forested watersheds where water infiltration rates into the soil are normally greater than the precipitation intensity.

When soils aren't compacted, infiltration capacities may be many times greater than maximum rainfall rates, and no surface runoff occurs (Harr 1976).

Environmental Effects

Direct and indirect effects are discussed at the Activity Area scale (the thinning units). The current condition described in the analysis below incorporates all past actions that have occurred within the analysis area which correspond to the proposed thinning unit boundaries. The Planning Area (Upper South Fork Skokomish River subwatershed) is considered as the analysis area for cumulative effects.

All of the effects analysis in this section assume that the required project design criteria, mitigation measures, and best management practices described in chapter 2 would be implemented.

Soil Productivity

The majority of existing ground disturbance features readily observable in the field were heavily compacted historic skid trails, landings, and existing unclassified roads. Also observed were areas of displacement or removal of organic material resulting from historic logging activity. The ground based units visited still show signs of skid trail compaction. There does not seem to have been substantial recovery on skid trails where the old harvest units are located on slopes less than 30 to 40 percent.

The percentage of area in a detrimental soil condition within the activity area varies from stand to stand due to the occurrence, manner, and extent of past timber harvest and fuel treatment activities. All of the units were previously harvested between 35 and 65 years ago, and subsequent site preparation included broadcast burning and perhaps machine piling. Management practices at that time did not restrict machine movement, skid trail location and density, removal of woody debris or intense burning. Therefore existing detrimental conditions within some ground based units are higher than the 20 percent allowed under the current guidelines. Decompaction of existing skid trails and unclassified roads proposed for use on the project would decrease this value, again varying on a unit-by-unit basis. Overall, average existing detrimental soil conditions within the 44 proposed thinning units (880 treatment acres and 157 acres of pre-designated skips) are at approximately 15.7 percent. Included in this 15.7 percent estimate are 88 acres of existing system and unclassified roads, and 75 acres of legacy landings and skid trails.

Table Soils-2 displays the existing detrimental soil conditions and estimated soil disturbance associated with each alternative.

Table Soils-2. Soil disturbance estimates for Alternatives A and B (Activity Area scale)

Type of Soil Disturbance (estimated acres)	Alternative A: No Action	Alternative B: Proposed Action
Legacy (existing) compaction (acres) [1]	163	163
New compaction - permanent roads (acres)	0	0
New compaction- thinning, landings, temporary roads (acres)	0	66
Decompaction/obliteration of existing unclassified roads (acres)	0	(41)

Table Soils-2. Soil disturbance estimates for Alternatives A and B (Activity Area scale)		
Type of Soil Disturbance (estimated acres)	**Alternative A: No Action**	**Alternative B: Proposed Action**
Severely burned soils - slash treatments (acres) [2]	0	7
Net soil disturbance (acres)	163	195
Net soil disturbance (percent of total unit acres)	15.7 %	18.8 %

1 *Legacy compaction is compaction that already exists, and includes unclassified roads, skid trails, landings, and OHV and other trails.*

2 *Severely burned soil is a condition where soil has been heated to a point that alters soil structure, resulting in increased soil erosion potential, decreased soil organisms, and decreased nutrient holding capacity. Severely burned soil often occurs in the immediate area of concentrated pile burning.*

Alternative A – No Action Alternative

Direct and Indirect Effects

Because there are no ground disturbing management activities proposed in this alternative, there would be no new soil disturbance or losses to soil productivity. Existing logging roads and landings would not be used or restored, and would likely remain in a detrimental condition for the foreseeable future. Approximately 41 acres of existing unclassified roads that would be decompacted and obliterated as mitigation in the proposed action would remain in their current condition. Detrimental soil conditions in the proposed thinning units would remain unchanged at approximately 15.7 percent.

Because there would be no management activities, there would be no cumulative effects with other past, present, or foreseeable management activities. Percent disturbed soil condition would slowly decline in the long-term, as compacted areas move toward recovery due to physical and biological processes.

Alternative B - Proposed Action

Direct and Indirect Effects

Under Alternative B, approximately 66 acres of new soil disturbance would be expected in the form of new temporary roads, log landings, and skid trails. These would be decompacted ("ripped") after use as part of project operations. Approximately 41 acres of pre-existing temporary roads, landings, and skid trails used for the project would be decompacted and obliterated after use. Soil damage in skyline cable yarding and helicopter thinning units would be minor, with a six-acre increase in detrimental conditions.

At the completion of project activities, Alternative B would continue to meet standards and guidelines for soil disturbance with an overall estimated 18.8 percent of the activity area in detrimental soil conditions. Restoration of temporary roads and landings by decompaction and revegetation would initiate recovery of productivity, but is not expected to return the soil to its original condition and productivity. Existing temporary roads and landings within activity areas not used during the project would remain in a compacted and displaced condition. These may be treated as a sale area improvement if sale area improvement funds are available.

Specific soil and water quality concerns include the potential for puddling and concentration of water on newly compacted skid trails and landings, leading to overland flow, erosion and potential sedimentation. However, these impacts should be minimized due to the following:

- The majority of the ground-based thinning units are located on the Deep Glacial Valley soils group (M, N, and L landforms) on slopes less than 30 percent. Stream densities are low on these landforms, and riparian no-cut buffers and equipment setback requirements would provide adequate vegetative filtering of any erosion or overland flow of water on skid trails.
- Soils on M, N, and L landforms have a moderate compaction hazard rating. Surface soils are moderately coarse textured, and have high infiltration and permeability, so any surface runoff on compacted soils would travel only a relatively short distance before it would quickly infiltrate into less compacted areas.
- Compaction and other detrimental conditions that occur on soil types with seasonal high water tables on landforms N and M should be minimal, primarily due to the design criteria and mitigations described in Chapter 2, particularly the requirement that operations on these soil types would be conducted during the dry summer season (see table 2.24).

Erosion

Existing management-related erosion sites are minor in all harvest units, and are primarily associated with skid trails, landings, and unclassified roads on slopes greater than 30 percent in the Deep Glacial Valley soils category. None of these sites appeared to be contributing toward sedimentation. Isolated areas of active erosion were observed in the following thinning units or along thinning unit boundaries within the activity area, or on system roads that would be used for log haul.

- Steep, incised stream channels and escarpments landforms (SMU 663X7): thinning units S53B1, S53B2, S52B, S74, S72, S99B, S99C, S71, S70C, S70A, L60A, L1A. Areas of small (less than 1/8-acre) streambank failures and other very steep slopes along escarpment margins and headwall areas. Total acreage estimated at 3 acres. It could not be determined if these erosion features were associated with previous management activities.
- Minor gullying, sheet erosion, and washouts on unclassified and previously decommissioned roads within harvest units. These sites have mostly stabilized. Total acreage estimated at 0.5 acres. These sites are management-related.
- Steep, unstable cutslopes on several roads located on both Mountain Upland Soils and Deep Glacial Valley Soil types (SMUs 423H7, 416D8, 663X7). System roads with active cutslope and fillslope erosion include: 2300-000, 2340-430, 2356-000, 2360-000, and 2400-000. These sites are also isolated, although they may contribute to minor amounts of chronic sedimentation, primarily associated with cutslope erosion features and road stream crossing failures and diversions. Total acreage estimated at 2.0 acres. These sites are management-related.

Estimated changes in exposed soil and effective ground cover associated with the two alternatives are displayed in table Soils-3.

Table Soils-3. Estimated effects to effective ground cover from the two alternatives

Exposed Soil	Alternative A: No Action	Alternative B: Proposed Action
Harvest and landings (acres)	0	71
Slash treatments (acres)	0	7
Exposed soil from management (% of unit acres)	na	7.5
Effective groundcover (%)	95-100% [1]	87.5-92.5% [2]

1 *In the case of the No Action alternative, this is existing effective groundcover, or the baseline condition that would be affected if management activities were to occur.*

2 *For the Proposed Action, reduction would be 7.5% from the No Action baseline.*

Alternative A – No Action

Direct, Indirect Effects, and Cumulative Effects

Because no activities would occur, erosion risk and erosion rates would remain at current levels, with adequate levels of effective ground cover (estimated at 95 to 100 percent) within all proposed thinning units. Opportunities to address existing management-related erosion and compaction, primarily on existing unclassified roads, landings, and skid trails, would be foregone.

Because there would be no management activities, there would be no cumulative effects with other past, present, or foreseeable management activities. The impacts from past activities would continue to be ameliorated slowly through root mass expansion, and also with continued ground cover, organic matter, and litter layer development.

Alternative B – Proposed Action

Direct and Indirect Effects

The combined effect of thinning, landings, and fuel treatments would expose soil across approximately 7.5 percent of the activity area under the Proposed Action (Table Soils-3). While limited effects on ground cover would occur, disruption of natural processes such as surface erosion and nutrient cycling would be very limited under this alternative. Lopping and scattering of slash and tops as described in the Fuels section would increase effective ground cover distribution after logging.

With the proposed action, all thinning units would have some temporary reductions in effective ground cover, but the remaining ground cover would be sufficient to minimize erosion. Reduction in predicted estimated ground cover after thinning is estimated at 3 percent in cable and helicopter units (including helicopter landings), and 10 percent in ground based thinning units. Road development accounts for 1 percent.

Ground disturbing activities associated with timber harvest and road development have been designed to maintain effective ground cover and to minimize the risk of erosion and the potential for sediment to be transported to streams (see chapter 2). These concerns are

primarily addressed through riparian no-cut buffers and road development restrictions that provide adequate vegetation with effective ground cover and tree canopy between streamcourses and areas where activities would occur. The proposed temporary roads are in locations that are nearly level to gently sloping, and that have very few stream crossings.

Road development and ground-based yarding activities are largely confined to the dry season. This restriction would reduce the risk of any surface erosion due to ground disturbances. All new temporary and unclassified roads and primary skid trails for the project would be fully obliterated and have slash and mulch placed on them following completion of harvest operations to reduce compaction, increase infiltration rates, and provide for effective ground cover to reduce surface erosion.

Based on previous monitoring by the project Soil Scientist, it is anticipated that some erosion may still occur within or directly adjacent to activity areas, primarily during winter storm events, producing sediment that could potentially reach streamcourses. Conditions where such sedimentation might originate include:

- Rutted areas on compacted skid trails on slopes greater than 10-15 percent, and at temporary road intersections and landings near system roads. Water transport of erosion on these sites may enter the road prisms, where sediment reaching ditchlines could be transported to nearby streamcourses.
- Yarding operations along roads, where operations cause destabilization of steep cutslopes, resulting in erosion into ditchlines.

Implementation of the erosion and sediment control management practices described in Chapter 2, as well as the numerous standard timber sale contract clauses that address erosion, should minimize sedimentation from these activities; any effects would be minor and short-term.

Landslide Risk

Road construction and timber harvest can increase the rate of mass failures (landslides) by changing slope configuration and strength, and hydrologic processes. Slope configuration is altered by roads where cut and fill slopes area steeper than natural slopes. Slope strength is decreased by removal of trees where root systems provide resisting forces to slope movement and provide uptake of subsurface water that is a driving force to slope movement. Hydrologic processes are altered through interception of subsurface water by roads, and decreased evapotranspiration from loss of vegetation cover. Changes in slope condition that affect slope stability also require a natural triggering mechanism such as heavy rainfall, windthrow or earthquake activity to initiate a landslide.

The evaluation of historic landslide incidence was accomplished by using the Washington State Department of Natural Resources Landslide Assessment mapping, a compilation of historic aerial photo mapping and field verification. Additional recent evaluation was made through aerial photographs and 2009 NAIP digital imagery, field investigations, and local knowledge. During the development of the proposed action, proposed treatment units where active slope instability or a likely increase in slope instability associated with proposed activities were

identified were added to the Riparian Reserve "potentially unstable" management allocation. These areas then had one or more of the following applied:

- The proposed thinning unit was dropped from the project;
- The unit boundary was modified to exclude potentially unstable areas;
- A "no cut" buffer was established;
- A "skip" area was applied within the unit so that no trees around the unstable feature would be cut;
- The proposed logging system was modified to reduce the landslide risk associated with the yarding system;
- Proposed temporary road development in an area with landslide risk was dropped or modified;
- Other project design criteria, mitigations, or management practices were applied to address landslide risk.

Within the Upper South Fork Vegetation Management planning area, a total of 629 inventoried landslides have been mapped from aerial photos (table Soils-1, above). Although the report did not differentiate between natural and management-related landslides, many of these mass wasting features were associated with clearcut harvesting and roads (poor road location and/or construction techniques). Over the last 15 years, numerous high intensity rain-on-snow winter storms have resulted in additional landsliding events, many of which delivered large quantities of sediment to major tributaries and the mainstem of South Fork Skokomish River (anadromous and resident fish habitat). These landslides are generally associated with deteriorating and undersized road infrastructure (stream crossing culverts, fills, sidecast failures), and lack of adequate road maintenance.

Alternative A – No Action

Under the No Action alternative, no management actions would take place. The extent of instability (both shallow rapid and deep seated) in the planning area and activity area would be unaffected by project activities. Mass soil movement and landsliding in areas of instability would likely continue when triggered by intense rainstorm events. The overcrowded trees within the project stands would continue to grow slowly. Existing shallow landslide scars within the project area would slowly stabilize and revegetate.

No new temporary road construction or reconstruction would occur, so there would be no increased landslide risk from road development. Within the project area (activity areas and haul routes), there would be no change in current system road maintenance. System road repairs, stormproofing and upgrading activities proposed under alternative B would not occur, although some roads would receive restorative treatment through unrelated projects.

Alternative B – Proposed Action

All of the proposed thinning units were clearcut harvested 35 to 65 years ago. Few considerations were made to protect potentially unstable areas located within riparian zones and other potentially unstable landforms. Cable and tractor logging equipment travelled on steeper slopes, dragging logs and causing soil damage. Road construction techniques and

logging practices did not meet the standards that they do today. Therefore, the level of stability of all proposed thinning stands have been "tested" by past activities that were considerably more impactful than the current proposal. Areas that remained stable after the original clearcut harvest would likely continue to be stable after thinning. A conservative approach to evaluating the effects of thinning on slope stability is to identify the areas of the units that show evidence of landslide activity and exclude those areas from any harvest. This approach was taken in the development of Alternative B.

Thinning of the proposed units, road development, and associated activities are not expected to contribute to any new landslides within or adjacent to the activity areas. The action alternative is designed to exclude activities from existing active or potentially active landslide features, so that the risk of triggering a landslide is avoided. The proposed action would thin areas that are considered to be stable by a slope stability specialist. Additional unstable areas identified during thinning unit layout would be designated as "skips" or otherwise excluded from treatment. Thinning would not affect hillslope stability in the short term because the roots of the remaining trees already intermingle with those trees that would be cut, and new root growth would result before the roots of cut trees decay and lose their strength. Over the long term, the thinning would enhance tree growth and tree root development, restoring hillslope stability to original levels. Existing shallow landslide and small rotational failures within the activity area would be protected and would continue to slowly stabilize and revegetate.

Existing system roads that would be used for haul would be maintained and repaired as needed. These actions would reduce risk associated with the proposed action, as well as some of the risk of future resource damage from road-related landsliding.

Alternative B

Cumulative Effects

Cumulative effects on the soil resource include effects of all past, present, and foreseeable actions that cause soil disturbance within the project area. The proposed action, in combination with past or reasonably foreseeable future actions on nearby federal lands, would not likely increase the amount of detrimental soil conditions caused by past actions. The contribution of soil disturbing impacts by the proposed action would not cumulatively degrade soil productivity or the soil resource. Because no roads or other permanent features would remain as part of this project, the amount of detrimental soil conditions would not increase across the watershed. By obliterating some existing skid trails and unclassified roads, the project would incrementally reduce existing detrimental soil conditions by 41 acres.

The proposed action would have no measurable incremental impacts on slope stability when added to the impacts of other nearby, past, present, or reasonable foreseeable future actions.

Monitoring (Alternative B)

If Alternative B is implemented, the following monitoring would be conducted:

- Compliance review monitoring would be completed during project implementation to assure that soil and related resource protection design criteria, mitigation measures, and best management practices described in Chapter 2 are implemented.

- Effectiveness monitoring would be conducted prior to the close of the implementation of project activities to evaluate the effectiveness of mitigation measures to protect water quality, water quantity, and Riparian Reserves.
- Effectiveness monitoring would be conducted after project implementation to determine effectiveness of project design criteria and mitigations in minimizing soil and water impacts and in meeting Forest Plan standards and guidelines for soil, riparian, and related resource protection. Results of this monitoring would be used to inform future project proposals.

FISHERIES AND AQUATIC HABITAT

Affected Environment

The Upper South Fork Skokomish Vegetation Management Project planning area falls within the South Fork Skokomish River watershed. This watershed is on the east-side of the Olympic Peninsula and drain into the Hood Canal. All of the proposed sale area units fall within the Upper South Fork Skokomish River subwatershed. The timber haul route passes through the Lower South Fork Skokomish River and North Fork Skokomish River subwatersheds. Primary streams (which include the tributaries that flow into them) that have the potential to be affected are the South Fork Skokomish River, Flat Creek, Rock Creek, Brown Creek, LeBar Creek, Cedar Creek, Pine Creek, and Church Creek. Lower tributaries to the North Fork Skokomish River that have the potential to be effected are McTaggert Creek, Gibbons Creek, and Frigid Creek.

Upper South Fork Skokomish River subwatershed

Potential affected reaches of the South Fork Skokomish River are approximately from River Mile (RM) 14.2 (confluence with Brown Creek) to 23.5 (confluence with Church Creek). Other potential affected tributary reaches to the South Fork Skokomish are as follows: Brown Creek RM 0-2.7, LeBar Creek RM 0-1.5, Cedar Creek RM 0-3.1, Pine Creek RM 0-0.8, and Church Creek RM 0-0.7. The anadromous barrier on the South Fork Skokomish is at approximately RM 26.5. Extents of anadromous habitat within the tributaries to the South Fork Skokomish are as follows: Brown Creek RM 6.5, LeBar Creek RM 1.2, Cedar Creek RM 0.4, Pine Creek RM 0.2, and Church Creek RM 0.7. Fish observed in the upper anadromous reach of the South Fork Skokomish are coho salmon, steelhead, bull trout, sea-run cutthroat trout, lamprey and sculpin. Above anadromous barrier resident rainbow and cutthroat trout are present.

Lower South Fork Skokomish River

Potential affected streams would be streams that intersect the main timber haul routes of FSR 2300 and 2340, which are a number of unnamed tributaries to the South Fork Skokomish River, SF Skokomish River, Rock Creek and Flat Creek. The unnamed tributaries to the South Fork Skokomish are non-fish-bearing streams. The reaches of Rock and Flat Creeks that intersect the haul route have resident rainbow or cutthroat trout in them.

Lower North Fork Skokomish River

Potential affected streams would be streams that intersect the main timber haul route of FSR 2340, which are a number of tributaries to the North Fork Skokomish River such as: McTaggert Creek, Gibbons Creek, and Frigid Creek. McTaggert and Gibbons Creek have had anadromous fish observed at the 2340 road crossings. Only resident fish have been observed at the Frigid Creek road crossing. Fish present in the South Fork Skokomish River and Lower North Fork Skokomish River, their stock status, and their potential presence within the project area are listed within Table Fisheries-1.

Table Fisheries-1. Fish presence in potentially affected watersheds							
Species and status information				**Potential presence in watershed** (X = species does or may occur within the named watershed)			
Fish Species	**ESU**	**Status***	**Sensitive Species**	**Within Project Area**	**Lower South Fork Skokomish River**	**Upper South Fork Skokomish River**	**Lower North Fork Skokomish River**
Chinook salmon	Puget Sound	Threatened[1]	No	No	X	Extirpated	X
Summer chum salmon	Hood Canal summer-run	Threatened[2]	No	No	Extirpated		Extirpated
Coho salmon	Puget Sound/Strait of Georgia	Healthy[3] (Skokomish stock)	Yes	Yes	X	X	X
Steelhead trout	Puget Sound	Threatened[4]	No	Yes	X	X	X
Cutthroat trout	Puget Sound	Unknown[5]	Yes	Yes	X	X	X
Bull trout	Coastal Puget Sound	Threatened[6]	No	Yes	X	X	X
Lamprey	Not Applicable	Unknown	Yes	Yes	X	X	X
Sculpin	Not Applicable	Unknown	No	Yes	X	X	X

** Sources for status information:*

1. *NMFS 1999a*
2. *NMFS 1999b*
3. *WDFW Salmonid Stock Inventory (SaSI) 2002*
4. *NMFS 2007*
5. *WDFW SaSI 2000*
6. *USFWS 1999*

Threatened Fish Species and Critical Habitat

Hood Canal summer chum salmon, Puget Sound Chinook salmon, and Puget Sound steelhead have been listed as threatened by the National Marine Fisheries Service (NMFS) under the Endangered Species Act and are present in the South Fork Skokomish River watershed. Critical Habitat for Hood Canal summer chum salmon and Puget Sound Chinook salmon have also been designated by NMFS. Coastal Puget Sound bull trout have been listed as threatened and critical habitat has been designated by the U.S Fish & Wildlife (USFWS).

Hood Canal summer chum salmon are considered to be recently extinct in the Skokomish basin (PNPTT & WDFW 2000). The historic upper extent of summer chum in the South Fork

Skokomish would have been at approximately RM 6. Critical habitat for Hood Canal summer chum does not extend into the South Fork Skokomish River.

Puget Sound Chinook (summer/fall) extend up to approximately RM 6 in the SF Skokomish and do not pass beyond the gorge to the upper SF Skokomish River. Distance to the closest harvest unit in the planning are is about 9 miles. However critical habitat for Puget Sound Chinook in the SF Skokomish River extends up to RM 14.2 (confluence with Brown Creek) and up approximately to RM 1.2 in Brown Creek.

Puget Sound steelhead are present in the Upper South Fork Skokomish subwatershed primarily in the mainstem of the SF Skokomish River up to RM 26.5 (anadromous barrier) and also within the anadromous reaches of the SF Skokomish tributaries: Brown Creek, LeBar Ck, Cedar Creek, Pine Creek, and Church Creek. Critical habitat for Puget Sound steelhead has not yet been designated.

Coastal Puget Sound bull trout are present in the Upper South Fork Skokomish subwatershed primarily in the mainstem of the South Fork Skokomish River up to RM 26.5 (anadromous barrier) and also within the anadromous reaches of the South Fork Skokomish tributaries: Brown Creek, LeBar Ck, Cedar Creek, Pine Creek, and Church Creek. Critical habitat for bull trout follows their distribution in the upper South Fork Skokomish River as described above.

Essential Fish Habitat

Under the Magnuson-Stevens Fishery Conservation and Management Act, federal agencies are required to consult with the NMFS on activities that may adversely affect Essential Fish Habitat (EFH). EFH includes spawning and rearing habitat for Chinook, coho, and pink salmon. There is not a sustained pink salmon population in the Skokomish basin. Chinook salmon are not found in the Upper South Fork Skokomish River subwatershed. All anadromous reaches within the Upper South Fork Skokomish River, Lower South Fork Skokomish, and Lower North Fork Skokomish River subwatersheds are considered EFH.

Sensitive Fish Species

Fish species on the Sensitive Species List that occur within the Upper South Fork Skokomish River subwatershed are: Puget Sound/Strait of Georgia Coho Salmon, Puget Sound Coastal Cutthroat Trout and, River lamprey. These sensitive fish species have the potential to be present within the proposed project area.

Environmental Consequences

Method of analysis

Selected indicators from the “Matrix of Pathway and Indicators” taken from the 1996 NMFS document, “Making Endangered Species Act Determinations of Effects for Individual or Grouped Actions at the Watershed Scale” were used to analyze the proposed action. There are three Project Elements (PE) – thinning within Riparian Reserves, temporary road construction and reconstruction, and log haul – that have the potential to affect the following nine matrix indicators: temperature, sediment, substrate embeddedness, pool quality, streambank

condition, drainage network increase, road density and location, and function of riparian reserve (Table 3). The proposed action was analyzed using these selected indicators to assess potential environmental effects based on existing conditions at the project and watershed. The ratings of these indicators show relative change to the baseline, and display if the action would have a beneficial, neutral or negative impact on the habitat indicator.

A detailed discussion of all the habitat indicators that are included in the NMFS matrix for salmon will be included in a Biological Assessment (BA) for this timber sale proposal prior to implementation of work. This BA will include the entire list of indicators and accompanying narratives.

Table Fisheries-2 shows a summary of the indicators used for this analysis. Indicators were evaluated for long-term impacts, and are relative to desired conditions unless otherwise specified.

Table Fisheries-2. Potential project effects to indicators from the "Matrix of Pathway and Indicators"

	Baseline (Watershed Scale – 5th field HUC) South Fork Skokomish River			**Effects of Proposed Alternatives (Project Scale)**		**Effects of Proposed Alternatives (Watershed Scale)**	
Indicator [1]	**Properly Functioning**	**At Risk**	**Not Properly Functioning**	**Alt A – No Action**	**Alt. B – Proposed Action**	**Alt A – No Action**	**Alt. B – Proposed Action**
Temperature			X	M	M	M	M
Sediment		X		M	D	M	M
Substrate Embeddedness		X		M	D	M	M
Streambank Condition			X	M	D	M	M
Drainage Network Increase			X	M	M	M	M
Road Density & Location			X	M	M	M	M
Riparian Reserve			X	M	R	M	M

1 Source: NMFS 1996

The "Baseline" columns in Table fisheries-2 represent the current condition of the overall South Fork Skokomish River watershed. The two "Effects" columns present the effects the proposed action would be likely to have on the indicators:

- R (restore) = project is likely to have a beneficial impact on habitat indicator
- M (Maintain) = project may affect indicator, but impact would be neutral

- D (Degrade) = project is likely to have a negative impact on the habitat indicator.

At the fifth-field watershed scale, none of the indicators are currently considered to be "properly functioning" in the South Fork Skokomish River.

Alternative A - No Action

Direct and Indirect Effects

This alternative represents no change to the existing baseline, and would have no direct or indirect effects on instream or wetland aquatic habitat, or water quality within the Upper South Fork Skokomish River subwatershed. All indicators – temperature, sediment, substrate embeddedness, streambank condition, drainage network increase, road density and location, and function of riparian reserve – would be maintained (M). The present sediment recruitment rates into stream channels would continue. The current amounts of bedload and suspended sediment routed down river channels associated with natural conditions and previous activities (timber harvest, road building) would slowly reduce over time, through regrowth of the cutover areas within the drainage.

Riparian vegetation would continue to grow at current rates, creating some mature conifers that would eventually be recruited into channels as large organic debris. The species diversity of riparian vegetation would be similar to current conditions over the next few decades, but hardwoods would then begin to be slowly displaced by conifers. In the absence of any large flood events, instream aquatic habitat would continue to be similar to current conditions. The possible impacts of large flood events events are variable, and are dependent on reach specific channel conditions.

Cumulative Effects

No cumulative effects would occur within the South Fork Skokomish River watershed and Lower North Fork Skokomish subwatershed because there would be no management action taken that would add to existing effects of past, present, and foreseeable actions.

Alternative B – Proposed Action

The following discussion of potential environmental consequences of the proposed action draws on and expands the information presented in the "Effects" columns of table Fisheries-2. Each indicator is assessed in light of the three Project Elements (PE): thinning within Riparian Reserves; temporary road construction and reconstruction; and log haul. This discussion frequently refers to the riparian no-cut buffers prescribed for the proposed action (table 2.10). For reference, the no-cut stream buffer width information from table 2.10 is repeated in table Fisheries-3. Implementation of these minimum buffer widths is assumed in this analysis.

Table Fisheries-3. Riparian no-cut buffer widths by stream type

Stream type	Minimum no-cut buffer width
South Fork Skokomish River mainstem	200 feet, measured from outer edge of the channel migration zone on either side of channel.

Table Fisheries-3. Riparian no-cut buffer widths by stream type	
Stream type	**Minimum no-cut buffer width**
All other fish bearing streams (includes intermittent fish-bearing streams).	100 feet, measured from the outer edge of the streambank.
Non-fish-bearing perennial streams	70 to 85 feet, based on existing tree heights and adjacent land slopes, measured from the outer edge of the streambank.
Non-fish-bearing intermittent and ephemeral streams	50 feet, measured from the outer edge of the streambank.

Direct and Indirect Effects

Temperature

PE – Thinning within Riparian Reserve

Proximity: Three harvest units out of the 44 proposed units – S053B1, S053B2; S071 – are adjacent to fish habitat. Of these three, units S053B1 and S053B2 (ground base yarding) are adjacent to Church Creek – bull trout and steelhead habitat. Unit S071 (helicopter with prebunching) is adjacent to the mainstem SF Skokomish River – coho, bull trout, and steelhead habitat.

Probability: Commercial thinning would occur within the Riparian Reserve; however no thinning would occur in close proximity to streams. No cut buffers would be implemented on all streams in part to protect existing shade-producing trees from being cut (see table fisheries-3). The width of the no-cut buffers would expand on steep and unstable slopes. The thinning would be removing the less dominant and co-dominant trees within the stand; the dominant shade-producing trees would remain. Given the riparian no-cut buffers and silvicultural prescriptions, changes in stream shading or stream temperature would be very unlikely.

Magnitude: None

Element Summary: No change in stream shade would be anticipated from the proposed timber sale activities. No increase in water temperature would be anticipated as a result of any activities under this alternative, which would have a neutral effect to water temperature.

Sediment/turbidity and Substrate embeddedness

These two indicators, Sediment/turbidity and Substrate embeddedness, are grouped because they are affected similarly by project elements. Turbidity is used as an indicator of fine sediment suspended in the water, and substrate embeddedness is an indicator of fine sediment that settles onto the streambed.

PE – Thinning within Riparian Reserves

Proximity: Four harvest units out of the 44 proposed units – S053B1, S053B2; S071, S072 – are adjacent to fish habitat. S053B1 and S053B2 (ground base yarding) are adjacent to Church Creek – bull trout and steelhead habitat. S071 and S072 (helicopter with prebunching, and helicopter yarding) is adjacent to the mainstem South Fork Skokomish River – coho, bull trout, and steelhead habitat.

Probability: Table Fisheries-4 summarizes the type of logging systems that would be used within the Riparian Reserve. Ground-based logging has the highest potential to disturb soils of the different logging systems because of its potential to displace the organic and surface soil layers, increasing the potential for overland flow and erosion. Approximately 53 acres within the Riparian Reserve would be logged using ground-based equipment. The project design criteria described in chapter 2, including the no-cut buffers, would all but eliminate the potential for sedimentation associated with ground-based logging. Rashin et al. (2006) reported that restricting ground disturbance in 10 meter (30 foot) buffer along streams channels prevented sediment delivery to streams from about 95 percent of harvest-related erosion features. This project's minimum buffers are all wider than 10 meters.

Table Fisheries-4. Acres in Riparian Reserve (RR) by logging system

Logging System	Acres in RR
Ground-based yarding	53.0
Cable yarding	97.4
Helicopter yarding	77.7
Helicopter/prebunching	10.9
Total	**239.0**

Magnitude: None

Element Summary: Buffers on all streams in the sale area would provide a sufficient distance from water sources to protect them from sediment related to felling, yarding, skidding, and slash disposal activities from entering streams.

PE – Temporary Road Construction and Reconstruction

Proximity: There is only one stream crossing associated with temporary road construction (reconstruction of an old unclassified road) that would entail new culvert installation. The culvert installation would be on temporary road S70B off of FSR 2300240 to access Unit S070C. The new culvert installation is on a non-fish-bearing stream, which flows into the South Fork Skokomish River. The distance to anadromous fish habitat is approximately 0.4 miles.

Probability: Culvert installations and removals at stream crossings have the potential for generating sediment and turbidity that could impact aquatic habitat. Only one new stream crossing culvert would be installed in conjunction with the reconstruction of unclassified roads. All newly installed stream crossing culverts that would be in place during the wet-season would be sized to accommodate 100-year flow events.

Magnitude: Installation and removal of culverts has the potential to cause sediment input and turbidity during project activities. Stream channels, however, would likely be dry or have minor amounts of flow during low summer flows when culverts would be installed and removed. Dewatering the stream channel within the project area prior to culvert installation would further minimize any short-term impacts.

Since the culvert installations would occur during summer low flow conditions, the amount of sediment mobilized during actual project activities would be small and transport would be very limited. Duncan et al. (1987) demonstrated that even fine sediments produced from road surfaces settled out rapidly and were stored in small mountain stream channels. Less than 50 percent of sediments traveled further than approximately 310 - 410 ft. The closest new stream crossing culvert installation to anadromous habitat is along temporary road S70B off of FSR 2300240 and is approximately 0.4 miles (2112 feet) downstream.

There would be a potential for some additional sediment to be mobilized from the disturbed fill slopes at culvert installation and removal sites during the first winter before they become fully revegetated. Grass seeding and soil stability treatments applied during and immediately after excavation would limit short-term sediment production. Any sediment that erodes from the disturbed fill slopes could be carried into the South Fork Skokomish River during high flows. Given that erosion control measures would be implemented at the stream crossings sites, erosion and sediment production from stream crossing sites is expected to be minimal.

Table Fisheries-5 contains a summary of proposed construction and reconstruction of roads in Riparian Reserve (RR).

Table Fisheries-5. Summary of proposed temporary road development by road type

Type of temporary road construction	Miles proposed	Miles in RR
Reconstruction of existing unclassified road	2.27	0.58
Reopening of existing decommissioned road	0.37	0.02
New road construction	0.91	0.16
Total temporary road mileage	**3.55**	**0.76**

Element Summary: Impacts to fish and fish habitat from temporary road construction, reconstruction, and decommissioning would be negligible and discountable. The small total length of proposed road development (including 0.76 miles in Riparian Reserve), with only one new culvert stream crossing, would generate only limited sediment and turbidity. Road construction activities would occur during the summer low-flow season, which would limit transport of any introduced sediment in small tributary channels. The long distance to downstream fish habitat would further limit potential sediment transport to fish habitat.

PE – Log Haul

Proximity: Fish-bearing streams that intersect the timber haul routes and potentially may be effected by sediment generated from log haul are: Pine Creek, Cedar Creek, LeBar Creek, Brown Creek, Rock Creek, Flat Creek, McTaggert Creek, Gibbons Creek, Frigid Creek and the SF

Skokomish River. Anadromous stream crossings are the SF Skokomish River, LeBar Creek, McTaggert Creek, and Gibbons Creek.

Probability: Sediment would be likely to be generated by log haul during wet weather. Some sediment may enter streams, especially after major rain storms and during heavy levels of timber haul. Sediment delivery generally occurs where roads are either close to or cross streams. Sediment derived from road surfaces would be delivered either directly or via ditches during higher flows (storm events). Fine sediments would probably remain in suspension and move rapidly through the system to settle in low gradient reaches.

Best management practices would be implemented to minimize the potential for sediment delivery to streams. If standard mitigation erosion-control methods such as sediment traps and spot rocking at stream crossings are inadequate to prevent sediment delivery to streams log haul would be suspended. This is intended to reduce the frequency and magnitude of potential sediment delivery to stream channels.

Magnitude: Approximately 75 percent of the total proposed treatment acres in the planning area would be hauled on the FSR 2300 road. On average approximately four truckloads per day is the anticipated traffic volume generated from ground base and cable harvested units. Sediment delivery to streams can increase 7.5 times baseline conditions from more than four loaded trucks per day (Reid and Dunne 1984). Truck traffic and road maintenance procedures such as grading or resurfacing have a major influence on the amount of sediment transported by the road ditch during the subsequent precipitation event (Reid 1981). The amount of sediment that is delivered to stream channels is also influenced by the frequency of ditch-relief culverts that spread accumulated ditch water out onto the forest floor, and by erosion control techniques such as check dams and settling basins. FSR 2300 is a mainline road that receives regular maintenance. The combination of these factors and the prescribed mitigation measures would result in a small potential magnitude of sediment delivery to streams.

Some sediment that reaches stream channels would be trapped and stored in tributary streams before reaching anadromous reaches of the SF and NF Skokomish River; however, finer particles may reach downstream reaches in the form of suspended sediment. The magnitude of material transported downstream to fish-bearing stream reaches and the potential effects to substrate composition is expected to be small. During rain events, when there is the potential for sediment to be routed through smaller tributaries, sediment effects would be diluted as the smaller tributaries enter the mainstem of both the South Fork and North Fork of the Skokomish River. Just below the confluences of these smaller tributaries, the sediment associated with the project's log haul would probably be indistinguishable from the natural higher background sediment loads during storm events.

Distribution: Log haul would occur on approximately 3.5 miles of proposed temporary roads and approximately 51.5 miles of existing authorized Forest Service system roads. Main arterial roads on which log haul potentially may occur are the 2300, 2340, 2353, 2354, 2356, 2360, 2361. Table Fisheries-6 contains a summary of haul routes by subwatershed.

Table Fisheries-6. Haul routes by subwatershed			
Subwatershed	**Miles of Paved Road**	**Miles of Gravel Road**	**Number of stream crossings**
Upper South Fork Skokomish	0.8	26.6	82
Lower South Fork Skokomish	7.8	6.5	25
Lower North Fork Skokomish	0	11.3	9

Frequency: On average, for ground based and cable operations, approximately four truckloads per day is the anticipated traffic volume generated from the proposed thinning. Traffic volume would be higher for helicopter and prebunching harvested units. Most of the ground-based and cable units would be harvested in the summer, early fall season, while the helicopter and prebunching would be harvested in the late fall, winter, spring seasons.

Duration: Sedimentation due to log haul is considered short-term in duration. The duration of sedimentation due to log haul is expected to last only while hauling activities occur. This planning area would likely be broken into at least two timber sales, and timber sales have the potential to last up to 5 years. Thus, temporary roads for each timber sale have the potential to be open for up to 5 years, with timber haul occurring intermittently over that same time. Timber sales would likely be sold one to two years apart, thus effects across the planning area could be dispersed across 5-7 years.

Timing: Approximately 85 percent of the roads that would be used have gravel surfacing, and log haul could occur throughout the year.

Nature: Negative effects to aquatic habitat from sediment inputs from log haul would likely occur, however, adverse impacts would be limited. The relatively low magnitude and frequency of haul, and the mitigation measures that would be implemented to control erosion and sediment delivery to stream channels would all minimize potential effects. Pulses of sediment during storm events are anticipated to occur. Haul would be shut down until road conditions improve. No long-term adverse impacts to fish populations are anticipated.

Element Summary: Increased sediment delivery and turbidity in streams from timber haul would occur only during periods when timber haul was actually occurring. Because timber sale activity is typically intermittent, adverse sediment and turbidity impacts would also be intermittent, however they would extend for several years as various sales were prepared and logged.

Actual adverse impacts to the aquatic system from increased sediment delivery or turbidity would be small, localized, intermittent, and temporary. No adverse impacts would be discernable at the watershed scale.

There would be a negative and short-term effect to the Sediment/turbidity and Substrate embeddedness Indicators due to log haul activities at the site scale. Effects to fish or fish habitats are expected to be minor.

Streambank Condition

PE – Temporary Road Construction and Reconstruction

Proximity: The closest new temporary stream crossing is approximately 0.4 miles (2112 feet) from fish habitat.

Probability: Some disturbance would occur on streambanks at the one new stream crossing that would be part of new temporary road construction in Unit S070C along the South Fork Skokomish River. Short term disturbance would occur when the culvert is installed and then again when the culvert is removed as the temporary road is decommissioned. In the long term, streambank condition at the one new crossing site would recover as re-vegetation takes place. Road construction and decommissioning would likely extend over more than one year at the site.

Magnitude: Actual adverse impacts to the aquatic system from decreased streambank condition at the one new culvert site would be minimal. The new culvert site is on a temporary road that would be decommissioned after the timber sale. The new crossing does not present any unusual long-term slope stability or erosion concerns. The new crossing is on a non-fish-bearing stream above anadromous fish habitat. No adverse impacts to streambank condition would be discernable at the watershed scale.

Element Summary: At the project scale, temporary road construction would have a short-term, localized negative impact to this indicator. Effects to fish species or fish habitats would be negligible.

Drainage Network Increase

PE – Temporary Road Construction and Reconstruction

Proximity: The closest road building to fish habitat is 0.4 miles (2112 feet).

Probability: New temporary road construction in the Riparian Reserve has the highest probability of increasing the drainage network. The proposed action plans to construct approximately 0.9 mile of new temporary road, and of that 0.9 mile of new temporary road, only 0.2 mile are within the Riparian Reserve.

Magnitude: Because the amount of new temporary road construction is small – less than one mile – and roads would be on relatively flat ground, there would be no increase to the drainage network.

Element Summary: Due to the relatively low amount of new temporary road building, especially in the Riparian Reserve, effects to this indicator would be neutral. Effects to fish species or fish habitats would be negligible.

Road Density and Location

PE – Temporary Road Construction and Reconstruction

Proximity: The closest road building to fish habitat (which is anadromous habitat) is 0.4 mile. Current road density in the Upper South Fork Skokomish subwatershed is 1.2 mi/mi2 and would slightly increase while temporary roads are open, and then return to pre-project levels.

Probability: A total of 3.6 miles of new temporary and unclassified roads would be constructed and reconstructed. Approximately 0.9 miles of new temporary roads would be constructed, and 2.7 miles of existing unclassified and previously decommissioned road would be reopened under the proposed action. Only 0.2 mile of new temp road would be constructed in Riparian Reserve; and 0.6 mile of existing unclassified and previously decommissioned road within Riparian Reserve would be reopened. All new temporary roads and all reopened unclassified and previously decommissioned roads would be decommissioned after timber harvest.

Magnitude: There would be small and temporary increases in road densities in the Upper South Fork Skokomish subwatershed. Road densities would increase temporarily by 0.1 mile per square mile (mi/mi^2) within the subwatersheds. Decommissioning of temporary roads at the completion of the timber sales (which may last up to 5-7 years) would return road densities to pre-harvest conditions.

Element Summary: Because of the temporary and relatively minor increases to road densities, this indicator would not be effected, thus having a neutral rating. Effects to fish species or fish habitats would be discountable.

Riparian Reserve

PE – Thinning within Riparian Reserves

Proximity: Approximately 239 acres of Riparian Reserve would be thinned. Thinning prescriptions within the Riparian Reserve are expected to result in variable canopy densities. Nearest the stream, canopy cover would remain as it is currently because there would be no thinning within the no-cut buffers (see table Fisheries-3 for minimum buffer widths).

Probability: As reported in Rashin et al. (2006), a 10 meter (approximately 33 feet) buffer is expected to prevent about 95 percent of harvest-related erosion features from delivering sediment to streams. All no-cut buffers for this project are wider than 10 meters. These untreated buffers along all streams would protect the immediate area along streams from a number of potential effects, including direct and indirect impacts to channel functions or instream habitat, water temperature, sediment filtering, large wood, nutrient and detritus inputs, soil and ground cover, and microclimates. The no-cut stream buffers would also maintain the habitat connectivity within these core areas of the Riparian Reserve.

Magnitude: Treated portions of the Riparian Reserve outside the no-cut buffers would be thinned to a 60 percent to 90 percent canopy cover. It is expected that over time the thinning conducted in the outer Riparian Reserves would produce larger trees sooner than they may

otherwise have developed. The thinning treatments within the Riparian Reserve are also expected to increase structural and species diversity within these stands.

Thinning in Riparian Reserve could reduce the number of trees that would naturally fall into the stream and contribute to instream large wood; however this impact is expected not to be substantial. The 100-200 ft and 50-85 ft no-cut buffers along fish streams and non-fish streams, respectively, would maintain the vast majority of potential instream large wood sources. Because the thinning would generally remove the smaller trees, most of the trees that would be cut in the Riparian Reserve outside the no-cut buffers are currently too short to reach the stream channel and contribute to instream large wood. The remaining trees within the Riparian Reserve would increase in growth rate, both in height and diameter, in response to the thinning. An increase in stand complexity within the treated portion of the Riparian Reserve is also anticipated.

Element Summary: By implementing riparian reserve stand treatments, positive changes would be expected in the structure and composition of the large wood within riparian reserves as late-successional conditions develop over time. Immediate effects to fish species or fish habitats would be negligible.

Cumulative Effects

Cumulative effects are the impacts on the environment which result from the incremental impact of the project when added to other past, present, and reasonable foreseeable future actions. Cumulative impacts can result from individually minor but collectively substantial actions that overlap through space and time.

The major impacts to aquatic resources across all three subwatersheds from past actions have come from fire, timber harvest, and roads. Generally, on the eastside of the Olympic Mountains, large stand replacement fires occur approximately every 200 years, see Fire/Fuels sections for further detail. All three subwatersheds have had extensive timber harvest starting from the early 1900's. Additionally, logging roads have caused numerous landslides.

In the past few years there have also been several positive efforts made to improve salmonid habitat within all of the South Fork Skokomish subwatersheds by local environmental groups, tribal, federal, state and county governments. Projects such as road decommissioning, levee removal, instream placement of LWD, and conservation easements to protect high value floodplain and riparian areas have been accomplished, and others are underway within the South Fork Skokomish and Lower North Fork Skokomish River watersheds. On National Forest lands, approximately 97.8 miles of road have recently been decommissioned within the South Fork Skokomish watershed, and approximately 25.5 additional miles of existing roads are planned to be decommissioned in within the next several years. Other foreseeable activities across all subwatersheds include repair and maintenance of the road network.

Existing and foreseeable activities on non-federal across the Lower South Fork and Lower North Fork Skokomish subwatersheds include timber sales, road construction, and bank hardening. These future private and state actions are likely to continue, potentially exacerbating the existing adverse effects on salmonid habitat within the lower subwatersheds.

Timber harvest on private lands is expected to continue into the near future, and it is possible that there will be some harvest activities occurring simultaneously on federal lands in the Upper South Fork Skokomish subwatershed and on private lands in Lower South Fork Skokomish subwatershed. In the upper watershed riparian conifers will develop into older large diameter trees, providing habitat-forming woody debris in small streams and rivers. Some of this large wood may transport downstream to private lands. Abandoned roads on private lands may be reopened and new roads constructed to access timber on private lands. Intensive (clearcut) logging, mainly on private lands, would increase surface erosion from log haul and road construction, and some quantity of fine sediment is likely to continue to reach the stream channel network. The long term disposition of unclassified (non-system) roads on National Forest lands is unknown, but changes in the Washington State forest practice regulations require that private and state land managers develop management plans for their road systems aimed at meeting Clean Water Act requirements.

The proposed action would not contribute to downstream cumulative effects, because the incremental increase of sediment to stream channels from log haul, road building, and road decommissioning would last only during implementation of timber sales. Cumulative effects may occur within lower gradient response reaches (stream gradient less than 3 percent) where project-related sediment would deposit and may remain, in which case the following indicators would be degraded at the project level: sediment, substrate embeddedness, and streambank condition. However, this effect would be so slight as to be insubstantial, and would not cause any of the indicators to be degraded at the subwatershed (6th field) and watershed scale (5th field).

Threatened Fish Species

The preliminary effects determination for the proposed action is “No Effect” to Hood Canal summer chum and Puget Sound Chinook; and “Not Likely Adversely Affect” Coastal Puget Sound bull trout and Puget Sound steelhead. The proposed action would have “No Effect” on critical habitat for Hood Canal summer chum; and “Not Likely Adversely Affect” critical habitat for Puget Sound. See sediment section for impacts to fish.

Essential Fish Habitat

For all action alternatives road construction, reconstruction and log haul would deliver fine and coarse sediment to streams within the proposed project area; however effects are anticipated to be insubstantial. Measurable impacts to Chinook, coho, and pink habitat are not expected to occur in any of the watersheds in the planning area; adverse effects to Essential Fish Habitat are not anticipated.

Sensitive Fish Species

The proposed action may impact individuals or habitat for Puget Sound/Strait of Georgia Coho Salmon, and Puget Sound Coastal Cutthroat Trout, but it will not likely contribute to a trend towards Federal listing or cause a loss of viability to the population or species.

Northwest Forest Plan Aquatic Conservation Strategy

The Northwest Forest Plan requires consistency with Aquatic Conservation Strategy (ACS) with specific reference to nine ACS Objectives. Below is a summation of the environmental analysis regarding consistency with the elements and components of the objectives. Specific rationale may be found in analysis documented under other reports contained in this chapter of the EA: Soils and Site Productivity, Fisheries, Water Quality, and Wildlife.

ACS Objective 1. *Maintain and restore the distribution, diversity, and complexity of watershed and landscape scale features to ensure protection of the aquatic systems to which species, populations and communities are uniquely adapted.*

The project contributes to a restorative effect on Objective 1 by promoting the development of late-successional forest characteristics in second growth stands in portions of the watershed, and helping to meet the desired future condition for Late Successional Reserves, Adaptive Management Areas, and Riparian Reserves described in the Olympic National Forest Land and Resource Management Plan as amended by the Northwest Forest Plan Record of Decision (ROD).

The Upper South Fork Skokomish Vegetation Management Project would accelerate development of late successional habitat features and promote increased vegetative diversity, both within and outside of Riparian Reserves in the Upper South Fork Skokomish subwatershed. The project meets Northwest Forest Plan ROD standards and guidelines for management of Riparian Reserves (ROD p.C-32) with the application of silvicultural practices to control stocking, reestablish and manage stands, and to acquire vegetation characteristics needed to attain the Aquatic Conservation Strategy Objectives.

Thinning treatments would increase structural and compositional diversity by releasing understory vegetation, and promoting development of residual trees with relatively large diameters, crowns, and limbs. Skips within the treatment areas would insure that not all young stands are treated in the project area, providing forest complexity at project and landscape scales.

Where vegetative complexity is high, no-cut riparian buffers along all streamcourses would maintain the high level of vegetative complexity associated with these areas. Riparian buffer widths would be variable depending on fish presence, stream size, slope stability, shade cover, sediment delivery potential, and water quality considerations.

Project Design Criteria and Mitigations Measures were developed to retain desirable habitat components in the treated stands.

ACS Objective 2. *Maintain and restore spatial and temporal connectivity within and between watersheds. Lateral, longitudinal, and drainage network connections include floodplains, wetlands, upslope areas, headwater tributaries, and intact refugia. These network connections must provide chemically and physically unobstructed routes to areas critical for fulfilling life history requirements of aquatic and riparian dependent species.*

The project contributes to a restorative effect on Objective 2 through restoring spatial and temporal connectivity within and between watersheds.

The vegetation treatments and associated activities proposed in this project are spread across six drainages of the Upper South Fork Skokomish subwatershed. Vegetation treatments within the Upper South Fork Skokomish planning area are designed to develop a landscape scale pattern of more complex and diverse forest stands. No-cut riparian buffers along all streamcourses would maintain a high level of connectivity along streamcourses.

ACS Objective 3. *Maintain and restore the physical integrity of the aquatic system, including shorelines, banks, and bottom configurations.*

The project would contribute to maintaining physical integrity of aquatic systems addressed in Objective 3. No-cut buffers along all streamcourses would protect riparian areas from disturbance and maintain the physical integrity of stream channels and streambanks. Stand treatments and road construction, reconstruction, and decommissioning activities are designed to minimize impacts at the project sites.

The use of unclassified and system roads for harvest unit access may require re-constructing existing failed crossings on small, non-fish bearing streams, which are intermittent. New temporary road construction would not require crossing any fish bearing or non-fish bearing streams. After project completion all unclassified and temporary roads being used in the planning area would be decommissioned. Decommissioning would require removal of all culverts, and blocking road access to motor vehicle use. This would start the process of streambank and streambed restoration to more natural conditions.

ACS Objective 4. *Maintain and restore water quality necessary to support healthy riparian, aquatic, and wetland ecosystems. Water quality must remain within the range that maintains the biological, physical, and chemical integrity of the system and benefits survival, growth, reproduction, and migration of individuals composing aquatic and riparian communities.*

The project would contribute to maintaining water quality conditions addressed in Objective 4 in the project area by designating no-cut buffers along all streamcourses and by implementing best management practices and required mitigation measures. Stream buffer designations consider slope stability, shade cover, sediment delivery potential, and water quality considerations.

Riparian no-cut buffers would also prevent sediment generated from timber harvesting operations from reaching stream channels. New temporary road construction would be limited. There is the potential that increased surface erosion from road haul and equipment operation on disturbed soils during periods of wet weather may reach the stream channel network. Through the application of best management practices (BMPs), any water quality impacts would be minor and of limited duration along the stream channel continuum.

Project design criteria (best management practices, management requirements, and mitigation measures) were developed to address potential impacts at the project scale and to retain

desirable habitat components in the treated stands. These criteria outline specific requirements for roads, landings, and skid trails to minimize and mitigate potential impacts to soil and water. These measures would be employed to limit and restrict sediment from reaching flowing waters during project implementation, especially during log haul in wet weather.

At the project scale, the project would have a minor impact on water quality from newly exposed stream banks and streambeds when failed culverts are replaced or removed. Any short-term increases in sediment production or turbidity are expected to be well within the range of what would typically occur during high winter flows or as a result of natural streambank erosion. At the watershed scale, changes in the overall sediment rates would not be detectable. After the completion of the proposed project, numerous existing unclassified roads and all new temporary roads would be decommissioned. These actions would contribute to the health of the riparian, aquatic, and upland ecosystems.

ACS Objective 5. *Maintain and restore the sediment regime under which aquatic ecosystems evolved. Elements of the sediment regime include the timing, volume, rate, and character of sediment input, storage, and transport.*

The project contributes to maintaining Objective 5 at the project scale and the watershed scale. Based on observations of past Olympic National Forest thinning sales with similar prescriptions, riparian buffers, soils, and landforms, there is no evidence that the project will increase failure risk or cause additional shallow or deep-seated landslides. Over the long term, the thinned stands are expected to produce healthier stand conditions that will promote slope stability.

At the project scale, all stream courses are protected with no-cut riparian buffers, minimal impact logging systems, and mitigation measures. The project includes activities at individual sites that would result in short term increases in sediment production, but have long-term benefits. For example, culvert installations or upgrades, and road decommissioning work all have the potential to create short term sediment movement. Sediment inputs to streams from culvert work would be likely to create turbidity pulses that last for only a few hours, at most, before water clarity returns to background levels, based on past observations from implementation of large culvert removals and replacements on Olympic National Forest drainages. Disturbance at reconstructed and/or decommissioned stream crossings may continue to produce small amounts of sediment throughout the first winter until the sites are fully revegetated and stable. Any short-term increases in sediment production or turbidity are expected to be well within the range of what would typically occur during high winter flows or as a result of natural streambank erosion.

A short term increase in surface erosion from road haul would be expected in the planning area from log haul associated with the commercial thinning. Surface erosion from log haul would be mainly expected to occur during winter storm events. With the application of BMP's, proper road drainage and maintenance, and mitigation measures such as curtailing log haul during storm events, any impacts would be short term. In the long term, the decommissioning of unclassified roads would restore the sediment regime in the planning area watersheds to more natural conditions.

At the watershed scale changes in the overall sediment rates would not be detectable given the high variability in natural rates of sediment input.

ACS Objective 6. *Maintain and restore in-stream flows sufficient to create and sustain riparian, aquatic, and wetland habitats and to retain patterns of sediment, nutrient, and wood routing. The timing, magnitude, duration, and spatial distribution of peak, high, and low flows must be protected.*

The proposed action would be expected to maintain in-stream flows sufficient to create and sustain riparian, aquatic, and wetland habitats and to retain patterns of sediment, nutrient, and wood routing (Objective 6) at both the project and the watershed scales due to the hydrologic maturity of the vegetation, and the small portions of the watersheds that would be affected. Hydrologic maturity is important due to the vegetative canopy's ability to intercept snow, reducing the amount on the hillside that would be available for runoff during large rainfall events. This project will treat less than three percent of the 6th field watershed area. Of that area treated only about one-third of the standing green trees will be removed. At the 6th field watershed scale this project would result in a negligible change in vegetation in the Upper South Fork Skokomish planning area.

This project would not substantially affect instream flows. While tree removal may result in reduced evapo-transpiration rates, allowing more water in the soils for runoff, this would be a temporary effect lasting between three and five years, until crown expansion and ground vegetation response offsets the short-term reduction. The initial reduction in vegetation represents only a small overall change that would not be measurable at the project or watershed scale. Small increases in stream flow could occur within some of the individual tributaries adjacent to harvest units, but given the very small drainage areas affected, these changes would not be detectable at the project or watershed scale. There is high natural variability in discharge that is related directly to annual or seasonal precipitation. Over time, the accelerated growth response of the residual trees as well as the development of under story vegetation would increase evapo-transpiration rates.

ACS Objective 7. *Maintain and restore the timing, variability, and duration of floodplain inundation and water table elevation in meadows and wetlands.*

The project would maintain the current floodplain inundation and water table conditions (as related to Objective 7) at both the project and the watershed scales due to the protection measures that would be implemented along all stream channels and waterbodies, and the small portions of the watersheds that would be affected by thinning activities.

The project would not affect the timing, variability, or duration of floodplain inundation or water table elevation in meadows and wetlands within the project area. At the project scale, floodplains are protected with no-cut riparian buffers, exclusion of road construction, minimal impact logging systems, and mitigation measures. The proposed removal of vegetation with the stand treatments would not affect the floodplain or water table elevations in the project area watershed.

ACS Objective 8. *Maintain and restore the species composition and structural diversity of plant communities in Riparian Reserves and wetlands to provide adequate summer and winter thermal regulation, nutrient filtering, appropriate rates of surface erosion, bank erosion, and channel migration and to supply amounts and distributions of coarse woody debris sufficient to sustain physical complexity and stability.*

The Upper South Fork Vegetation Management project would contribute to the restoration of Objective 8 at the project and watershed scale by restoring the composition and structural diversity of riparian vegetation by promoting the development of late-successional forest characteristics in second growth stands both outside and within Riparian Reserves.

The project requires no-cut buffers along all riparian corridors and wetlands. These buffers encompass diverse plant communities, protect current shading levels for thermal regulation, protect stream banks from operational disturbances, and ensure that soil disturbance does not get routed to streams or wetlands. Designated no-cut buffers along units in the planning area will also protect channel migration processes. All temporary roads would be decommissioned after project completion and culverts would be removed. The decommissioning of unclassified roads used for the project would initiate restoration along riparian corridors at existing road crossings.

The size and number of new helicopter landings within Riparian Reserves would be minimized by utilizing existing openings and landings as much as possible and by incorporating new helicopter landing sites into designed gaps within timber harvest units where feasible. All landings would be outside of designated riparian no-cut buffers.

The proposed thinning treatments are designed to accelerate the development of late-successional characteristics in second-growth stands, and to increase structural heterogeneity and plant species diversity in the landscape. The proposed thinning treatments would increase plant species diversity by providing resources for the development of understory plants, and would retain hardwoods and less abundant conifer species. Structural heterogeneity would be increased through the retention of larger diameter trees, variation in thinning intensity, and no-cut buffers. Skips would also protect snags and coarse woody debris. Coarse woody material of all sizes would remain on site in treated areas. Any large pieces of wood moved during temporary road construction would be replaced on scarified roads after the stand treatment and road decommissioning is completed.

ACS Objective 9. *Maintain and restore habitat to support well distributed populations of native plant, invertebrate, and vertebrate riparian dependent species.*

This project contributes to restoration of ACS Objective 9 through restoring habitat for riparian-dependent species by promoting the development of late-successional forest characteristics in second growth stands within Riparian Reserves. No-cut buffers along all streamcourses would protect riparian areas from disturbance and maintain the existing riparian conditions. The proposed decommissioning of unclassified roads used for the project would initiate restoration along riparian corridors at existing road crossings.

At the site specific scale, the project requires no-cut buffers along riparian areas. This would help maintain the existing microclimates that are especially important for species sensitive to changes in temperature and humidity, such as amphibians and certain types of vegetation, as well as for those animals that use the riparian areas as travel corridors. These riparian areas contribute to the landscape heterogeneity of both untreated and treated stands. The retention of less abundant conifers (such as cedars), minor hardwood species, and untreated areas or "skips" provides for different stocking levels and species composition. This variety of stand conditions would create a diverse range of habitats that would support a variety of species within the riparian areas and across the landscape.

There are a number of roads with existing weed infestations that are proposed for reconstruction or decommissioning. If there is no treatment of these invasive plant species, these infestations would continue to spread and new infestations would be likely, including in riparian areas. The project proposes weed spread prevention and eradication activities to be implemented before, during, and after project activities. Native plant species are supported through the proposed noxious weed treatments associated with the project, and the project's mitigation measures to minimize introduction and spread of invasive plant species.

The proposed action provides for the development of habitat conditions within the riparian areas and across the landscape to support well-distributed populations of native plant, invertebrate, and vertebrate riparian-dependent species at the project and watershed scales.

Conclusion: The impacts associated with the proposed action, either directly, indirectly, individually, or cumulatively, would not prevent attainment of Aquatic Conservation Strategy nor the nine ACS Objectives, at the site, watershed or landscape scales.

HERITAGE RESOURCES

Cultural Setting

The Skokomish River Valley and the entire Hood Canal drainage were once occupied by the Twana people. The Twana were skilled hunters, gatherers, and fishermen who shared a common culture and language (Suttles and Lane 1990). Within the larger Twana group were smaller village communities that functioned as independent economic, social, and political units. Elmendorf (1992) recognized nine village communities. Most village communities had one winter village location situated near the mouth of a salmon stream on Hood Canal. The exceptions to this were the Skokomish and Vance Creek groups. The Skokomish maintained at least five winter village sites in the Skokomish River Valley, but functioned together as one community (Elmendorf 1992). During historic times, all of the Twana groups were moved together onto the Skokomish Indian Reservation and differences between the groups became blurred.

The Twana utilized a variety of resources including salmon and other fish; shellfish; land mammals, especially deer and elk; marine mammals; small game and birds; and many different plants. They practiced a seasonal pattern, congregating at villages during the winter and splitting into smaller family groups during the warmer months. They travelled into the Olympic Mountains to fish, hunt deer and elk, and gather certain resources. A large communal elk drive was carried out each fall in the upper Skokomish River Valley (Elmendorf 1992). The South Fork Skokomish watershed was also noted for blackberry picking, peeling bark from cedar trees, and harvesting of cedar roots along the river (James 1991).

Euro-American explorers came to the Pacific Northwest in the late eighteenth century. Trappers, traders, and settlers soon followed the early explorers. The first settlers to the Olympic Peninsula came in the mid to late 1800s. In 1853 Washington was officially made a US Territory, and Isaac Stevens was appointed Territorial Governor. One of his first jobs was to negotiate treaties with the Indian tribes so that the land could be settled. The Point-No-Point Treaty was negotiated by Stevens with the Twana, Chemakums, and Klallams in 1855 (Marino 1990). Most of the Twana were relocated, sometimes by force, to a reservation established a few years later at the mouth of the Skokomish River.

Settlers slowly moved inland from the coast up the major river valleys but did not utilize most of the higher elevation areas. The first settlers in the Upper Skokomish River Valley (above the confluence of the river's South and North Forks) were the Vance and Kirkland families in the late 1870s (Richert n.d.). Many more people moved into the region in the late 1880s through the early 1900s. From the early 1890s through the first decade of the 20th century there were a number of settlers on the Upper South Fork; mostly making their way overland from Lake Cushman rather than following the river up through the lower valley (Richert n.d. 25-27). Many of these settlers may not have lived year-round on the South Fork. Economic pursuits in the area included farming, mining, and logging, and the area was also well used recreationally by hunters and fishermen.

In 1897 the Olympic Forest Reserve was established around the Olympic Mountains, and by 1907 administration of the reserve was transferred to what is now the USDA Forest Service. An early emphasis was to extend trails to access fire lookouts and guard stations throughout the backcountry. The Forest Service and Civilian Conservation Corps constructed numerous campgrounds, ranger stations, lookouts, bridges, and many miles of roads and trails within the Olympic National Forest during the first half of the twentieth century (Righter 1978).

Environmental Effects

Direct, Indirect, and Cumulative Effects

For the Upper South Fork Skokomish Vegetation Management project, cultural surveys were conducted in the proposed thinning units and along proposed temporary roads. No artifacts or other cultural resources were found within the Area of Potential Effects (APE) for this project, and no additional work is recommended at this time. No historic properties would be affected as a result of this project.

In the event that archaeological materials are encountered during project implementation, work should be halted and the Forest Archaeologist should be contacted in order to assess the discovery and evaluate the significance. In the event that skeletal material or features of burial/interment are encountered, all work must be stopped immediately and contact must be established with local law enforcement, the Washington State Historic Preservation Office (SHPO) and the affected Indian Tribes.

RECREATION AND VISUAL QUALITY

The South Fork Skokomish River watershed's location in proximity to population centers and Highway 101 provides the residents of Puget Sound with easy access to the area's recreational opportunities. Open roads within the watershed are available for people to drive for pleasure. In addition, there are 27 miles of trails within the watershed, ranging from the South Fork Skokomish Trail #873 to shorter trails that access viewing areas, small lakes and ponds. Dispersed recreation opportunities are numerous in the Upper South Fork Skokomish Vegetation Management Project planning area, with many areas being accessible for rustic camping and privacy. The largest developed recreation facility within the Upper South Fork subwatershed is Brown Creek Campground.

Visual Quality Objectives (VQOs) are described in the 1990 LRMP Final Environmental Impact Statement, pages IV-94 to IV-100. Of the 880 acres proposed for active treatment, 469 acres (53 percent) are in Management Prescription (MP) E1-Timber Management, which has a VQO of either Modification or Maximum Modification. For areas with this VQO, management activities may dominate the natural landscape. Of the remaining 411 acres, 390 are within MP A2-Scenic, which has a VQO of Partial Retention. For the Partial Retention VQO, management activities may be evident but do not dominate the natural landscape. Twenty-one acres near the South Fork Skokomish mainstem are within MP A4BN-Natural Management River Corridors, with a VQO of Retention (management activities are not evident) or Partial Retention as seen from the riverbank: some evidence of timber harvest and housing may be visible, but the shorelines are generally undeveloped (LRMP pIV-78). There are no designated wild and scenic rivers in the planning area. The current condition of the landscape on National Forest Lands in the Upper South Fork Skokomish River subwatershed is consistent with the VQOs set forth in the 1990 LRMP.

Environmental Effects: Recreation and Visual Quality

No Action Alternative

The No Action alternative would not directly or indirectly affect recreation opportunities in the planning area. Roads, camping areas, and trails would remain accessible to the public, and would continue to be managed for current developed and dispersed recreation and other authorized uses. Visual Quality Objectives would continue to be met. Because there would be no project activities, there would be no cumulative effects to recreation resources and visual quality.

Proposed Action

Direct Effects

Trails and dispersed sites in or adjacent to several treatment units may be directly affected by the proposed action. These sites are identified, along with proposed mitigations to minimize potential effects, in Chapter 2, table 2.12. Potential effects include restricted access during logging operations, and increased activity and noise during operations within the affected units. Visual impacts and safety issues along trails and at dispersed sites are mitigated with no-cut

buffers; directional falling along the trail corridors; restoration of the ground surface of existing dispersed camping sites to smooth, pre-thinning conditions; trail and road closures during logging operations; and seasonal restrictions on logging activities. An additional effect on recreation activities would be the closure of some customary mushroom harvest areas during logging operations. All of these effects would be temporary, occurring only during actual project operations. Thinning is compatible with the VQOs of Retention and Partial Retention, and the no-cut buffers along the South Fork Skokomish mainstem would further ensure that evidence of the thinning would not be visible. VQOs would continue to be met.

Indirect Effects

Indirect effects associated with the proposed action may include increased use of unaffected nearby trails by displaced hikers during trail closures; increased road traffic in the South Fork Skokomish area associated with logging operations; and sounds and sights of logging operations including helicopter operations, logging machinery, timber felling, and road traffic. All of these effects would be temporary, occurring only during actual project operations. Temporary unavailability of customary dispersed recreation sites may result in user development of new dispersed sites. There is also the potential for unauthorized motor vehicle use on temporary roads and skid trails. Mitigation measures described in table 2.12 are intended to prevent such motor vehicle access after thinning operations are complete.

Cumulative effects

This project would have only temporary direct and indirect effects on recreation resources in the planning area. No cumulative effects to recreation resources would be anticipated from implementation of the proposed action.

WILDERNESS, INVENTORIED ROADLESS, POTENTIAL WILDERNESS, UNDEVELOPED AREAS, AND WILD & SCENIC RIVERS

Introduction

A discussion of each of these types of lands, and their extent within the Upper South Fork Skokomish planning area, follows the Background section, below. The environmental effects associated with the project's two alternatives, No Action and the Proposed Action (Alternative B) are summarized in the Environmental Effects section.

Background

From the mid-1970s through 2001 the Forest Service maintained a roadless area inventory of undeveloped lands that the agency used and updated for RARE (Roadless Area Review and Evaluation) and RARE II, and in support of the Land and Resource Management Plan (Forest Plan) completed in 1990 for the Olympic National Forest. Throughout that time the Forest Service called these areas or map polygons "roadless areas" or "inventoried roadless areas." With the completion of the Roadless Area Conservation Rule (RACR) in 2001 many of these areas ceased being just an inventory, and were designated as Inventoried Roadless Areas (IRAs), with fixed boundaries and prohibitions set by Forest Service regulation (36 CFR 294). This led to confusion as two sets of maps exist, both using the "inventoried roadless area" terminology. One set of maps is an inventory with changeable boundaries based on inventory criteria, while one set has fixed boundaries set by the RACR.

To alleviate the confusion the Forest Service created a new term for its inventory of undeveloped lands, called "potential wilderness areas" (PWAs), to make a clear distinction from the IRA term used by the 2001 RACR. This terminology addition was made policy by changing the 2006 Forest Service Handbook (FSH) for wilderness evaluation (FSH 1909.12 Chapter 70) and is also reflected in the 2008 Forest Service NEPA regulations (36 CFR 220). In the regulations, potential effects to "inventoried roadless areas" and "potential wilderness areas" are factors in determining the appropriate NEPA documentation for a particular project.

The terms and definitions as stated below will be used in this site-specific analysis. Discussion of the four resource topics is based on current law, regulation and agency policy; as well as the Olympic Forest Plan and the Olympic National Park General Management Plan (USDI 2008).

Wilderness: A wilderness area is designated by congressional action under the Wilderness Act of 1964 and other wilderness acts. Wilderness is undeveloped Federal land to be administered to provide for the protection of these areas and the preservation of their wilderness character.

Inventoried Roadless Areas (IRA): These areas were identified in the 2001 Roadless Area Conservation Rule in a set of inventoried roadless area maps, contained in Forest Service Roadless Area Conservation Final Environmental Impact Statement, Volume 2, dated November 2000 (or any subsequent update or revision of those maps (36 CFR 294.11)), which are held at the National headquarters office of the Forest Service. These areas were set aside through administrative rulemaking and have provisions, within the context of multiple use management, for the protection of inventoried roadless areas. Most IRA boundaries are

substantially identical to those identified as "roadless areas" referred to in the 1982 planning rule (36 CFR 219.17) and identified in Appendix C of the 1990 Forest Plan FEIS.

Potential Wilderness Areas (PWA): Areas of potential wilderness identified using inventory procedures found in Forest Service Handbook (FSH) 1909.12 Chapter 71 are called potential wilderness areas. The inventory is conducted by the Forest Service with the purpose of identifying potential wilderness areas in the National Forest System. The National Forest System Land and Resource Management Planning Rule (currently the 1982 Rule, 36 CFR 219.17) directs that roadless areas be evaluated and considered for wilderness recommendation during the forest planning process.

Potential wilderness areas are not a land designation decision, they do not imply or impart any particular level of management direction or protection, they are not an evaluation of potential wilderness (as in FSH 1909.12 Chapter 72), and lastly they are not preliminary administrative recommendations for wilderness designation (as in FSH 1909.12 Chapter 73). The inventory of PWAs does not change the administrative boundary of any Inventoried Roadless Area or any congressionally designated wilderness. The purpose of identifying PWAs is to develop an inventory of areas that can be evaluated for recommendation as wilderness during forest planning. Evaluating the value of recommending these areas as wilderness is not intended to be a part of project planning.

Typically, PWAs substantially overlap, and/or are contiguous with Inventoried Roadless Areas and may also be contiguous with designated wilderness. PWAs overlap Inventoried Roadless Areas only where those acres are consistent with the inventory criteria (FSH 1909.12 Chapter 71) and may extend beyond IRA and wilderness boundaries consistent with inventory criteria. Some newly inventoried PWAs may be stand-alone areas that were not identified as "roadless areas" in Appendix C of the 1990 Olympic Forest Plan or "Inventoried Roadless Areas" as identified in the set of maps in the 2001 RACR.

Other undeveloped lands: These areas have no history of harvest activity, do not contain forest roads and are not designated as a wilderness area, Inventoried Roadless Area, or inventoried as a potential wilderness area.

Olympic Wilderness and Wonder Mountain Wilderness

The far northern tip of the Upper South Fork Skokomish River subwatershed lies within the Olympic National Park's Olympic Wilderness. The Olympic Wilderness was congressionally designated as wilderness on November 16, 1988 (P.L. 100-668). Management direction for the Olympic Wilderness is found in the Olympic National Park's General Management Plan. In the vicinity of the Upper South Fork Skokomish project planning area, the park's wilderness follows the boundary between the Forest and the park. The closest proposed activities are about 4.2 air miles from the park boundary.

The Wonder Mountain Wilderness, which is contiguous with the Olympic Wilderness, is managed by the Olympic National Forest and lies within the Upper North Fork Skokomish River subwatershed. This wilderness is entirely outside of the Upper South Fork Skokomish planning

area. The closest proposed activities are about 2.9 air miles from the Wonder Mountain Wilderness boundary.

Upper Skokomish and Lightning Inventoried Roadless Areas

There is one Inventoried Roadless Area (IRA) on National Forest Lands within the Upper South Fork Skokomish River subwatershed: the Upper Skokomish IRA. This IRA occupies most of the upper portion of the watershed, and extends to the boundary of the Olympic National Park. The Lightning IRA lies outside the planning area, within the Upper North Fork Skokomish River subwatershed. The Lightning IRA is contiguous with the Upper Skokomish IRA, and is adjacent to a portion of the planning area boundary. Old-growth forest conditions prevail within both IRAs. Because conditions within the Upper Skokomish IRA already meet the desired future condition described in item 1 of this project's purpose and need, there is no need to treat stands within the IRA to meet project objectives, and no activities are proposed within the IRA boundaries.

Potential Wilderness Area analysis

Methods

A combination of GIS analysis, aerial photograph interpretation, and professional judgment was applied to determine the existence of potential wilderness areas (PWAs) within the planning area. The scope of the PWA inventory included all National Forest System (NFS) acres within the Upper South Fork Skokomish planning area, and all NFS lands outside the planning area sufficient to be considered contiguous with similar areas within it.

First screen

Areas qualify for placement on the potential wilderness inventory if they meet the statutory definition of wilderness. An area meets this definition if it meets either criteria 1 and 3, or criteria 2 and 3 from Section 71.1 of Forest Service Handbook 1909.12. These criteria are:

1. Areas containing 5,000 acres or more;
2. Areas containing less than 5,000 acres but can meet one or more of the following three criteria:
    a. Areas that can be preserved due to physical terrain and natural conditions,
    b. Areas that are self-contained ecosystems, such as an island, that can be effectively managed as a separate unit of the National Wilderness Preservation System,
    c. Areas that are contiguous to existing Wilderness, primitive areas, Administration-endorsed wilderness, or potential wilderness in other Federal ownership, regardless of their size;
3. Areas that do not contain forest roads (these are classified or system roads) or other permanently authorized roads.

These criteria constitute the first screen for this analysis. The planning area and National Forest System lands closely adjacent to it were assessed for areas of any size that do not contain authorized Forest System roads (criterion 3). Seven general areas were identified, two of which

were initially large enough to meet criteria 1 and 3; and seven of which shared at least a portion of a boundary with either the Upper Skokomish or Lightning IRA, and so met criteria 2c and 3. No areas were identified that met either criteria 2a or 2b.

Second screen

The areas identified in the preliminary analysis were further evaluated by applying the "criteria for including improvements" found in Section 71.11 of FSH 1909.12. There are 11 criteria in Section 71.11 but only criteria #9 is applicable to the project planning area. Criteria #9 pertains to timber harvest areas. To meet this criterion, logging and prior road construction cannot be evident. FSH 1909.12 further explains how to evaluate this criterion by describing these areas as places where stumps and skid trails or roads are substantially unrecognizable or areas where clearcuts have regenerated to the degree that canopy closure is similar to surrounding uncut areas. Criterion #9 was used to further refine the areas which were included in the preliminary inventory as a result of applying the three initial criteria.

Examples of situations that required applications of professional judgment included, but are not limited to:

- Determination if there is substantially recognizable evidence of timber harvest (such as stumps, roads, and differences in canopy closure as compared to surrounding uncut areas).
- Determination about whether decommissioned roads are still evident.
- Placement of PWA boundaries along permanent natural or semi-permanent human-made features such as ridges, streams, topographic breaks, past harvest, or forest roads to facilitate easy on-the-ground identification.
- Whether to proceed through an isthmus (or pinch point) created by two roads or two harvest areas or place a PWA boundary across the isthmus.
- Whether to locate a PWA boundary around a peninsula or place the boundary through the peninsula.

Results

Because of the extensive road decommissioning that has taken place in the South Fork Skokomish watershed, as well as some roads that have been decommissioned in the Upper Wynoochee River subwatershed to the west, there are some areas outside of the IRAs that no longer contain authorized Forest System roads and so meet criterion 3. However, many of these areas contain substantially recognizable evidence of timber harvest, and many of the decommissioned roads are still clearly evident.

Of the 16,125 acres identified in the preliminary analysis, a total of 4,993 acres meet the inventory criteria as potential wilderness areas. These areas range in size from 27 acres to 3474 acres. Table PWA-1 presents the results of the potential wilderness area analysis. The Upper Skokomish IRA is also included as a potential wilderness area.

Table PWA-1. Potential wilderness inventory analysis results

Polygon ID	Acres	FSH 1909.12 71.1(1)	FSH 1909.12 71.1(2a)	FSH 1909.12 71.1(2b)	FSH 1909.12 71.1(2c)	FSH 1909.12 71.1(3)	Comments
1a	3474	No	No	No	Yes	Yes	Added to Forest inventory
1b	1636	No	No	No	Yes	Yes	Includes substantially recognizable harvest units and roads.
1c	519	No	No	No	Yes	Yes	Contiguous with PWA 1a but not with an IRA. Includes substantially recognizable harvest units and roads
1d	437	No	No	No	Yes	Yes	Contiguous with PWA 1a but not with an IRA. Includes substantially recognizable harvest units and roads.
1e	50	No	No	No	Yes	Yes	Contiguous with PWA 1a but not with an IRA. Includes substantially recognizable harvest units and roads.
1f	36	No	No	No	Yes	Yes	Contiguous with PWA 1a but not with an IRA. Includes substantially recognizable harvest units and roads.
2	171	No	No	No	Yes	Yes	Includes substantially recognizable harvest units and roads.
3	86	No	No	No	Yes	Yes	Includes substantially recognizable harvest units and roads
4a	527	No	No	No	Yes	Yes	Includes substantially recognizable harvest units and roads
4b	40	No	No	No	Yes	Yes	Added to Forest inventory
4c	27	No	No	No	Yes	Yes	Added to Forest inventory
5	373	No	No	No	Yes	Yes	Includes substantially recognizable harvest units and roads

Table PWA-1. Potential wilderness inventory analysis results							
Polygon ID	**Acres**	**FSH 1909.12 71.1(1)**	**FSH 1909.12 71.1(2a)**	**FSH 1909.12 71.1(2b)**	**FSH 1909.12 71.1(2c)**	**FSH 1909.12 71.1(3)**	**Comments**
6a	1155	No	No	No	Yes	Yes	Separated from IRA by authorized system road. Includes substantially recognizable harvest units and roads.
6b	373	No	No	No	Yes	Yes	Added to Forest inventory
6c	85	No	No	No	Yes	Yes	Contiguous with PWA 6b but separated from IRA by authorized system road. Includes substantially recognizable harvest units and roads.
6d	49	No	No	No	Yes	Yes	Contiguous with PWA 1a but not with an IRA. Includes substantially recognizable harvest units and roads.
7a	4150	No	No	No	Yes	Yes	Includes substantially recognizable harvest units and roads.
7b	1960	No	No	No	Yes	Yes	Contiguous with PWA 7c but separated from IRA by authorized system road. Includes substantially recognizable harvest units and roads.
7c	1079	No	No	No	Yes	Yes	Added to Forest inventory

Other Undeveloped Lands

Much of the Upper South Fork Skokomish project area has been subject to some degree of timber harvest and road building. However there are stand-alone polygons that have no history of harvest activity and do not contain authorized Forest System roads, but do not meet inventory criteria as potential wilderness areas, and are not inventoried roadless areas or designated as wilderness. For this analysis these areas are called other undeveloped lands. These areas have not been mapped but are scattered throughout the planning area.

Wild and Scenic Rivers.

There are no designated Wild and Scenic rivers in the planning area. The proposed action would have no direct, indirect, or cumulative effects on Wild and Scenic Rivers.

Environmental Effects

Environmental Effects: Olympic Wilderness and Wonder Mountain Wilderness

The definition of wilderness from Section 2(c) of the 1964 Wilderness Act was used to identify qualities of wilderness related to wilderness character that could potentially be affected by project activities.

Untrammeled, Undeveloped and Natural: The Wilderness Act states that wilderness is "an area of undeveloped Federal land retaining its primeval character and influence, without permanent improvements of human habitation; and generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable."

Outstanding opportunities for solitude and remoteness: The Wilderness Act states that wilderness has "outstanding opportunities for solitude or a primitive and unconfined type of recreation." This quality is about the opportunity for people to experience the wilderness; it is not directly about the individual visitor experience.

Effects of No Action

Direct, Indirect and Cumulative Effects

The No Action alternative would not affect, directly or indirectly, the characteristics of either designated Wilderness. There would be no change to current Wilderness conditions. Because there would be no management actions, there would be no cumulative effects.

Effects of the Proposed Action (Alternative B)

Direct and Indirect Effects

There are no proposed project activities within or near the boundary of either Wilderness; both Wildernesses are located well north of the farthest northward extent of the proposed activities. The closest proposed activities, thinning units S053C, S053B1, and S053B2, are roughly 2.9 air-miles from the Wonder Mountain Wilderness boundary, and 4.2 air-miles from the Olympic Wilderness (Olympic National Park) boundary. Neither Wilderness is adjacent to any roads proposed for haul. Neither Wilderness is within the flight path of any helicopter yarding operations. The proposed action would have no direct effects on the "untrammeled, undeveloped and natural" characteristics of either wilderness; or on the opportunity the wilderness affords for people to experience solitude and remoteness.

There may be indirect effects to wilderness visitor experience if helicopter activities are audible within the Wilderness Areas. However, this would not affect the character or integrity of the Wildernesses themselves.

Cumulative Effects

Sights and sounds of other ongoing activities in areas adjacent to the wilderness and within the wilderness would continue. Due to the remoteness of both Wilderness Areas, the effects from ongoing activities outside of the wilderness, primarily traffic on existing forest roads, would be minor to non-existent. The use and maintenance of the Forest's Upper South Fork Skokomish

Trail, which passes through the Upper Skokomish IRA and accesses the Olympic Wilderness, would continue, but has only a very minor effect on the sense of solitude and remoteness. There are no reasonably foreseeable actions proposed for the Olympic Wilderness itself. The Upper South Fork Skokomish Vegetation Management project; when combined with past, present and reasonably foreseeable actions; is not expected to have any cumulative effects on wilderness qualities.

Environmental Effects: Inventoried Roadless Areas

The following values and features often characterize Inventoried Roadless Areas (36 CFR 294):

- High quality or undisturbed soil, water and air
- Diversity of plant and animal communities
- Habitat for threatened, endangered, proposed, candidate and sensitive species and for those species dependent on large, undisturbed areas of land
- Natural appearing landscapes with high scenic quality
- Traditional cultural properties and sacred sites

No Action Alternative

Direct, Indirect, and Cumulative Effects

The No Action alternative would not affect, directly or indirectly, the characteristics of either the Upper Skokomish or the Lightning Inventoried Roadless Area. There would be no change to current conditions within the IRAs. Because there would be no management actions, there would be no cumulative effects.

Effects of the Proposed Action (Alternative B)

Direct Effects

The Lightning IRA is entirely outside of the project planning area, and would not be affected by proposed project activities. Conditions within the Upper Skokomish IRA already meet the desired future condition identified for the project, and there are no activities proposed within the IRA. No changes to existing IRA acreage or boundaries are proposed. Because no activities are proposed within or adjacent to the IRAs, there would be no direct effects from the Proposed Action.

Indirect Effects

The project would not interrupt access to or use of the Upper South Fork Skokomish Trail, which accesses the Upper Skokomish IRA. There would be no indirect effects to the inventoried roadless area characteristics listed above, because they are inherent to the IRA and are not affected by project activities occurring outside the IRA boundaries.

Cumulative Effects

There are no reasonably foreseeable actions proposed for the IRA. Alternative B itself is a relatively small project and is located outside of the IRA. All proposed project activities are along existing roads and within previously harvested stands. The Proposed Action is unlikely to incrementally add to or influence the cumulative effects of past, present, or reasonably foreseeable actions on the Upper Skokomish IRA.

Environmental Effects: Potential Wilderness Areas

The PWAs identified in table PWA-2 are the scale for this effects analysis. The following values and features of both wilderness and inventoried roadless areas are useful indicators for evaluating the potential effects of the project's two alternatives on potential wilderness areas (PWAs).

- Untrammeled, Undeveloped and Natural
- Outstanding opportunities for solitude and remoteness
- High quality or undisturbed soil, water and air
- Diversity of plant and animal communities
- Habitat for threatened, endangered, proposed, candidate and sensitive species and for those species dependent on large, undisturbed areas of land
- Natural appearing landscapes with high scenic quality
- Traditional cultural properties and sacred sites

No Action Alternative

Direct and Indirect Effects

The No Action alternative would have no direct, indirect or cumulative effects on the indicators listed above because no project related activities would take place.

Proposed Action (Alternative B)

Direct and Indirect Effects

No project activities would occur in any inventoried PWAs, therefore there would be no direct or indirect effects to the current conditions within the PWAs. The proposed action would not reduce the acres currently identified as meeting the criteria for potential wilderness.

There would also be no indirect effects to most of the wilderness and inventoried roadless area characteristics listed above as many of them are inherent to the inventoried PWAs themselves and are not affected by project activities occurring outside of the PWAs.

The sights and sounds of project activities in areas adjacent to PWAs would reduce the sense of solitude and remoteness, and could reduce the habitat quality for some species within the PWAs. Indirect effects would be minor, short-term, and limited to areas within PWAs that are close to project activities. Alternative B would not substantially alter the undeveloped character of the inventoried PWAs.

Cumulative Effects

Few if any projects have occurred within the inventoried PWAs within this project's planning boundary and there are no reasonably foreseeable actions. Many of the areas identified in the first screen were not places on the PWA inventory because timber harvest and roads are still evident within them. Because of the cessation of clearcut harvest in the 1990s and the recent decommissioning of many miles of developed roads in the subwatershed, the evidence of these past activities can be expected to diminish. Over time some of these areas may meet the criteria for inclusion in the potential wilderness area inventory.

The Upper South Fork Skokomish Vegetation Management project, when combined with past, present and reasonably foreseeable actions, is not expected to have any cumulative effects on wilderness qualities and roadless characteristics in inventoried PWAs.

Other Undeveloped Lands

Other undeveloped lands have intrinsic ecological and social values because they do not contain roads or evidence of past timber harvest. These values below are used as indicators for comparison between the alternatives. Values and features previously used in this document that characterize an inventoried roadless area (36 CFR 294) were specifically avoided as other undeveloped lands are not inventoried roadless areas.

- Intrinsic physical and biological resources (soil, water, wildlife, recreation, fisheries, etc.)
- Intrinsic social values (apparent naturalness, solitude, remoteness)

No Action Alternative

Direct, Indirect, and Cumulative effects

There would be no effects to other undeveloped lands because no activities would occur in these areas. The affected environment would remain unchanged, except by natural processes and ongoing management activities. Biological and ecosystem functions would be likely to continue as they are in the present condition.

The Proposed Action (Alternative B)

Direct and Indirect Effects

No project activities would occur in any of the other undeveloped lands, therefore there would be no direct effects. There would be no change in the number of acres or a change in size of these areas. There could be indirect effects to some of the intrinsic biological resources where proposed project activities are in close proximity to undeveloped areas. Any indirect effects are the same as those disclosed for the corresponding resource area in other sections of this chapter and are not reiterated here. There could also be indirect effects to intrinsic social values of solitude and remoteness, but because most of the areas identified as other undeveloped lands are relatively small and are interspersed among areas with previous and ongoing management, the opportunities for solitude and remoteness are limited to begin with. Any indirect effects would be minor, short-term, and limited to areas within other undeveloped areas that are close to project activities, and would not substantially alter the undeveloped character of these areas.

Cumulative Effects

Few if any projects have occurred within the other undeveloped areas within this project's planning boundary and there are no reasonably foreseeable future actions. The Upper South Fork Skokomish Vegetation Management project, when combined with past, present and reasonably foreseeable actions is not expected to have any cumulative effects on the values and features that characterize these areas.

FIRE AND FUELS

Introduction

Fire history in the South Fork Skokomish watershed has been moderately intense compared to the rest of the Olympic National Forest. The natural historic pattern of fire is for large, intense fires to burn on a landscape level with an average return interval of about 200 years. These generally were stand-replacing crown fires, fueled by the large amount of fuel and vegetation that built up over the long periods between fires. Recent fire activity observed in Olympic National Park suggests that naturally occurring fires, left to their own devices, may begin at any point in the fire season hiding in large ground fuels and deep duff layers. These fires may stay small or, when conditions permit, grow rapidly. Conditions that contribute to large fire growth include dry periods of two weeks or more with no precipitation, and east wind events with strong winds, low relative humidities, and high temperatures.

Today's fires, however, are generally human-caused and small in size. Hood Canal Ranger District fire statistics from the past 10 years show that 82 percent of all fires are human-caused, and 88 percent of fires are less than 0.25 acres in size. The area being thinned sees a high level recreational use during the summer months. This is important because half of all fires are a result of campfires being left unattended or abandoned. Minimizing the number and effects of these human-caused fires is the main concern of Fire Management on the Olympic National Forest.

Methods

To determine the effects of the treatments performed in the proposed stands, fire behavior estimates were made using Behave Plus 4 software. This program uses fuel models developed by Scott and Burgan (2005) to represent the structure, arrangement and condition of fuels that determine fire behavior. Historic weather information was used from the nearby Jefferson Remote Automated Weather station (RAWS) to predict the weather conditions a fire may burn under. In this case the 90th percentile weather conditions were used to calculate the fuel moisture content and 20 foot wind speeds for input into Behave Plus 4.

Pre-treatment stand attributes were represented by the fuel model TL3. Fuel loading of dead and down wood debris is approximately 10 to 15 tons per acre. Fire behavior is expected to be a ground fire with spread rates of 1.6 chains (about 100 feet) per hour, one-foot flame lengths, and a fire size of 0.3 acres at the time of initial fire suppression action. A crown fire would not be expected. It is expected that local Initial Attack resources available on the Olympic National Forest during fire season would be able to contain a fire occurring under these conditions. This is based on Behave Plus 4 calculations using rates of spread, fire size, firefighting resource type, fire line production rate estimates and maximum resource response times. This pre-treatment model result represents conditions under the no-action alternative.

Commercial thinning of the stands identified in the plan for this project would affect the attributes of the thinned stands related to fire management. Current conditions are a second growth stand with a closed canopy and sparse understory. Thinning would result in opening the overstory allowing increased sunlight promoting the growth of understory vegetation, creating

ladder fuels that would increase the potential for crown fire. Light to moderate amounts of fine and medium sized fuel left behind after thinning would, in the short term, be highly susceptible to ignition sources. This increased fuel load would make both initial attack and containment efforts by firefighting resources more difficult. Post-thinning stands would resemble a fuel model SB1. Modeled fire behavior in post-treatment stands showed spread rates of seven chains (about 450 feet) per hour, flame lengths of 3.4 feet, and a fire size of 4.5 acres at time of initial fire suppression action. This fire behavior would be likely to exceed the capacity of Olympic National Forest initial attack resources.

Fuel treatments would need to be conducted to allow firefighting resources to meet their objective of containing wildfires during initial attack. The recommended treatments are included as required mitigation measures for this project (Chapter 2, table 2.16). Because 82 percent of fires on the forest are caused by humans, it is important that all fuels along all roads be treated. Options for treatment include pulling fuels within 100 feet of roads ways back into the units and scattered so as to not create any large concentrations of fuel. Fuels within this buffer strip can also be machine piled on landings or hand piled within the buffer for burning or removal as biomass. The goal of this back haul, piling, or removal is to return this buffer to pre-thinning fuel loading and fire behavior conditions. The fire behavior in this 100-foot treated strip is expected to be low enough for initial attack resources to respond to an ignition and take action before the fire has reached the increased amount of fuels within the unit. Removing these fuels also makes the road corridors less susceptible to ignitions. Fuels inside the units will remain more susceptible to fire starts and increased fire intensities due to the accumulation of fuels. The increased chance for successful initial attack in the buffer strips along the road ways would reduce the risk of a fire reaching these interior fuels to a level that has been deemed acceptable by Fire Management.

Environmental Effects

No Action Alternative

Direct, indirect, and cumulative effects

The No Action alternative would have no direct or indirect effects on current fuels and fire risk conditions within the watershed. Conditions would remain as they are, and are within the suppression capacity of local Initial Attack resources. Because there would be no project activities, there would be no cumulative effects associated with the project.

Proposed Action

Direct Effects

Based on fire modeling, the Proposed Action would increase fire risk within the thinned units beyond the suppression capacity of local Initial Attack resources. However, with implementation of the required fuels treatment mitigation activities described in table 2.16, that risk would be reduced to a level acceptable to Olympic National Forest Fire Management.

Cumulative effects

Past activities that have influenced ignition risk and fire behavior include timber harvest, road building, and fire suppression. Currently the great majority of ignitions in the project area are human-caused and recreation-related. The Proposed Action and its associated fuels mitigation measures are unlikely to contribute to cumulative effects of past, present, and reasonably foreseeable future management actions in the watershed.

ECONOMIC VIABILITY

Introduction

Because the primary purpose of the Upper South Fork Vegetation Management project is ecological, the generation of revenue is not a priority. Still, economic viability and fiscal responsibility are important considerations. The only certain means of accomplishing the project's purpose is through the sale of wood products that would be removed as part of the thinning treatment. Therefore, the project needs to be commercially viable in order to accomplish its stated objectives.

The resource issues that drove the development of the proposed action, which includes the design criteria, mitigations, and restrictions discussed in Chapter 2 of this EA, also affect the commercial viability of the project, and are ultimately expressed in benefit-to-cost ratios of the proposal. Use of existing system roads and temporary roads enables the use of conventional ground-based and skyline harvest systems, and is the greatest single factor affecting the viability of the proposed project. Lack of road access necessitates the use of helicopters for yarding logs. The cost of this helicopter yarding is considerably higher than the costs associated with the costs of temporary road construction, maintenance, and obliteration associated with skyline and ground-based harvest methods. To display the effect of reduced road access (due to road decommissioning and seasonal restrictions), a sensitivity analysis was performed on the costs and values associated with the action alternative to assess the effect of helicopter yarding on project viability.

The socio-economic environment affected by activities within the Olympic National Forest is discussed in the Final Environmental Impact Statement (FEIS) for the Olympic National Forest's 1990 Land and Resource Management Plan (USDA 1990b).

Method of analysis

The Forest Service's Region 6 TEA.ECON (version 5.3) economic analysis tool was used to evaluate the economic viability of the action alternative. This tool was developed to evaluate timber sale economics at the planning or sale layout level, and takes into account factors such as estimated timber volume, the market value of wood products, planning, and implementation costs. The estimated value of wood products is based on regional market values and the revenues that local Forests are receiving from actual timber sales. The values take into account tree species, tree size, and wood quality. The estimated implementation cost is also based on regional and local logging costs, including the type of yarding system to be used (ground-based, cable, helicopter). Estimated revenue can fluctuate over time as market conditions change. If a timber sale is bid higher than its appraised value, then there would be more revenue return to the US Treasury, part of which would be available for qualifying restoration or improvement projects such as those described in the Additional Restoration and Improvement Activities section in Chapter 2.

This analysis considers only identifiable and quantifiable economic benefits and costs, and does not reflect non-quantifiable economic considerations such as wildlife habitat, water quality, and other ecosystem services. Those considerations are assessed in other sections of this chapter.

Scenarios

The proposed action includes a relatively large proportion of acres (over 40 percent) designated for helicopter yarding. Based on the high cost of helicopter yarding, and on past timber sale experiences on the Olympic National Forest, there is a low probability that thinning would actually be implemented on most of the acres planned for helicopter yarding. Based on this, three possible scenarios for the implementation of the action alternative were included in the economic analysis. The "all" analysis includes all acres proposed for treatment, and would treat 880 acres yielding approximately 10.1 MMBF of timber output. The "less helicopter" scenario, which is considered more economically realistic than the "all" scenario, would treat 660 acres, yielding approximately 7.8 MMBF. The "no helicopter" scenario, included for comparison, would treat 518 acres, yielding 5.2 MMBF. All three scenarios are based on the logging systems proposed in the proposed action (table A.1 in Appendix A). No changes in the proposed logging systems are assumed under these scenarios, and they do not represent alternatives to the proposed action.

Table Econ-1 contains a summary of timber output, project value, project cost, net present value (NPV), and benefit-to-cost ratio for the three implementation scenarios. This analysis was conducted in June of 2011, using values current at that time.

Table Econ-1. Summary of TEA.ECON economic analysis results

Scenario	A (No Action)	Proposed Action: All	Proposed Action: Less Helicopter	Proposed Action: No Helicopter
Estimated timber volume harvested (MMBF)	0	10.05	7.85	5.18
Product value (in millions)	na	$0.02	$0.21	$0.55
Project cost (in millions)	na	$0.35	$0.27	$0.18
Net Present Value (NPV) (in millions)	na	(-$0.32)	(-$0.06)	$0.37
Benefit-to-cost ratio	na	0.07	0.78	3.08

The key factor for comparison between scenarios is the benefit-to-cost ratio, found in the bottom row of Table Econ-1. When the revenues of a project exactly equal its costs, the benefit-to-cost ratio equals 1.00. As can be seen in the above table, only the "no helicopter" scenario has a benefit/cost ratio greater than 1.00. Although the other two scenarios could represent viable sales, they do not cover all the estimated costs associated with them. With a benefit-to-cost ratio of 0.07, the "all" scenario is so low that it could be considered unfeasible

from a fiscal standpoint, although it would thin more acres and therefore more fully achieve the project's primary ecological objectives. The "less helicopter" scenario has a benefit-to-cost ratio of 0.78. It would generate less revenue than the "no helicopter" scenario, but would accomplish most of the project's objectives. Of the three scenarios, only "no helicopter" would be expected to generate much in the way of revenues that could be applied to the Additional Restoration and Improvement Activities described in Chapter 2.

Economic effects

Alternative A-No Action

Direct, indirect, and cumulative effects

Alternative A would provide no timber output, and would have no costs or revenues. With no costs or benefits, the NPV would be zero and there would be no benefit-to-cost ratio. Sale viability is irrelevant under this alternative because no timber sales would be offered. Alternative A would not result in any project-related economic activity. Because there would be no project activities, there would be no cumulative effects from this alternative.

Alternative B – the Proposed Action

Direct and indirect effects

All three implementation scenarios considered would generate wood products and the economic activity associated with those products. Quantities of wood harvested would range from approximately 5.2 – 10.1 MMBF.

While all three implementation scenarios analyzed would produce viable timber sales, the scenarios with a helicopter component would probably not cover all the costs involved, nor would they be likely to generate any funds for other project work. With careful planning, implementation, and higher selling values the "less helicopter" scenario could potentially cover all the costs, and possibly generate some revenue.

Cumulative effects

Each of the action alternatives would contribute wood products to the local economy and support jobs. Past timber-related economic influences associated with National Forest Lands in the planning area are largely based on management direction and market conditions, both of which change over time. The proposed Ahl Over thinning project, which would commercially thin approximately 800 acres in the Lower South Fork Skokomish River subwatershed, is the only foreseeable future timber harvest activity on federal lands in the general vicinity. Considerably more economic activity is associated with commercial timber harvest on nearby non-federal lands. The proposed action is a relatively small project, and no cumulative effects with past, present, or reasonably foreseeable actions are anticipated.

CLIMATE CHANGE

Introduction

A growing body of scientific evidence and long-term climate modeling indicate that climate change is occurring at a global scale, and that it is associated with increased outputs of carbon dioxide (CO2) and other greenhouse gases (GHGs) resulting from human activities. Mote and Salathe (2009) used a wide range of climate models to explore possible future climate scenarios for the Pacific Northwest. All models indicate that the future climate will be warmer than the past, with rates of warming greater than those observed in the 20th century. Model projections for precipitation are much more uncertain than those for temperature, and remain within the 20th century range of annual variability (Mote 2003). There are others who believe that climate change is not occurring or that, if it is, it is not a result of human activity. They cite evidence such as a downward trend in temperature in the last decade (1998-2009) as a reason to question climate models that predict steady long-term increases in temperature. This analysis is not intended to support or refute any of the various positions on climate change. Its purpose is to fulfill the NEPA requirement to provide the public and the decision maker with relevant information about the environmental effects of a proposed action.

This analysis focuses on aspects of climate change that may lead to changes in the effects, sustainability, vulnerability, or design of the Upper South Fork Skokomish Vegetation Management project's proposed action. It recognizes the limits of our scientific ability to accurately predict climate change effects, and does not devote effort to analyzing wholly speculative effects. It follows CEQ regulations at 40 CFR 1502.22 regarding acquisition and disclosure of information that is relevant to reasonably foreseeable impacts and is essential to a reasoned choice among alternatives.

This project was not specifically designed to respond to or mitigate potential climate change. This analysis will consider two types of climate change effects: the effect of climate change on the proposed action; and the effect of the proposed action on climate change. Because these are complex issues, large-scale issues, and there are no fine-scale models available to provide meaningful project-level information, this is not a quantitative analysis.

Potential effects of climate change on the proposed project

Much of the information presented in the following discussion is summarized from *Adapting to Climate Change at Olympic National Forest and Olympic National Park* (Halofsky et al. 2011). Where no other references are specified, the climate-related information below should be attributed to Halofsky et al. (2011) and references therein.

Some of the most important projected future changes in climate relevant to forest planning on the Olympic Peninsula are:

- Very likely increase in temperature on all seasons, particularly in summer;
- Very likely increase in precipitation, probably as an increase in winter precipitation, but with a decrease in summer precipitation;
- Likely increase in water balance deficit in summer;

- Possible increase in winter extreme precipitation events.

These changes can be loosely summarized as warmer overall, with a likely increase in droughty conditions in the summer, and a possible increase in strong storms in the winter. Climate models predict a warming rate of roughly 0.5 degrees F (0.3C) per decade in the 21st century. Projected changes in average annual precipitation are small, but the distribution of precipitation is projected to become increasingly more seasonal (wetter winters, drier summers).

To increase ecosystem resilience to climate change, the Olympic National Forest is focusing on maintaining, reconnecting, and reestablishing ecosystem processes and functions, considering past and current management practices, and assessing their contributions to current and future habitat conditions. The possible climate change effects summarized above were taken into consideration during the planning phase of the proposed Upper South Fork Skokomish Vegetation Management project.

Climate change modeling is done on a very coarse scale, and results are generalized over areas considerably larger than a single watershed or planning area. The scale of this analysis is the sub-watershed scale (Upper South Fork Skokomish River subwatershed). Potential climate change effects at a scale as small and precise as a single watershed or planning area cannot be effectively modeled, and potential risks associated with climate change at such a localized scale are speculative and cannot be quantified.

Watershed

The implications for physical watershed processes include shifts in timing and magnitude of peak stream flows and the frequency of flooding. Increasing temperatures have led to more precipitation falling as rain rather than snow, earlier spring snowmelt, and reduced spring snowpack. These changes result in higher winter and spring streamflows and lower summer streamflows in snowmelt-dominated and transient (rain and snow mixed) watersheds. The Skokomish River watershed is a rain-dominated watershed that also receives some precipitation in the form of snow at higher elevations. Warming is likely to have moderate impact on the timing of streamflow in this watershed. It is possible that an increase in extreme winter precipitation events may result in an increase in associated landslide and erosion risk.

Vegetation

Drier conditions associated with projected climate change may increase summer drought stress and fire frequency in the Pacific Northwest. Higher temperatures and lower summer precipitation may result in increased evapotranspiration, slower tree growth, and increased susceptibility to insects and disease. It is possible that an increase in extreme winter storm events may result in increased windthrow. Changing climatic conditions may favor the establishment of invasive plant species.

Alternative A – No Action

Direct, Indirect, and Cumulative Effects

Under the No Action alternative, watershed and vegetation conditions in the watershed would not be altered by project-related activities. Watershed and vegetation response to projected trends in climate would not change from their current trajectory. There would be no interactions between project activities and potential effects of climate change on watershed and vegetation conditions within the watershed. Because no management activities would occur, there would be no cumulative effects with other past, present, or foreseeable future activities.

Alternative B – the Proposed Action

Direct and Indirect Effects

Watershed

The projected trend toward wetter winters and more extreme storm events may increase erosion and landslide risk in the watershed. The project design criteria and other management requirements described in chapter 2 would be likely to be sufficient to prevent any project-related increases to the risk of sedimentation and landsliding associated with the potential effects of climate change. Improvements to road-related drainage conditions resulting from project-related decommissioning of unstable unclassified roads used for of project activities would be likely to decrease existing landslide and sedimentation risks currently associated with these roads. As an indirect effect, funds from the sale of harvested timber may be available for decommissioning additional roads listed in chapter 2, Additional Restoration and Improvement Activities, further reducing existing landslide and sedimentation risks in the watershed.

Vegetation

The projected trend toward drier summer conditions may increase drought stress and inter-tree competition in the watershed. In the dense, managed stands proposed for treatment, thinning would reduce competition between trees and may offset potential climate change-related drought stress for a period of time. The proposed thinning prescriptions would temporarily result in increased sunlight reaching currently bare forest floor, potentially increasing evaporation, but the anticipated rapid post-thinning growth of understory and groundcover vegetation would decrease this effect within a few years. Also, post-thinning canopy cover would remain relatively high, ranging from 60 to 90 percent, and the canopy is expected to close again relatively quickly, minimizing any increased drying effects. Thinning prescriptions would be designed to minimize any blowdown risk associated with the thinning treatments. The proposed thinning treatments are not anticipated to be directly or indirectly affected by climate change, and are not anticipated to either exacerbate or mitigate climate change effects on vegetation in the watershed.

Cumulative Effects

Because it is difficult to assess the effects of climate change on past management actions in the watershed, it is not feasible to assess whether there may be cumulative effects of climate change interactions with other management actions associated with this project. The project was designed to accommodate potential effects that could be associated with the climate trends presented in Halofsky et al. (2011), and to maintain and increase ecosystem resilience in the face of projected future climate scenarios.

Potential effects of the proposed project on climate change

Forests and forest management influence the production of GHGs and therefore influence global climate change. Forests help mitigate GHG emissions by absorbing CO2 and sequestering carbon in the form of biomass. Large-scale deforestation both releases GHGs (from burning and decomposition of slash and woody debris) and reduces the global rate of carbon sequestration until the forest regrows or the loss of sequestration potential is offset by the growth of other forests or replaced by other means. The use of petroleum-fueled equipment associated with timber harvest and the manufacture of wood-based products consumes fossil fuels and contributes CO2 to the atmosphere. Harvested timber that is converted into building products no longer actively sequesters carbon, but it does continue to serve as carbon storage for the duration of its lifetime of use as structural and non-structural components of buildings.

For this assessment of the potential effects of the Upper South Fork Vegetation Management project on climate change, the two alternatives will be compared relatively on the basis of changes in carbon sequestration potential (timber output), and GHG (CO2) emissions (use of fossil fuels by harvest equipment).

Alternative A – No Action

Direct, Indirect and Cumulative Effects

Under the No Action alternative, there would be no timber output, and no change to current rates of carbon sequestration in the stands proposed for thinning. Tree growth in these stands is slowing as a result of overcrowding, and competitive exclusion is causing some trees to die. In the absence of disturbance, this process would continue, and the pace of carbon sequestration is likely to remain unchanged. There would be no timber harvest and associated activities, so there would be no project-related GHG emissions. Because there would be no project activities, there would be no cumulative effects with other past, present, and foreseeable future management actions.

Alternative B – the Proposed Action

Although carbon sequestration and release of GHGs are local events, their effect on climate change occurs at a global scale. Because of this, it is impossible to precisely assess the potential effects of the Upper South Fork Skokomish Vegetation Management project, and even relative comparisons between the alternatives are meaningless on a global scale.

Direct and Indirect Effects

The proposed thinning of 800 acres may result in a short-term decrease of carbon sequestration potential, but that would be fairly quickly offset by the increase in tree growth that would result from a reduction in inter-tree competition.

Cumulative Effects

Global climate change has been described as the ultimate cumulative effect, overlapping in space and time with countless other human actions across the entire earth in the past, present, and the foreseeable future. Its extent is worldwide, and it affects different geographical regions differently. On a global scale, the Upper South Fork Skokomish Vegetation Management project

is likely to have a negligible cumulative effect on climate change. The ongoing demand for forest products implies that equivalent volumes of timber would be harvested elsewhere. This project would provide a small quantity of forest products without converting any currently forested land to non-forest. Commercial thinning of forested land that does not convert that land to other uses but retains it in a predominantly forested condition may be preferable to other forms of forest management in terms of its contribution to current trends in global climate change.

OTHER EFFECTS

This section discusses those effects for which disclosure is required by National Environmental Policy Act (NEPA) regulations, Forest Service policy or regulation, various Executive Orders, or other laws and direction covering environmental analysis and documentation. In many cases, the information found here is also located elsewhere in this document. In other cases, the effects are not necessarily connected to any particular resource area previously discussed in this EA. All of the effects discussed below are effects that would be associated with Alternative B, the Proposed Action.

Clean Water Act

Section 303 of the Clean Water Act mandates that Total Maximum Daily Load (TMDLs) be developed for the parameters causing the impairment of beneficial use for all 303(d) listed waters. Within the planning area, one section of LeBar Creek is listed; as is one section within the mainstem South Fork Skokomish River, slightly downstream of the planning area. Both are listed as 303(d) waters because of temperature. There are currently no TMDLs assigned to these two listed waters. Field review of the project area determined that the riparian no-cut buffers specified for this project would prevent project-related increases on temperature. See the stream temperature discussion of the Water Quality and Hydrologic Change section of this EA for more details.

Clean Air Act

As disclosed in the Fire and Fuels section of this EA, there would probably be burning of activity-generated slash. Any planned burning of this slash would be done in compliance with all State and Federal laws, including the Clean Air Act.

Forest Plan Consistency

The analysis performed by the interdisciplinary team found that the actions proposed under both project alternatives are consistent with the Forest Plan. The project's Purpose and Need are consistent with Forest Plan goals and objectives, and impacts to resources as evaluated in this EA are consistent with Forest Plan direction and standards and guidelines.

National Forest Management Act Compliance

Compliance with the National Forest Management Act (NFMA) can be demonstrated by finding that a project is consistent with the following applicable requirements of 16 USC 1604(g)(3).

(g)(3)(A): insure consideration of the economic and environmental aspects of various systems of renewable resource management, including the related systems of silviculture and protection of forest resources, to provide for outdoor recreation (including wilderness), range, timber, watershed, wildlife, and fish.

This EA considers the effects of implementing the alternatives on the economic and environmental aspects of the planning area. This consideration includes the forest resources of recreation (including Wilderness), watershed, wildlife, and fish.

(g)(3)B: provide for diversity of plant and animal communities based on the suitability and capability of the specific land area in order to meet overall multiple-use objectives, and within the multiple-use objectives of a land management plan adopted pursuant to this section, provide, where appropriate, to the degree practicable, for steps to be taken to preserve the diversity of tree species similar to that existing in the region controlled by the plan.

Actions proposed under the project alternatives provide for a diversity of plant and animal communities within the project area as described in the multiple-use objectives of the Forest Plan. The effects to plant and animal communities are described in the resource sections of this chapter.

(g)(3)C: insure research on and (based on continuous monitoring and assessment in the field) evaluation of the effects of each management system to the end that it will not produce substantial and permanent impairment of the productivity of the land.

Implementation monitoring and other monitoring proposed in this document would provide an evaluation of the effects of implementing any of the project alternatives.

Irreversible Commitment

Irreversible impacts result from the use or modification of resources that are replaceable only over a long period of time.

Soil productivity would be lost to some degree on temporary skid roads, skid trails, and landings due to soil displacement. Full recovery of soil productivity in these areas would not be anticipated for many decades, although measures to reclaim these areas would speed recovery. Permanent roads represent an irreversible modification of the soils within the road prism; the proposed action contains no increases to the existing system of authorized Forest roads. There are no other irreversible commitments associated with the proposed action.

Irretrievable Commitment of Resources

Irretrievable commitments are opportunities for resource uses that are foregone because of decisions that use that land in another way.

Rock pit development: The construction and use of roads and landings for this project would be likely to require the application of road surface rock. Existing rock pits in the planning area would be the source for this material. The further development of these rock sources would forego other uses of the pit area.

Adverse Effects That Cannot Be Avoided

Implementation the action alternative would result in some adverse environmental effects that cannot be avoided. For example, timber harvest and temporary road construction activities would probably have some adverse effects on water quality and soil productivity. The magnitude of these effects relative to the entire project would be very small, and would remain within prescribed standards and guidelines. The degree of these adverse effects would be minimized through the project's required design criteria and mitigation measures, described in chapter 2 of this EA.

Relationship to Other Agencies and Jurisdictions

The Washington State Department of Ecology (Ecology) is responsible for enforcing the Clean Water Act of 1972. A memorandum of Understanding between the Forest Service and Ecology states that Best Management Practices used by the Forest Service to control or prevent non-point sources of water pollution will meet or exceed Washington State water quality standards.

The Department of Ecology is also responsible for enforcing the Clean Air Act of 1972. The State's Smoke Implementation Plan provides guidelines for compliance which are intended to meet the requirements of the Clean Air Act. All burning plans for activities with the Upper South Fork Skokomish Vegetation Management project would comply with this plan.

The United States Fish and Wildlife Service (USFWS) is responsible for the protection and recovery of Threatened and Endangered Species. Because this project may affect Threatened or Endangered Species or their habitat, the USFWS has been consulted.

The National Oceanic and Atmospheric Administration (NOAA) is responsible for the protection and recovery of Threatened and Endangered marine fish species. Because this project may affect Threatened or Endangered marine fish Species or their habitat, the USFWS has been consulted.

Cultural Resource Site reports for all cultural resources found within the Upper South Fork Skokomish Vegetation Management planning area are filed with and have been approved by the Washington State Historic Preservation Officer.

Effects on Prime Farm Land, Range Land, and Forest Land

There have been no range activities within the planning area for several decades. There are no prime farm lands or prime range lands associated with the Upper South Fork Skokomish Vegetation Management project.

Effects on Energy Requirements

There would be no unusual energy requirements associated with implementing any of the project's alternatives. Energy consumption needed to harvest timber or for recreation would not necessarily be reduced by lower levels of either activity in the Upper South Fork Skokomish Vegetation Management planning area. Helicopter yarding operations are always evaluated due to their relatively higher level of fuel consumption, but it is likely that, if they did not occur for this project, they would take place at similar levels elsewhere on the Forest or in the region, with correspondingly similar energy requirements. The Upper South Fork Skokomish Vegetation Management project would not create unusual energy requirements.

Effects on the Human Environment

There is no known major scientific controversy surrounding the activities and potential effects of this project. While the sale of National Forest timber would create or sustain jobs and provide consumer goods, no quantitative output, lack of output, or timing of output associated with implementation of any alternative would affect the civil rights, privileges, or status quos of consumers, minority groups, women, or American Indians.

Several of the Forest Service roads that would be used for the project are frequently used by the public. Proper road closure and/or signing for safety would follow the Manual in Uniform Traffic Control Devices for Streets and Highways (MUTCD). Special attention would be focused on any helicopter operations associated with the proposed project.

There would be no adverse effects to human health or safety associated with the implementation of any alternative for this project.

Effects on Wetlands and Floodplains

The planning area is not associated with floodplains. Given the mitigation measures and design requirements included in the project, there would be no adverse effects to wetlands or floodplains from the implementation of any of the action alternatives.

Effects on American Indians

The Upper South Fork Skokomish Vegetation Management planning area lies within the area ceded to the United States by the 1855 Point-No-Point Treaty. The Skokomish Indian Nation was briefed on the Upper South Fork Skokomish Vegetation Management project at a field trip in August of 2010, and formally consulted regarding the project in a letter dated January 13, 2011. No concerns about the project's potential effects were raised.

Effects on Cultural Resources

No known historic and cultural sites are located within the proposed thinning units or access roads. Given the requirement for cessation of project activities if cultural resources are discovered, followed by an evaluation by a Forest Service Archaeologist, there would be no adverse effects to cultural resources from the implementation of any of the project's alternatives. The Washington State of Archaeology and Historic Preservation was consulted regarding the findings of cultural resource surveys conducted within the planning area, and concurred with the determination that the project would have no adverse effect on historic resources.

Environmental Justice

Environmental Justice means that, to the greatest extent practicable and permitted by law, all human populations are provided the opportunity to comment before decisions are rendered, are allowed to share in the benefits of, are not excluded from, and are not affected in a disproportionately high and adverse manner, by government programs and activities affecting human health or the environment.

One goal of Executive Order 12898 is to provide, to the greatest extent practicable, the opportunity for minority and low-income populations to participate in planning, analysis, and decision-making that affects their health or environment, including identification of program needs and designs. The Executive Order makes clear its provisions apply fully to programs involving Native Americans.

Analysis for the Upper South Fork Skokomish Vegetation Management project has been conducted under Departmental regulation 5600-2, December 15, 1997, including the Environmental Justice Flowchart, and CEQ's Environmental Justice – Guidance Under the

National Environmental Policy Act. The project's proposed action, purpose and need, and area of potential effect have been clearly defined. Scoping under NEPA has utilized extensive and creative ways to communicate. Consultation with Native American Tribes has taken place.

The proposed action and its alternatives do not appear to have a disproportionately high or adverse effect on minority or low income populations, or on American Indian Tribes. The proposed action and alternatives do not have disproportionately high and adverse human health effects, high or adverse environmental effects, substantial environmental hazard, or effects to differential patterns of consumption of natural resources. Scoping did not reveal any issues or concerns associated with the principles of Environmental Justice. In some areas of the Forest, the gathering of special forest products, particularly of salal and mushrooms, is an activity where there is the potential to disproportionally affect minority populations, but this is a very minor use within the project area. All interested and affected parties would continue to be involved with the comment and decision-making process.

CHAPTER 4 – LIST OF PREPARERS AND AGENCIES CONSULTED

A Forest Service interdisciplinary team (IDT) conducted and produced this Environmental Assessment (EA). The Forest Service also consulted Federal, State, and local agencies, Tribes, and non-Forest Service individuals and agencies during the development of this EA. Additional information was provided by private contractors who conducted surveys for streams, potential nest trees, and legacy snags.

Table 4.1. IDT Members and other Forest Service contributors

Name	Role
Jana Carlson	Timber Sale Administrator
Guadalupe Cisneros	Transportation Engineer
Tim Davis	Forest Planner
Susie Graham	Recreation Specialist
Scott Hagerty	Soil Scientist
Dean Yoshina	District Ranger, Hood Canal (Responsible Official)
Betsy Howell	Wildlife Biologist
Marc McHenry	Fisheries Biologist
Steve McNealy	Logging Systems Specialist, Economics
Jeff Neil	Fire and Fuels Specialist
Stephanie Neil	Archaeologist
Mark Senger	Silviculturist
Robin Shoal	NEPA Specialist, IDT Leader
Robin Stoddard	Hydrologist
Doug Sturhan	Geographic Information Systems (GIS)
Dean Yoshina	Hood Canal District Ranger
Joan Ziegltrum	Botanist/Invasive Plant Specialist

CHAPTER 5 – APPENDICES

APPENDIX A: DETAILED TABLES FOR ALTERNATIVE B – THE PROPOSED ACTION

Proposed treatment units

Table A.1 displays the acreage for all the individual proposed treatment units by anticipated logging system. It also shows the number of acres within the unit that are overlain by Riparian Reserve, and planned, pre-designated skip acres within each unit.

Table A.1. Proposed treatment units and logging systems

Unit ID	Logging system	Potential thinning treatment acres (880 acres)		Planned skips (157 acres)
		Unit acres	Unit acres in Riparian Reserves	Unit acres in pre-designated skip areas
D15A	Ground-Based Yarding	10.8	0.3	
D15B	Helicopter Yarding	11.1	3.6	
D15B1	Helicopter with PreBunching	5.4	3.8	
D24	Helicopter Yarding	20.5	7.7	
D25A	Helicopter Yarding	97.7	34.0	
D25B	Helicopter Yarding	7.2	4.9	
L01A	Ground-Based Yarding	52.7	6.2	
L03A	Ground-Based Yarding	8.6	2.9	
L03B	Ground-Based Yarding	28.3	0.3	
L13A	Ground-Based Yarding	13.7	1.2	1.1
L13B	Cable Yarding	44.2	20.6	
L60	Ground-Based Yarding	31.8	17.4	
L60B	Designated Skip (entire unit)	-	-	32.6
L65	Ground-Based Yarding	52.9	7.6	
S009	Helicopter Yarding	36.6	3.0	
S010	Helicopter Yarding	37.7	0.4	12.3
S015	Cable Yarding	20.1	4.0	
S016	Cable Yarding	30.4	10.7	12.5
S017	Cable Yarding	36.2	20.1	10.5
S026	Cable Yarding	5.0	1.7	
S026A	Helicopter Yarding	18.0	9.5	
S029	Cable Yarding	16.3	7.9	
S036	Helicopter with PreBunching	11.5	4.6	
S036A	Ground-Based Yarding	34.6	5.8	
S052A	Helicopter Yarding	29.4	2.1	
S052B	Helicopter with PreBunching	8.0	1.2	
S052C	Ground-Based Yarding	6.6	0.1	

Table A.1. Proposed treatment units and logging systems				
Unit ID	**Logging system**	**Potential thinning treatment acres (880 acres)**		**Planned skips (157 acres)**
		Unit acres	Unit acres in Riparian Reserves	Unit acres in pre-designated skip areas
S053B1	Ground-Based Yarding	12.2	3.6	
S053B2	Ground-Based Yarding	9.8	2.6	
S053C	Ground-Based Yarding	18.7	3.3	
S070A	Ground-Based Yarding	4.9	0.1	7.3
S070B	Designated Skip (entire unit)	-	-	18.2
S070C	Ground-Based Yarding	3.5	0.9	
S071	Helicopter with PreBunching	25.3	1.2	
S071A	Ground-Based Yarding	2.1	0.0	
S072	Helicopter Yarding	47.9	9.7	4.6
S072B	Designated Skip (entire unit)	-	-	5.0
S074A	Ground-Based Yarding	10.3	0.0	
S074B	Designated Skip (entire unit)	-	-	39.9
S084	Cable Yarding	21.8	16.3	6.2
S099A	Ground-Based Yarding	9.6	0.0	
S099B	Cable Yarding	13.7	1.3	
S099C	Helicopter Yarding	6.0	2.9	
S112	Ground-Based Yarding	19.5	0.6	6.4

Proposed temporary roads

Table A.2 displays road type, total miles, and miles within Riparian Reserves for all proposed temporary road segments.

Table A.2. Proposed temporary roads by road segment			
Temporary Road ID	**Road Type[1]**	**Total length (miles)**	**Miles within RR**
D15A	Decommissioned	0.11	
D25AD	Unclassified	0.08	0.01
D25AE	New	0.02	
D25AF	Unclassified	0.07	0.07
L13A	Decommissioned	0.08	
L1AA	Unclassified	0.09	
L1AB	Unclassified	0.06	
L1AC	Unclassified	0.05	
L1AE	New	0.03	
L3AB	New	0.02	0.02
L3AC	Unclassified	0.07	0.03
L3BA	Unclassified	0.11	

Table A.2. Proposed temporary roads by road segment			
Temporary Road ID	**Road Type[1]**	**Total length (miles)**	**Miles within RR**
L3BB	Unclassified	0.05	
L3BC	New	0.07	
L60A	Unclassified	0.13	
L60C	Unclassified	0.26	0.26
L60D	Unclassified	0.07	0.01
L60E	Unclassified	0.11	0.11
L65A	New	0.27	0.06
S112A	New	0.09	
S112A	Unclassified	0.08	
S112B	Unclassified	0.04	
S17A	Unclassified	0.17	
S36A	New	0.17	
S36B	Decommissioned	0.09	
S52A	New	0.04	
S52B	New	0.04	
S53AA	Unclassified	0.16	
S53AB	New	0.08	0.08
S53CA	New	0.01	
S53CB	New	0.03	
S53CC	Decommissioned	0.08	0.02
S70B	Unclassified	0.22	0.10
S70C	Unclassified	0.03	
S71A	Unclassified	0.18	
S71A	New	0.04	
S99A	Unclassified	0.25	

1 *Temporary road types:*

- *New = new construction where no roadbed currently exists.*
- *Decommissioned = reconstruction of a previously decommissioned system road.*
- *Unclassified = reconstruction of an existing non-system roadbed. These roads may have been used for timber harvest in the past, and are not part of the system of authorized forest roads. Current condition of these roads ranges from drivable with little vegetation, to undrivable with trees (typically alder) growing in the old roadbed. Some roads may have existing culverts or other constructed drainage features.*

Proposed haul routes

Table A.3 displays Forest System Roads (FSR) in the planning area (Upper South Fork Skokomish River subwatershed) by road number, operational maintenance level, and length of road (miles) that would be used for log haul. No log haul would occur on the portion of FSR 2340 that passes through the developed Brown Creek Campground.

Table A.3. Forest System Roads proposed for log haul in planning area		
FSR number	Operational ML[1]	Miles proposed for log haul
2300000	4	6.99
2300240	1	0.16
2300260	1	0.41
2340000	4	0.59
2340000	3	3.83
2340360	2	0.11
2340400	2	0.54
2340430	2	1.17
2340433	1	0.08
2340437	1	0.12
2353000	4	0.21
2353000	3	2.08
2353000	4	0.58
2353120	2	0.44
2354000	3	1.64
2356000	2	1.01
2360000	2	1.74
2361000	3	3.50
2361000	3	0.28
2361200	2	0.64
2361300	1	0.28
2361400	2	0.46
2361600	2	0.51
Miles of system road proposed for log haul in planning area		**27.37**

1 *Operational Maintenance Level (ML):*
4 = Maintained for passenger car travel.
3 = Maintained for passenger car travel.
2 = Maintained for high-clearance vehicles.
1 = Closed system road.

Some National Forest System roads outside of the planning area would also be used for log haul. These roads pass through the Lower South Fork and the Lower North Fork Skokomish River subwatersheds. Table A.4 shows these roads.

Table A.4. Forest System Roads proposed for log haul outside of planning area		
FSR number	Operational ML[1]	Miles of log haul
2300000	4	9.41
2340000	3 and 2	9.04
2340200	2	5.73
2340230	2	2.10
Miles of system road proposed for log haul outside of planning area		**26.28**

Table A.5. Road work and maintenance needs for system roads proposed for log haul

Route no.[1]	BMP[2]	EMP[3]	ATM Obj. ML[4]	Oper-ational ML[5]	Haul Miles	Work proposed[6]	Post Project Status	Project Use[7]
2300000	*0*	*1.10*	*4*	*4*	*1.10*	*Asphalt Patching 10 tons*	*Open*	*Haul Route*
2300000	*1.10*	*2.70*	*4*	*4*	*1.60*	*Resurfacing 500 CY (Double Lane); 2 culvert replacements*	*Open*	*Haul Route*
2300000	*2.70*	*9.41*	*4*	*4*	*6.71*	*Asphalt Patching 60 tons*	*Open*	*Haul Route*
2300000	9.41	16.40	4	4	6.99	Resurfacing 1000 CY (Double Lane); 2 culvert replacements	Open	Haul Route
2353000	0.00	0.80	4	4	0.80	Asphalt Patching 10 tons	Open	Haul Route
2340000	*0.00*	*4.45*	*3*	*3*	*4.45*	*Resurfacing 500 CY; 2 culvert replacements*	*Open*	*Haul Route*
2340000	9.04	12.50	3	3	3.46	Resurfacing 400 CY; 1 culvert replacement	Open	Haul Route
2353000	0.80	2.88	3	3	2.08	Resurfacing - 200 CY; 1 Culvert replacement	Open	Haul Route
2354000	0.00	1.64	3	3	1.64	Resurfacing - 200 CY; 1 Culvert replacement	Open	Haul Route
2361000	0.00	3.50	3	3	3.50	Resurfacing - 400 CY - 1 Culvert replacement	Open	Haul Route
2361000	3.50	3.78	3	3	0.28	Pit Run - 50 CY	Open	Haul Route
2340000	*5.15*	*5.31*	*2*	*2*	*0.16*	*Resurfacing 10 CY*	*Open*	*Haul Route*
2340200	*0.00*	*5.73*	*3*	*2*	*5.73*	*Resufacing 500 CY*	*Open*	*Haul Route*
2340230	*0.00*	*2.10*	*2*	*2*	*2.10*	*Resurfacing 400 CY, 1 culvert replacement., Clearing, Brushing*	*Open*	*Haul Route*
2340360	0.00	0.11	2	2	0.11	Resufacing - 10 CY	Open	Haul Route
2340400	0.00	0.54	2	2	0.54	Resufacing - 50 CY	Open	Haul Route
2353120	0.00	0.44	3	2	0.44	Resufacing 50 CY	Open	Haul Route
2356000	4.26	5.27	2	2	1.01	Resurfacing 50 CY; Blade and Shape	Open	Haul Route
2360000	0.00	1.74	2	2	1.74	Resurfacing 200 CY; 3 culvert replacements, Blade and Shape, Brushing	Open	Haul route
2361200	0.00	0.64	3	2	0.64	Blading and Shape	Open	Haul route
2361400	0.00	0.46	2	2	0.46	Blading and Shape, Brushing	Open	Haul Route
2361600	0.00	0.51	2	2	0.51	Blading and Shape	Open	Haul Route
2340430	0.00	1.17	D	2	1.17	Blading and Shape	Open	Haul Route

Table A.5. Road work and maintenance needs for system roads proposed for log haul								
Route no.[1]	**BMP[2]**	**EMP[3]**	**ATM Obj. ML[4]**	**Oper-ational ML[5]**	**Haul Miles**	**Work proposed[6]**	**Post Project Status**	**Project Use[7]**
2300240	0.00	0.16	2	1	0.16	Blading and Shape, Brushing	ML1	Dry Haul
2300260	0.00	0.41	2	1	0.41	Blading and Shape, Brushing	ML1	Dry Haul
2340433	0.00	0.08	D	1	0.08	Blading and Shape, Brushing	ML1	Haul Route
2340437	0.00	0.12	D	1	0.12	Blading and Shape	ML1	Haul Route
2361300	0.00	0.28	D	1	0.27	Blading and Shape, Brushing	ML1	Haul Route

1 *Road numbers in italics indicate roads outside of the planning area*
2 *BMP = Beginning Mile Post*
3 *EMP = Ending Mile Post*
4 *Obj. ML = Objective Maintenance Level (see note 1, table A.3)*
5 *Current ML = current maintenance level for indicated road segment (see note 1, table A.3)*
6 *CY = cubic yards*
7 *Dry Haul = log haul during the summer season*

APPENDIX B: SEASONAL OPERATING RESTRICTIONS AND OPERATING WINDOWS

This appendix contains project- and unit-level interpretation of the various seasonal restrictions and work windows that apply to project activities.

Seasonal operating restrictions and operating windows for thinning units and roads

Tables B.1 and B.2 describe the general seasonal restrictions and work windows that apply to the indicated thinning and road-related activities. They are identical to tables 2.26 and 2.27 in chapter 2.

Table B.1. General seasonal operating restrictions for thinning operations

ID	Reason for restriction	Restriction[1]	Operating Window
A	Seasonal high water table – prevent soil damage	No ground-based logging activities November 1 through May 31. Includes log haul on temporary roads.	June 1 - October 31
R	Recreation high use season – minimize trail closures	No project activities on weekends (4:00 pm Friday through Sunday) May 1 through September 30	October 1 - April 30
1	Owl and murrelet breeding season – prevent noise disturbance	Restriction on ground-based machine noise April 1 through August 5	August 6 - March 31
2	Owl and murrelet breeding season – prevent noise disturbance	Restriction on helicopter noise March 1 through August 5	August 6 - February 28
3	Wildlife gate closures (WDFW)	Wildlife gates closed October 1 through April 30	May 1 - September 30
4	Two-hour work window restriction to minimize disturbance to owls and murrelets	Noise-producing activities may not commence until two hours after sunrise, and must cease two hours before sunset. April 1 through August 5	August 6 - March 31

1 *Not all restrictions apply to all units or activities. See table B.4 for unit-level information.*

Table B.2. General seasonal operating restrictions for road construction and maintenance			
Restriction applies to	**Reason for restriction**	**Restriction[1]**	**Operating Window**
2361 Road and spurs	Bull trout habitat protection (as specified in USDI Fish and Wildlife Service 2003)	For 2361 road and spurs, no ditch blading, road blading, or other major road maintenance activities from October 1 through March 31. Minor maintenance to prevent washouts and sediment delivery is allowed year-round.	Major maintenance allowed April 1 through Sept 30. Log haul allowed year-round. To prevent need for major maintenance between October 1 and March 31, haul will cease if there is a risk of sediment delivery to streams or of road damage or rutting.
2300240 and 2300260 roads	Minimize soil damage (road located on sensitive soil type)	No haul November 1 through March 31	Haul window = April 1 through October 31
All instream work	Minimize sedimentation, protect aquatic habitat (per Hydraulic MOU with WDFW)	All temporary and system road instream work will occur during instream work window (July 15-Sept 30).	July 15 through September 30
All temporary roads	Minimize erosion, sedimentation, protect aquatic habitat	Temporary road construction, reconstruction, and decommissioning will not occur between October 1 and May 30.	June 1 through September 30
All temporary roads	Prevent noise harassment to spotted owls and marbled murrelets	Restriction on ground-based machine noise April 1 through August 6. Restriction on helicopter noise March 1 through August 6	Temporary road construction, reconstruction, and decommissioning seasons will match unit-level operating seasons 1 and 2 in table B.1 for the associated unit(s).
All system roads	Prevent sedimentation, protect aquatic habitat	It is assumed that any system road construction needed for the project would occur between June 1 and September 30.	

Table B.3 displays the general thinning unit-level operating restrictions and work windows in a graphic, monthly calendar format. The ID column corresponds to the ID column in table B.1. The dark grey boxes containing ID codes A, 1, or 2 indicate fully restricted periods. All other periods represent work windows with no restrictions (no shading) or partial restrictions (tan or pink shading – see explanation below table B.3). Not all restrictions apply to all units.

Table B.3. Month-by-month display of general seasonal restrictions

ID	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug		Sep	Oct	Nov	Dec
A	A	A	A	A	A							A	A
R					R	R	R	R	R	R	R		
1				1	1	1	1	1					
2			2	2	2	2	2	2					
3	3	3	3	3							3	3	3
4				4	4	4	4	4					

- **R**. The pink shading represents the recreation weekend operations restriction. No operations from 4:00pm Friday through all day Sunday during this period. In table B.4, where full restrictions overlap this partial restriction, "R" indicates the presence of this underlying restriction.
- 3. It is assumed that, pending an agreement between the District Ranger and USFWS, restriction 3 (the seasonal wildlife gate closure) would be waived for project operations. For this reason, this restriction is not shaded. In table B.4, the code "3" indicates units to which this restriction would apply if it were not waived.
- 4. The tan shading indicates the April 1 through August 5 two-hour work window restriction to minimize noise disturbance to ESA-listed spotted owl and marbled murrelet (4). Work may not commence until two hours after sunrise, and must cease two hours before sunset during this period. Applies to ALL units except D24, D25A, D25B, and L65. In table B.4, where full restrictions overlap this partial restriction, "4" indicates the presence of this underlying restriction
- The break in the August column indicates August 5, the end of the owl/murrelet breeding season and the last day of restrictions 1, 2, and the two-hour work window restriction.

In table B.4, where overlapping restrictions apply, all restriction codes are included in the table, with the color indicating the most restrictive on top.

Table B.4 displays the restrictions and combined work windows for each individual unit and associated temporary and system roads. Color coding for units matches that described for table B.3, above. For roads, pale blue indicates the dry haul only restriction on some temporary roads and system roads 2300240 and 2300260 (no haul November 1 through May 31); lavender shading indicates the seasonal maintenance restriction for system road 2361 and spurs. System road numbers in ***bold italic*** have a road construction noise restriction from March 1 through August 6 for segments passing through suitable spotted owl or murrelet habitat. General road-related seasonal restrictions that apply to all roads project-wide (see table B.2) are not represented in Table B.4

Table B.4. Unit-by-unit seasonal operating restrictions, including roads

Unit information			Unit-level restrictions and operating windows																			Road access and restrictions	
Unit ID	**Logging system**	**Acres**	**A**	**R**	**1**	**2**	**3[1]**	**4**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug 1-5**	**Aug 6-31**	**Sep**	**Oct**	**Nov**	**Dec**	**Temporary roads associated with unit**	**System road access to unit** (may include associated spurs)
D15A	G	10.8						4				4	4	4	4	4						D15A	***2340***
D15B	H	11.1						4				4	4	4	4	4						none	***2340***
D15B1	HP	5.4						4				4	4	4	4	4						none	***2340***
D24	H	20.5																				D25AD/E/F	***2340***
D25A	H	97.7																				D25AD/E/F	***2340***
D25B	H	7.2																				D25AD/E/F	***2340***
L01A	G	52.7			1		3	4				14	14	14	14	14						L1AA/B/C/E	2353120
L03A	G	8.6						4				4	4	4	4	4						L3AB/C	2354
L03B	G	28.3						4				4	4	4	4	4						L3BA/B/C	2354
L13A	G	13.7	A					4	A	A	A	A4	A4	4	4	4				A	A	L13A	2340430
L13B	C	44.2						4				4	4	4	4	4						none	2340430
L60	G	31.8	A		1		3	4	A	A	A	A4	A4	4	4	4				A	A	L60A/C/D/E	***2353***
L65	G	52.9																				L65A	2340400
S009	H	36.6				2		4			2	24	24	24	24	24						none	***2300***
S010	H	37.7				2		4			2	24	24	24	24	24						none	***2300***
S015	C	20.1						4				4	4	4	4	4						none	***2360***
S016	C	30.4						4				4	4	4	4	4						none	***2360***

Table B.4. Unit-by-unit seasonal operating restrictions, including roads

Unit information			Unit-level restrictions and operating windows																			Road access and restrictions	
Unit ID	**Logging system**	**Acres**	**A**	**R**	**1**	**2**	**3**[1]	**4**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug 1-5**	**Aug 6-31**	**Sep**	**Oct**	**Nov**	**Dec**	**Temporary roads associated with unit**	**System road access to unit** (may include associated spurs)
S017	C	36.2			1			4				14	14	14	14	14						S17A	***2360***
S026	C	5.0			1			4				14	14	14	14	14						none	***2356***
S026A	H	18.0				2		4			2	24	24	24	24	24						none	2356560
S029	C	16.3			1			4				14	14	14	14	14						none	***2356***
S036	HP	11.5	A	R			3	4	A	A	A	A4	AR4	R4	R4	R4	R	R	R	A	A	none	***2361***
S036A	G	34.6	A	R			3	4	A	A	A	A4	AR4	R4	R4	R4	R	R	R	A	A	2361300	***2361200***
S052A	H	29.4					3	4				4	4	4	4	4						none	***2361***
S052B	HP	8.0	A			2	3	4	A	A	A2	A24	A24	24	24	24				A	A	S52A	***2361***
S052C	G	6.6	A		1		3	4	A	A	A	A14	A14	14	14	14				A	A	S52B	***2361***
S053B1	G	12.2	A	R		2	3	4	A	A	A2	A24	A24	2R4	2R4	2R4	R	R	R	A	A	S53AA/B	***2361***
S053B2	G	9.8	A	R		2	3	4	A	A	A2	A24	AR24	2R4	2R4	2R4	R	R	R	A	A	S53AA	***2361***
S053C	G	18.7	A				3	4	A	A	A	A	A	4	4	4				A	A	S53CA/B/C	***2361600***
S070A	G	4.9	A		1			4	A	A	A	A14	A14	14	14	14				A	A	none	***2300240***
S070C	G	3.5	A		1			4	A	A	A	A14	A14	14	14	14				A	A	S70C2	***2300240***
S071	HP	25.3	A			2		4	A	A	A2	A24	A24	24	24	24				A	A	S71A	***2300260***
S071A	G	2.1			1			4				14	14	14	14	14						S71A	***2300260***
S072	H	47.9				2		4			2	24	24	24	24	24						none	***2300***
S074A	G	10.3	A				3	4	A	A	A	A4	A4	4	4	4				A	A	none	***2361400/410***
S084	C	21.8						4				4	4	4	4	4						none	***2360***
S099A	G	9.6						4				4	4	4	4	4						S99A	***2300***
S099B	C	13.7						4				4	4	4	4	4						none	***2300260***
S099C	H	6.0						4				4	4	4	4	4						none	***2300260***
S112	G	19.5	A	R			3	4	A	A	A	A4	AR4	R4	R4	R4	R	R	R	A	A	S112A/B	***2361200***

APPENDIX C: SILVICULTURAL DATA TABLES

Table C-1 presents information about basic characteristics of the stands proposed for thinning in the Upper South Fork Skokomish Vegetation Management Project.

Table C-2 presents information about current stand age and past timber harvest activities that have taken place in the project stands.

Table C-3 presents information about current tree species composition and understory vegetation in the project stands.

Table C-1. Characteristics of project stands

Unit ID	Acres	NWFP/LRMP Land Class[1]	Watershed[2]	Elev. (ft)	Slope (%)	Aspect	Soil Map Unit[3]
D15A, D15B, D15B1	457.0	LSR	Brown Creek	880	22	SW	563L8, 538M7
D24	302.4	LSR	Brown Creek	1675	28	E	425D7, 538M7
D25A	174.0	LSR	Brown Creek	1575	26	NE	538M7, 400D8, 423D7, 423H7
D25B	8.2	LSR	Brown Creek	1725	24	SE	538M7, 400D8
L01A	52.7	LSR	Lebar Creek; Middle South Fork Skokomish River	950	11	SW	563L8
L03A	12.1	LSR, A2	Brown Creek	960	10	SW	563L8
L03B	32.0	LSR, A2	Brown Creek; Lebar Creek	965	3	SW	563L8
L13A,L13B	82.6	LSR	Brown Creek	1410	34	S	400D8, 538M7, 563L8
L60	64.4	LSR	Middle South Fork Skokomish River	885	17	SW	505N7, 563L8
L65	52.9	LSR	Brown Creek	1065	3	SW	563L8
S009	38.2	LSR, A2	Middle South Fork Skokomish River	1290	60	NE	423D7, 506N7
S010	50.8	LSR, A2	Middle South Fork Skokomish River	1340	61	NE	423D7, 506N7
S015	20.1	LSR, A2	Cedar Creek	1295	46	N	506N7, 416D8
S016	42.9	AMA, LSR	Cedar Creek	2030	56	NW	425D7
S017	46.7	LSR, A2	Cedar Creek	1625	59	NW	425D7, 506N7

Table C-1. Characteristics of project stands							
Unit ID	**Acres**	**NWFP/LRMP Land Class[1]**	**Watershed[2]**	**Elev. (ft)**	**Slope (%)**	**Aspect**	**Soil Map Unit[3]**
S026, S026A	23.0	AMA, A2	Cedar Creek	1805	61	W	416D8, 511N8
S029	16.3	LSR, A2	Cedar Creek	1820	69	NW	416D8
S036, S036A	46.1	LSR, A2	Pine Creek	1095	17	NE	505N7, 506N7
S052A, S052B, S052C	44.2	LSR, A2	Upper South Fork Skokomish River	1115	32	NE	505N7, 506N7
S053B1, S053B2	24.2	LSR, A2	Church Creek; Upper South Fork Skokomish River	1040	14	E	505N7
S053C	42.2	LSR, A2	Church Creek; Upper South Fork Skokomish River	1215	28	E	505N7
S070A, S070B, S070C	34.0	A2, A4BN	Middle South Fork Skokomish River	825	22	N	505N7
S071, S071A	27.3	A2, A4BN	Middle South Fork Skokomish River	725	14	NE	563L8, 505N7, 416D8
S072	57.6	A2, A4BN	Middle South Fork Skokomish River	760	17	NE	563L8
S074A	51.9	LSR, A2	Upper South Fork Skokomish River	915	14	N	505N7
S084	27.9	AMA, LSR	Cedar Creek	2035	58	NW	425D7, 506N7
S099A, S099B, S099C	31.2	LSR, A2	Middle South Fork Skokomish River	885	18	NE	416D8, 506N7 563L8
S112	25.9	LSR, A2	Cedar Creek; Middle South Fork Skokomish River	1110	11	E	505N7

1 *AMA = Adaptive management area; LSR = Late-successional reserve; A2 = Scenic; A4BN = Natural river corridor; all stands also contain outer portions of Riparian reserves*

2 *Drainage (HUC 7); See fisheries report*

3 *See soils report for attributes of soil map units; soil map units comprising minimal acreage within stand were not included in this table*

Table C-2. Timber management history of project stands							
Unit ID	**Year of origin**	**Stand age in 2012**	**HCC[1]**	**FBR[2]**	**SPC[3]**	**SFL[4]**	**HTH[5]**
D15A, D15B, D15B1	1945	67	1944	1945	-	1984	-
D24	1948	64	1946	1947	-	1984	-
D25A	1949	63	1946	1947	-	1984	-
D25B	1949	63	1946	1947	-	2001	1995
L01A	1963	49	1964	1964	1980	1988	-
L03A	1964	48	1965	-	1978	1988	-
L03B	1964	48	1965	1900	1978	1988	-
L13A, L13B	1963	49	1964	1964	1979	1988	-
L60	1973	39	1973	1974	1988	1988	-
L65	1971	41	1972	1972	1984	1988	-
S009	1957	55	1957	1957	1974	1989	-
S010	1958	54	1958	1958	1974	1989	-
S015	1958	54	1957	1958	1989	1989	-
S016	1960	52	1961	1960	1979	1989	-
S017	1958	54	1957	1958	1989	1989	-
S026, S026A	1960	52	1960	1961	1974	1990	-
S029	1960	52	1961	1962	1981	1990	-
S036, S036A	1967	45	1967	1968	1980	1990	-
S052A, S052B, S052C	1962	50	1962	1964	1978	1990	-
S053B1, S053B2	1962	50	1962	1964	1973	1990	-
S053C	1962	50	1962	1964	1981	1990	-
S070A, S070B, S070C	1969	43	1969	1970	1980	1990	-
S071, S071A	1969	43	1969	1970	1985	1990	-
S072	1971	41	1970	1972	1991	1990	-
S074A	1974	38	1970	1972	1991	1990	-
S084	1971	41	1970	-	1986	1989	-
S099A, S099B, S099C	1972	40	1971	1973	1991	1990	-
S112	1972	40	1973	1974	1991	-	-

1 *HCC = year of clear cut harvest*
2 *FBR = year of broadcast burning*
3 *SPC = year of pre-commercial thinning*
4 *SFL = year of fertilization*
5 *HTH = year of commercial thinning*

Table C-3. Tree species composition and understory vegetation in the project stands.								
Overstory						Understory		
Unit ID	**Major Species[1]**	**Minor Species[1]**	**BA[2]**	**TPA[3]**	**QMD[4]**	**Species[1]**	**TPA[3]**	**Vegetation Cover (%)[5]**
D15A, D15B, D15B1	DF	WH, WRC	256	381	11.1	WH, WRC	46	50
D24	DF, WH	WRC	236	285	12.3	WH, WRC,DF	277	62
D25A, D25B	DF, WH	WRC	236	285	12.3	WH, WRC,DF	277	62
L01A	DF	WH	190	292	10.9	WH,DF, WRC	275	85
L13A, L13B	DF	-	129	233	10.1	DF, WH, WRC	204	90
L03A, L03B	DF	WH	170	382	9.0	DF,WH, WRC, WWP	300	54
L60	DF	WH	157	123	15.3	WH,DF, WRC	117	60
L65	DF	WH, WRC	213	393	9.9	WH, WRC	544	33
S009	DF	PSF, RA, WH, WRC	160	282	9.7	WH, WRC	243	30
S010	DF, WH	WRC	160	282	10.2	WH, WRC	169	12
S015	DF, PSF, WH	WRC	229	197	14.6	WRC, WH	25	30
S016	DF, WH	WRC, PSF	203	369	10.0	WH, WRC,PSF, DF	2000	32
S017	DF	PSF, WH	173	262	11.0	WH, WRC	100	30
S026, S026A	DF, WH	WRC	203	335	10.6	WH, WRC	158	17
S029	DF, WH	WRC	203	335	10.6	WH, WRC	158	17
S036, S036A	DF	WH, WRC	206	299	11.2	WH, WRC	67	7
S052A, S052B, S052C	DF,WRC	WH	185	281	11.0	WRC, WH	100	2
S053B1, S053B2	DF,WRC	NBC, WH	229	436	9.8	WH, WRC	220	2
S053C	DF, WH	RA, WRC	227	736	7.5	WH, WRC	175	2

Table C-3. Tree species composition and understory vegetation in the project stands.								
Overstory						**Understory**		
Unit ID	**Major Species[1]**	**Minor Species[1]**	**BA[2]**	**TPA[3]**	**QMD[4]**	**Species[1]**	**TPA[3]**	**Vegetation Cover (%)[5]**
S070A, S070B, S070C	DF, WH	-	220	289	11.8	WH, WRC	100	15
S071, S071A	DF	RA, WH	166	200	12.3	WH, WRC	117	20
S072	DF	WH	171	263	10.9	WH, WRC	186	30
S074A	DF, WH	PSF	154	239	10.9	WH, WRC	50	4
S084	WH, DF	WRC	151	185	12.2	WH, WRC,PSF, DF	1500	7
S099A, S099B, S099C	WH	DF	167	311	9.9	WH, WRC	172	20
S112	DF, WH	-	143	204	11.3	WH, WRC	250	30

1 *Species Codes: Douglas-fir (DF), western hemlock (WH), western redcedar (WRC), red alder (RA), western white pine (WWP), Pacific silver fir (PSF), and northern black cottonwood (NBC)*
2 *Basal Area (ft^2/acre)*
3 *Trees Per Acre*
4 *Quadratic Mean Diameter of trees 5" DBH and larger*
5 *Percent ground cover of shrubs, ferns and herbs*

APPENDIX D: DECAID ANALYSIS

DecAid Analysis

DecAID is an advisory tool developed to assist land managers in evaluating the effects of forest conditions and proposed management activities on organisms that use snags and down wood (Mellen et al. 2006). DecAID is not a model, but, rather, a statistical summary of the current knowledge and best available data on dead wood in Pacific Northwest ecosystems. The primary emphasis is on terrestrial vertebrate relationships to dead wood and not on decayed wood elements in aquatic or riparian environments. However, the summary also examines a broader look at key ecological functions and functional groups of wildlife that use snags and down wood.

DecAID is organized around basic "vegetation conditions," a broad descriptor which encompasses wildlife habitat type, vegetation alliance, structural condition (average tree size and canopy closure), and geographic location. It is recommended by the DecAID science team that the information (structural condition) be applied at a fairly large scale, such as on the order of sub-watersheds, watersheds, sub-basins, etc., or at least of a project size encompassing 20 square miles (Mellen et al. 2006). For this analysis, the entire South Fork Skokomish watershed (57.4 square miles) was used. Because much of this area is within spotted owl critical habitat, the existing conditions and potential effect of down wood and snag removal on the functioning of these territories (nesting structure, prey production, etc.) also needs consideration.

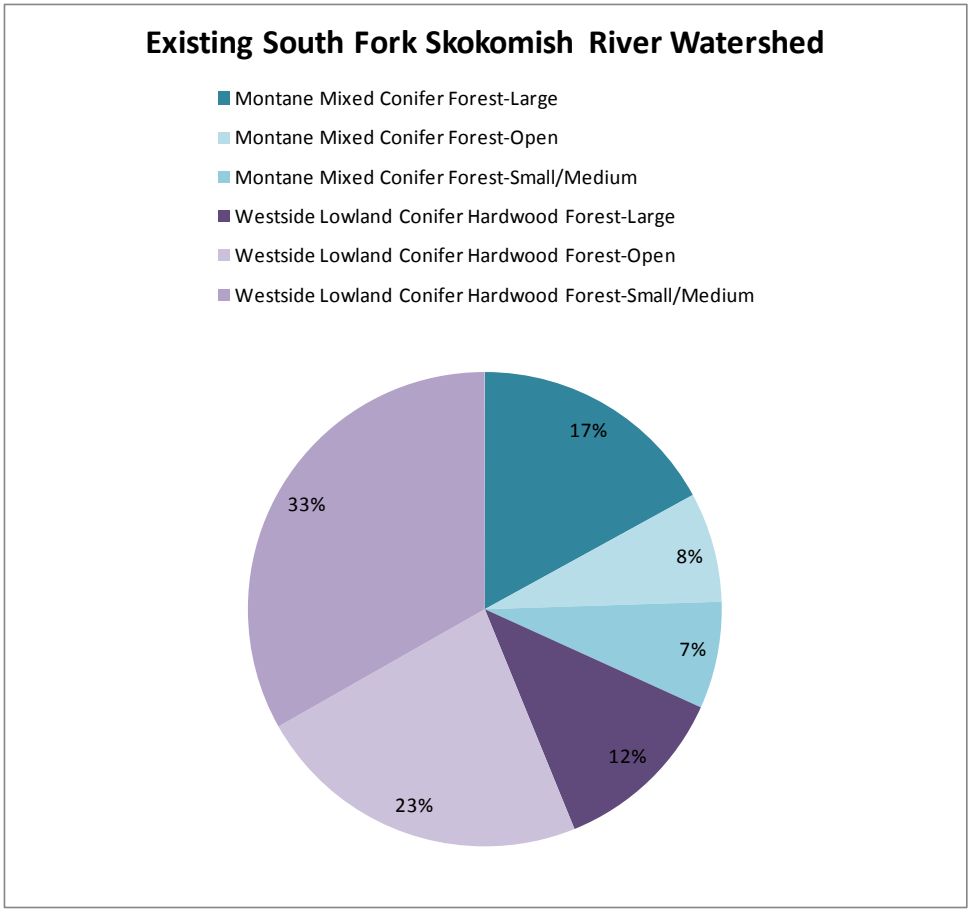
There were snag-creation efforts via tree-topping, girdling, and the creation of cavities that were conducted in the Upper South Fork Skokomish watershed in mid-1990's. Those contracts resulted in a total of approximately 57 trees being topped in the Upper South Fork Skokomish watershed, six of which also had cavities created in them. There are no records that any of these trees have been monitored during the intervening years for subsequent wildlife use. Likewise, there is no documentation that bird or mammal nesting structures have ever been installed in the watershed.

The basic premise of the DecAid analysis is to examine reference, or historical, conditions for coarse wood levels on the landscape, then compare those with current, or existing, conditions. To do this, one first must know what the vegetative types occurring in the watershed are and these were determined to be "Westside Lowland Conifer-Hardwood Forest, Washington Coast" and "Montane (higher elevation) Mixed Conifer Forest." In terms of structural conditions, the categories are "Large Tree," "Small/Medium Trees," and "Open Canopy," and these exist in a patchwork across the watershed, the unharvested areas of forest being the large tree condition and managed stands comprising the small/medium tree condition. Though it's easy to assume the Olympic Peninsula was once entirely old-growth (i.e. large trees) forest, this, in fact, was not the case. The historic reference structural conditions used for the South Fork Skokomish watershed, calculated using data in the "1930s Survey of Forest Resources in Washington and Oregon" (Harrington 2003), was determined to be 72 percent of the area existing in the Large Tree structural condition, 16 percent in Small/Medium Tree, and 12 percent in Open Canopy Structural Conditions. Historic reference conditions for coarse wood levels in the South Fork Skokomish River watershed were based on a combination of these reference structural

conditions and the unharvested plot inventory data provided in DecAID (version 2.10) for the Westside Lowland Conifer-Hardwood Forest, Washington Coast region and Montane Mixed Conifer Forest Wildlife Habitat Types (Mellen-McLean et al. 2009a). Reference conditions for coarse down wood cover in the Westside Lowland Conifer-Hardwood Forest, Open Canopy forest structural condition were based on the Washington Western Cascades region because there was not enough vegetation plot data available (<10 plots) for that structural condition in the Washington Coast Region.

For the current conditions, estimates came from the GNN (Gradient Nearest Neighbor) 2006 dataset for the Washington Coast and Cascades Modeling Region (Ohmann and Gregory 2002).

Based on this analysis, the existing structural condition breakdown in the watershed for the Westside Lowland Conifer-Hardwood Forest, Washington Coast type is: 18 percent Large Tree, 49 percent Small/Medium Tree, 33 percent Open Canopy. In the Montane Mixed Conifer Forest type, the breakdown was 53 percent large tree, 23 percent small/medium tree, and 24 percent open canopy. The reason for the Montane Mixed Conifer having higher amounts of large tree stands is probably a function of which areas were harvested first (low elevation sites typically). These data suggest the watershed, compared to historical levels, has a considerably smaller percentage of the large tree structural condition and considerably larger percentages of small/medium tree and open canopy structural conditions. This is not surprising given the amount of timber harvest activities that has occurred since the 1930s (our historic reference point), which resulted in the loss of a large portion of stands with large trees and their replacement by many younger stands. In terms of percentages, what this looks like across the watershed can be seen in the following pie chart. Note: this is for the entire South Fork, not just the upper watershed.

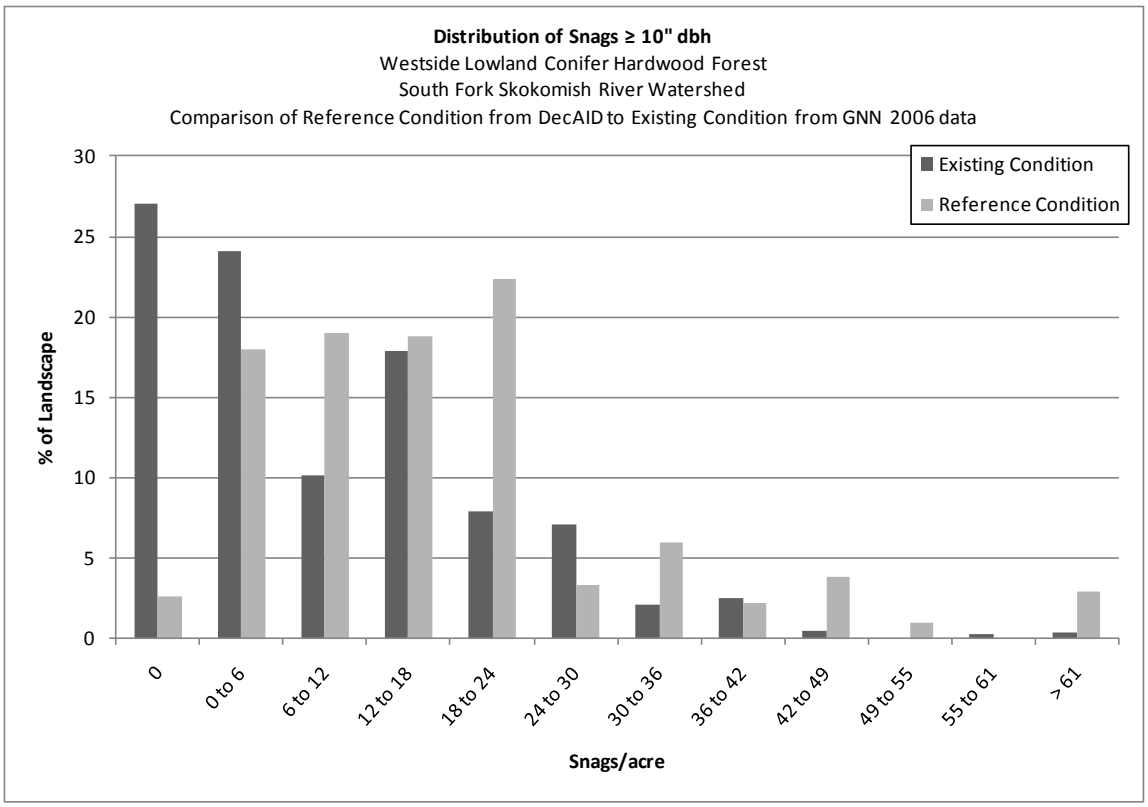


There are certain assumptions in using this process, including that, 1) the historic, reference structural conditions derived from the "1930s Survey of Forest Resources in Washington and Oregon" (Harrington 2003) represent the historic range of variability on the Olympic National Forest and in the South Fork Skokomish River Watershed; 2) reference structural conditions are assumed to represent the structural condition breakdown of both the Westside Lowland Conifer Hardwood Forest and the Montane Mixed Conifer Forest habitat types in the South Fork Skokomish River Watershed. There may be differences in the structural condition breakdown by watershed and/or habitat type, but estimates were not developed at this level of detail for this analysis; and 3) the GNN 2006 data provides a reasonable estimate of the existing dead wood levels in the South Fork Skokomish River Watershed.

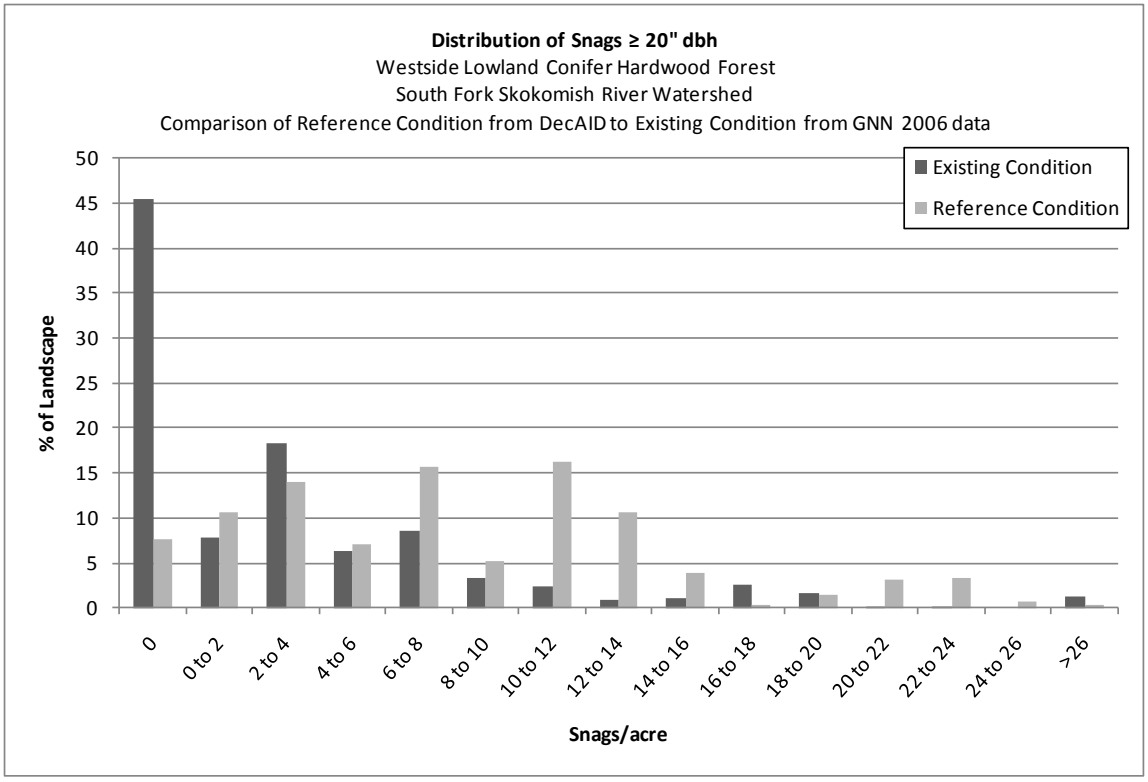
With those in mind, what can still be said about current levels of snag and down wood habitat in the watershed? The following are some general conclusions for the Westside Lowland Conifer-Hardwood Forest vegetative type on the Washington Coast:

There are fewer medium-large snags (≥10" dbh) in the watershed. A considerably larger percentage of the existing landscape appears to have no medium-large snags (0/snags) per acre, and a smaller percentage with 18 to 24 medium-large snags/ac than the historic reference condition. This could be related to past harvest activities that left limited to no snags after harvest. Some stands that were clearcut may have been burned after harvest and took out any

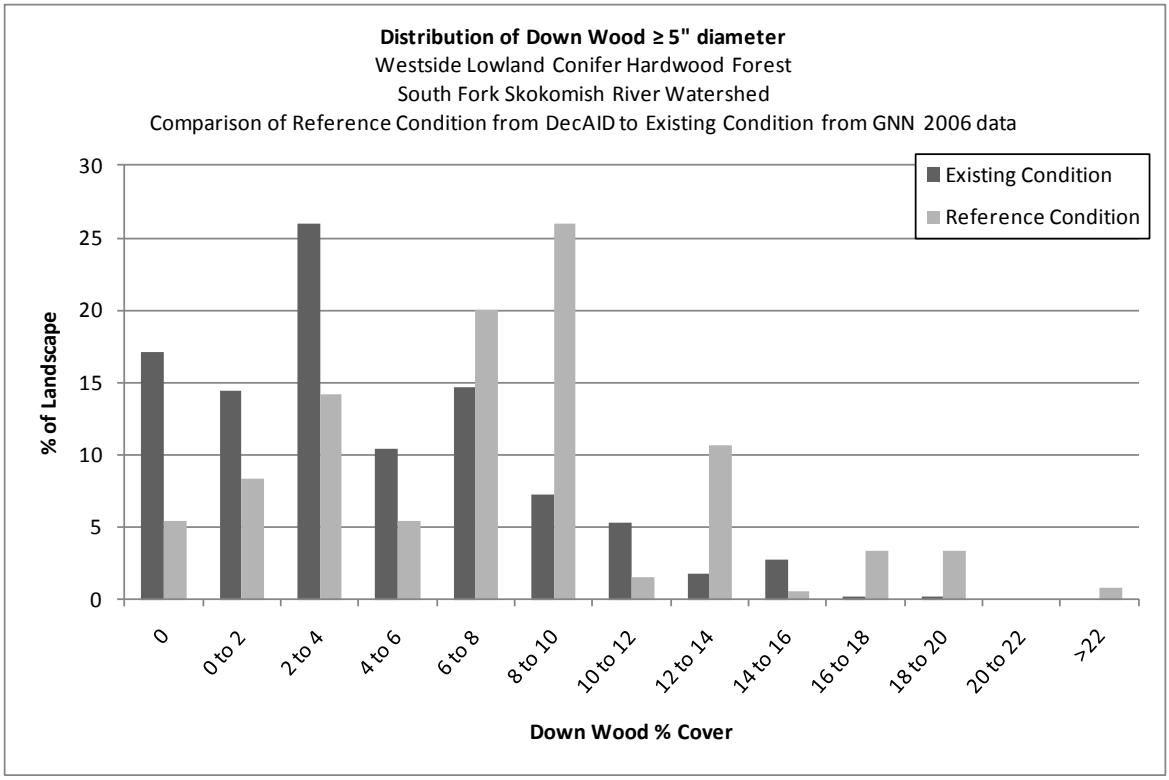
remaining snags. This also could have resulted from salvage activities after natural mortality events, or loss to natural fire events. In older stands, this may reflect past harvest activities that targeted the largest trees, and therefore harvested from the stands with the highest productivity, so the historic reference condition we are using from the 1930s may represent an unrealistic potential for some of the remaining Large Tree structural condition stands if they have lower productivity potential.



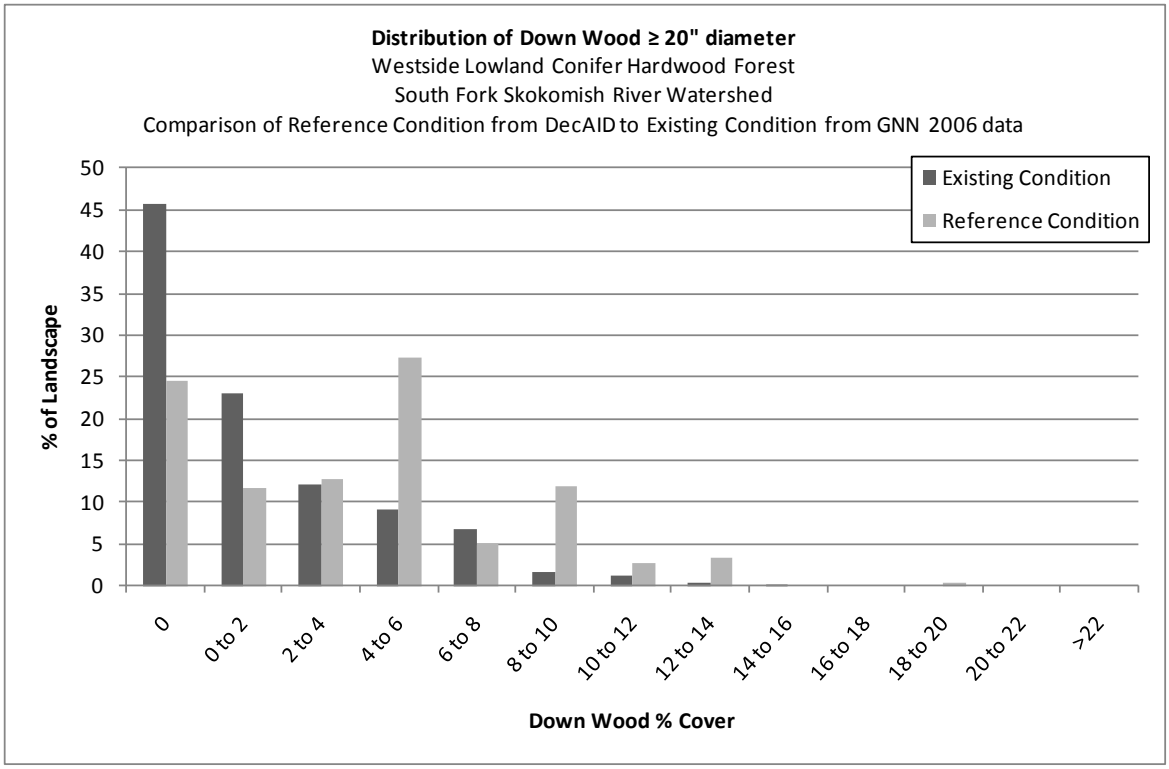
There are fewer large snags (≥20" dbh) in the watershed. A considerably larger percentage of the existing landscape appears to have no large snags per acre, and smaller percentages with 10 to 14 large snags/acre than the historic reference condition. The reasons for this are the same as those listed for the paucity of medium-sized snags listed above.



There is less small-large down wood cover. Compared to historic reference conditions, a smaller percentage of the existing landscape appears to have 8 to 10 percent down wood cover and larger percentages have 0 percent and 2 to 4 percent small-large down wood cover. A deficit of small-large down wood cover could reflect heavily managed stand conditions that provide limited opportunities for natural mortality events to produce inputs of dead wood. This also could have resulted from salvage activities after natural mortality events or the loss of dead wood to fires.



There is less large down wood cover. Compared to historic reference conditions, a considerably larger percentage of the existing landscape appears to have 0 percent large down wood cover, a larger percentage has 0 to 2 percent, and smaller percentages have 4 to 6 percent and 8 to 10 percent large down wood cover. This deficit of large down wood could reflect a lack of snags and/or down wood left in stands after harvest. It could also be the result of fire suppression in some stands, resulting in fewer dead wood inputs from fires, or reductions in natural mortality due to adjacent stand management (e.g. buffering root rot).

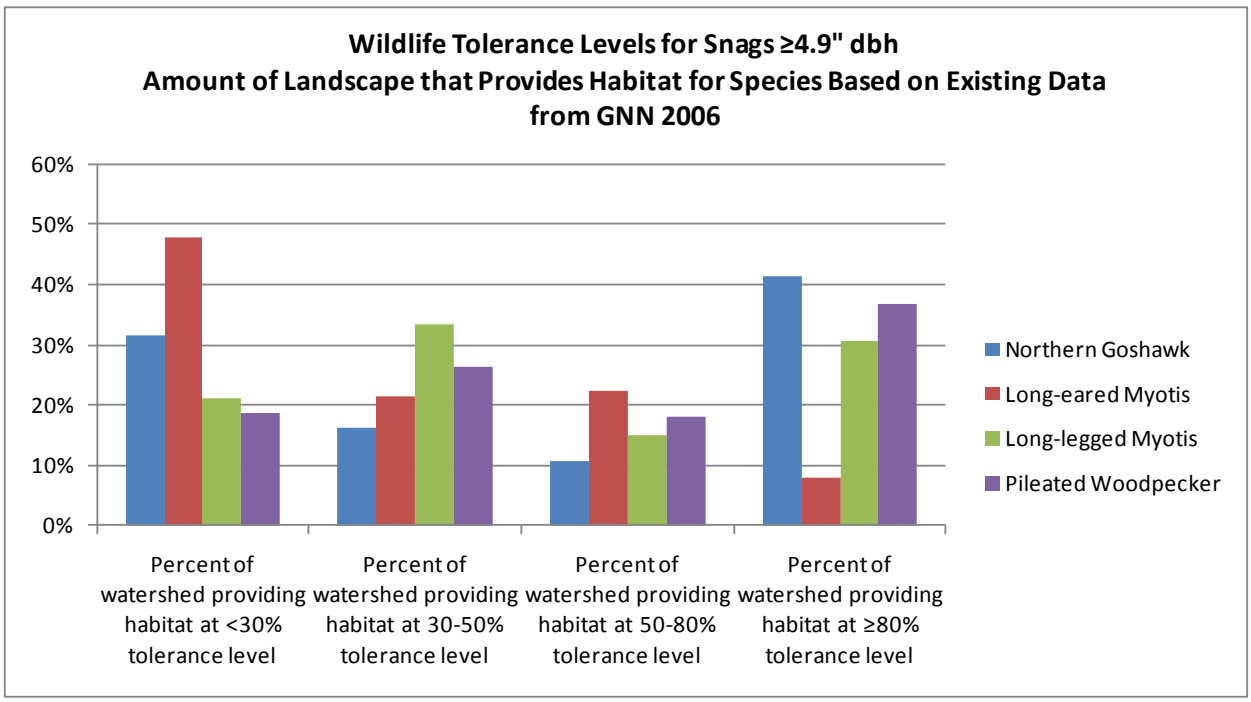


For the Montane Mixed Conifer Forest vegetative type, somewhat similar conditions exist, though the differences between current and historic are not so pronounced as with the lowland vegetative type: slightly fewer medium-large snags, slightly fewer large snags, and slightly less small-large down wood cover. The amount of large down wood cover is not so different from historic conditions. These results could reflect less extensive harvest in the higher elevation Montane Mixed Conifer forests, resulting in current coarse down wood conditions that are similar to the historical reference conditions. Differences in the levels of coarse down wood between historic reference and existing levels may be a result of the large geographic scope of the Montane Mixed Conifer Forest inventory data in DecAID, including only limited plots from the Olympic Peninsula. The data primarily consists of plots from the Washington and Oregon Cascades and includes some plots from eastern Washington and Oregon, both regions that may not accurately represent the conditions of Montane Mixed Conifer Forest on the Olympic Peninsula. The inclusion of lower elevation Pacific silver fir forest, unique to the Olympic Peninsula, in the Montane Mixed Conifer Forest habitat type could also provide a misleading representation of existing large snag conditions, as some of the lower elevation Pacific silver fir habitat may have been more heavily harvested. Alternatively, differences may result from accuracy problems in the estimation of current coarse wood conditions from the GNN 2006 data (Ohmann et al. 2010).

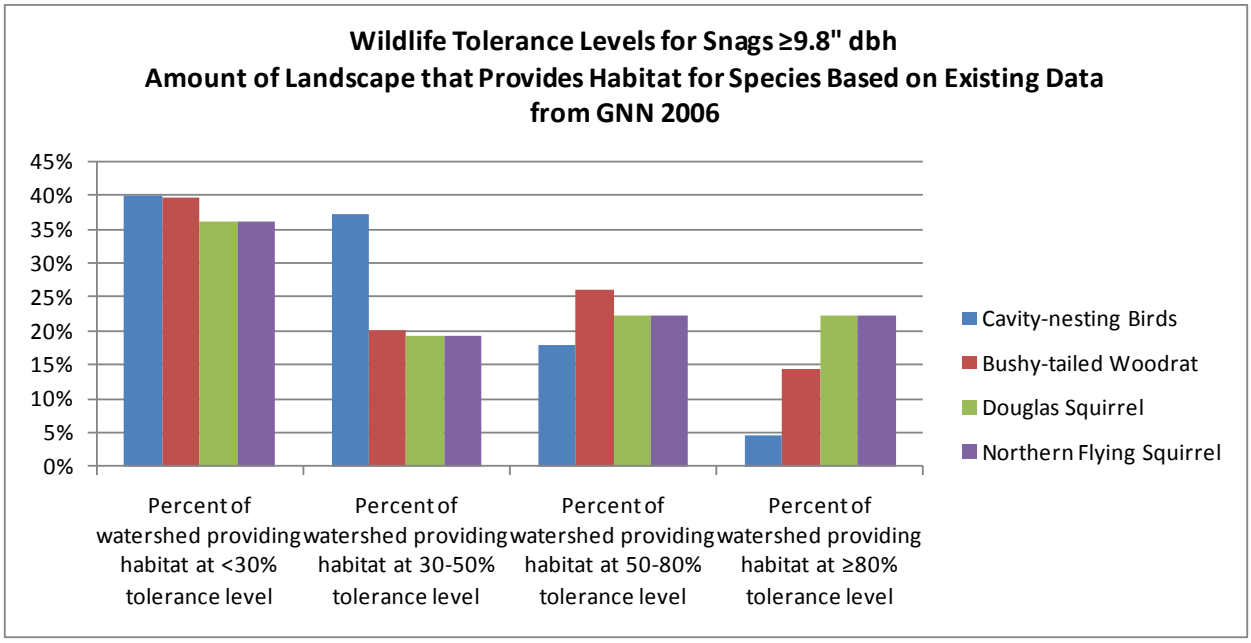
The existence of certain structural, vegetative conditions on the landscape is one thing; how those conditions relate to wildlife presence and meeting species' needs for shelter, forage, and requirements for breeding and raising young is another. DecAid approaches what different species need, in terms of snags and down wood, by determining "tolerance levels." Tolerance

intervals are estimates of the percent of all individuals in the population that are within some specified range of values. In the case of DecAID, for example, they tell us what percent of pileated woodpeckers in a population use snags, say, up to or above certain diameters. Thus, an 80 percent tolerance level indicates 80 percent of the individuals in the population have a value for the parameter of interest (say snag density) between 0 and the value for the 80 percent tolerance level. Or conversely, 20 percent of the individuals in the population have a value for the parameter of interest greater than the 80 percent level. The tolerance interval is the range between 2 tolerance levels. For example, the value for 80 percent is the level and the range of 0 to 80 percent is the interval." (Mellen-McLean et al. 2009b). The higher the tolerance level, the higher the proportion of individuals in the population that are being provided for, and the more assurance you have that you are providing habitat that will meet the needs of more individuals in the population. The basic assumption is that more is better and bigger is better. For the Upper South Fork Skokomish watershed, we focused on certain species and how well the landscape conditions were meeting their needs. Certain assumptions are inherent in this process as well, and include: 1) the summarized literature and data provided in DecAID reasonably estimate wildlife species habitat use in the Upper South Fork Skokomish River Watershed; and 2) the GNN 2006 data provides a reasonable estimate of the existing dead wood levels in the Upper South Fork Skokomish River Watershed.

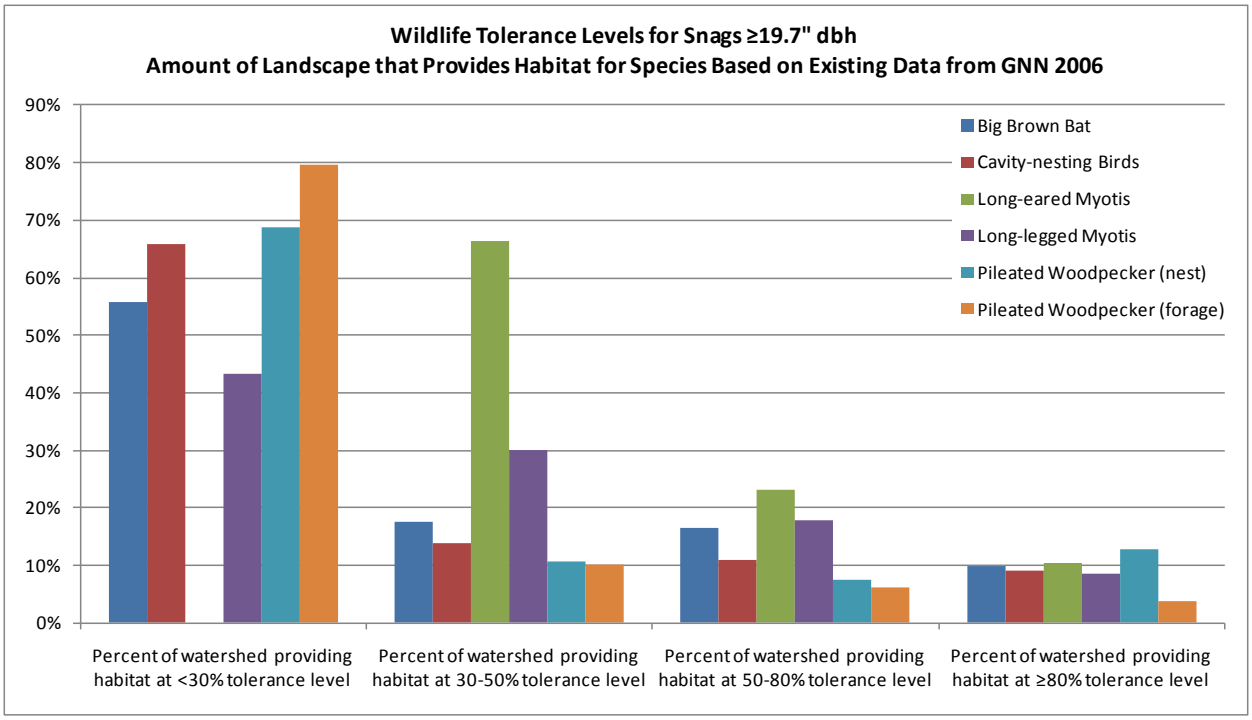
The following are several graphs illustrating how well the watershed (in the Westside Lowland Conifer-Hardwood Forest, Washington Coast vegetative type) is meeting the needs of certain species at different tolerance levels (this analysis can only be done for those species for which there have been field studies done). Again, the 80 percent level would be optimal; that is, at that level, more individuals in the population would be provided for.



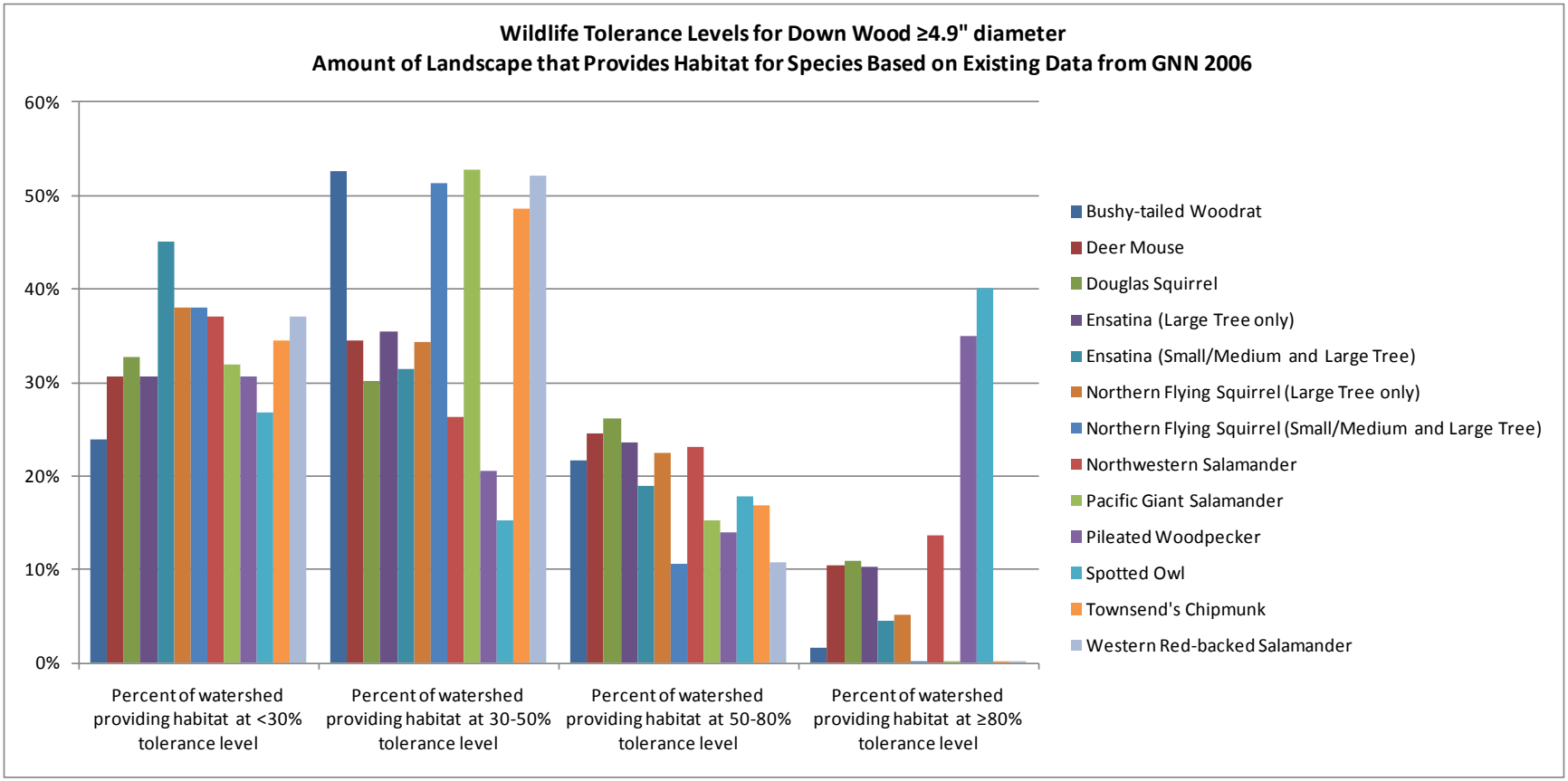
The above graph shows that amounts of smaller snags for northern goshawk, long-eared myotis, and long-legged myotis, all Federal Species of Concern, and pileated woodpecker, a Forest Service management indicator species, are being met across less than half of the watershed (less than 10 percent in the case of the long-eared myotis) in optimal amounts. The same is true, though to varying degrees, for slightly larger snags and different species, as shown below.



For much larger snags, less than 10 percent of the watershed meets the 80 percent tolerance level for several species as shown in the following graph:



In terms of down wood, less than 20 percent of the watershed is providing optimal habitat for a number of different species, and for some, none of the watershed is providing the 80 percent tolerance level (northern flying squirrel, Townsend's chipmunk, and western red-backed salamander). It should be noted that, similar to the other graphs, the watershed does provide other tolerance levels of habitat, just not the most optimal levels.


Wildlife Tolerance Levels for Down Wood ≥4.9" diameter
Amount of Landscape that Provides Habitat for Species Based on Existing Data from GNN 2006
60%
50%
40%
30%
20%
10%
0%
Percent of watershed providing habitat at <30% tolerance level
Percent of watershed providing habitat at 30-50% tolerance level
Percent of watershed providing habitat at 50-80% tolerance level
Percent of watershed providing habitat at ≥80% tolerance level
Bushy-tailed Woodrat
Deer Mouse
Douglas Squirrel
Ensatina (Large Tree only)
Ensatina (Small/Medium and Large Tree)
Northern Flying Squirrel (Large Tree only)
Northern Flying Squirrel (Small/Medium and Large Tree)
Northwestern Salamander
Pacific Giant Salamander
Pileated Woodpecker
Spotted Owl
Townsend's Chipmunk
Western Red-backed Salamander

APPENDIX E: MAPS

MAP 1: Planning Area

MAP 2: Northwest Forest Plan Land Allocations

MAP 3: 1990 Land and Resource Management Plan

MAP 4: Watersheds

MAP 5: Proposed Units

Map 6: Potential Wilderness Analysis

NOTE – For the electronic version of this document, see the six separate map files. The electronic files are available at:

http://www.fs.fed.us/nepa/fs-usda-pop.php/?project=34669

APPENDIX F: RESPONSE TO COMMENTS

The 30-day Public Comment Period for the proposed Upper South Fork Vegetation Management Environmental Assessment opened on April 24, 2012 and closed on May 24, 2012. Five comment letters were received, all by e-mail. Comments were received from the following individuals, representing either themselves or an organization:

Table F-1. Commenters who responded during the 30-day Public Comment Period

Name of commenter	Organization	Type of comment	Date received
Mike Marsh	Washington Native Plant Society (WNPS)	E-mail message	26 April, 2012
Richard (Dick) Artley	Self	E-mail message and attachments	13 May, 2012
Jacob Groves	American Forest Resource Council (AFRC)	Letter via E-mail	16 May, 2012
Harold Brunstad	Self	Letter via E-mail	18 May, 2012
Shelley Spalding	Olympic Forest Coalition (OFCO)/Polly Dyer Cascadia Broadband	Letter via E-mail	22 May, 2012

All comments received were considered and addressed. All comments received are valuable, and contribute to increased understanding. Examples of comments that are the most helpful are those comments that:

- Provide new information pertaining to an alternative in the analysis;
- Identify a new issue or expand on an existing issue;
- Identify a different (alternative) way of meeting the purpose and need of the project;
- Provide an opinion regarding one or more alternatives, including the basis of rationale for that opinion;
- Point out a specific flaw in the analysis; or
- Identify a different source of credible research, which if used in the analysis could result in different effects.

Table F-2 contains the comments received from each commenter, grouped by subject matter and paraphrased or excerpted where appropriate, followed by the Forest Service's response.

The comments received from Richard Artley included six lengthy attachments. Because of their combined length, those comments and their responses are contained in a separate appendix, Appendix F (Supplemental), which also includes the tables and text current appendix (Appendix F). The electronic version of Appendix F (Supplemental) is available at *http://www.fs.fed.us/nepa/fs-usda-pop.php/?project=34669*.

Table F-2. Comments and Responses			
Commenter	**Subject**	**Comment**	**Response**
Mike Marsh	Lack of background botanical information	"Occurrences of unusually varied and rich understory and ground cover need to be recognized and respected in the same way that the diversity of tree species is, when planning a thinning operation. It is unfortunate that plant species and plant communities are not given any consideration until they are on a Sensitive, Threatened or Endangered list."	The botanical resources section in the EA focuses on threatened, endangered, proposed, and sensitive plant species. No unusual or notably rich understory conditions were encountered during botanical reconnaissance in the project stands.
Mike Marsh	Lack of vegetation plot data for DecAid analysis	"My other concern is the lack of watershed or even Forest District level historical information on which the assumptions of the DecAid report could be prepared. "	DecAid is a statistical summary of the current knowledge and best available data on dead wood in Pacific Northwest ecosystems. Reference conditions are based on 1930s surveys (Harrington 2003) and unharvested plot inventory data. Where plot data are insufficient, as with the Westside Lowland Conifer-Hardwood Forest, Open Canopy forest structural condition (12% of the South Fork Skokomish Watershed), the nearest similar forest condition was used as a surrogate (EA Appendix D).
Harold Brunstad	Impacts of Barred Owl on Spotted Owl recovery and forest management	"Scientific data and opinions are evolving that suggest that the most significant impact on recovery and even sustaining populations of the Northern Spotted Owl is the intrusion of the Barred Owl into it's habitat. Are these new data being factored into the management prescriptions and strategies on the Olympic Forest?"	The wildlife section of the EA considers recent literature about the effects of Barred Owl range expansion on Northern Spotted Owls, including the 2004 Status Review (Courtney et al. 2004). The proposed action is consistent with late-successional habitat development objectives in the Northwest Forest Plan to benefit Northern Spotted Owls and other species associated with late-successional habitat.
Shelley Spalding	Thinning in Riparian Reserves	"If logging operations are to occur within the Riparian Reserves in order to pursue the objective of development of larger trees and more diverse understory, streams would receive the most benefit from the wood thinned in this project	Riparian Reserves include streamside no-cut buffers in which no trees will be cut. All of those trees would remain available for natural recruitment into streams. Outside of the buffers, the silvicultural prescription takes into consideration both the desired future condition of large trees, and leaving a

Table F-2. Comments and Responses			
Commenter	**Subject**	**Comment**	**Response**
		being left within the Riparian Reserve. The anticipated benefit of thinning in terms of growing larger trees faster appears to be more than off-set by a dramatic reduction in the pool from which future dead and down wood structures are recruited."	suitable number of downed logs within the reserve. In addition, any trees unintentionally felled into the no-cut buffer, and any trees felled for safety reasons, would be left on the ground.
Shelley Spalding	Thinning and large down wood (current and future) in uplands	"The proposed action is not likely to create the forest structure that would result in a net gain for healthy, functional habitat conditions beneficial to many late successional dependent species in the uplands either, including spotted owl, marten, Malone's jumping slug, and northern flying squirrel. Life cycles of these and other species are dependent upon large down and dead wood within the forest."	The project is designed to increase and improve late-successional habitat, including large down wood.
Shelley Spalding	Effects of logging operations and temporary roads	"Impacts include soil disturbance, compaction, and erosion, as well as incidental damage to leave trees. It will take many years before the temporary roads are truly stabilized and no longer pose the potential risk of contributing sediment to nearby streams and rivers. Roads are also a common vector for spreading noxious weeds and invasive plants."	Temporary road construction proposed for this project is very limited. All road segments were carefully considered and their potential effects analyzed. Design criteria and mitigation measures would minimize the potential for soil disturbance, erosion, sedimentation, an introduction or spread of invasive plants. Temporary roads and skid trails would be monitored for weeds during and for several years after project implementation.
Jacob Groves	Economic viability	"AFRC would like to see all timber sales be economically viable. Appropriate harvesting systems should be used on all units to achieve an economically viable sale and increase the revenues to the government. Because of its high proportion of helicopter logging, this project may not be economical now or in the future."	Economic viability is discussed in the EA. While maintaining economic viability is an overall project objective, improving late-successional habitat conditions is the project's primary purpose.

Table F-2. Comments and Responses			
Commenter	**Subject**	**Comment**	**Response**
Jacob Groves	Prescription information	"It is useful when for an EA to provide not only total acres treated, but also an indication of treatment prescribed (RD, basal area, TPA), and an estimated total volume removed for each alternative."	The thinning treatment would reduce stand relative density to between 25 percent and 35 percent of maximum stand density index (SDI). Approximately 100 to 180 trees per acre would remain in the post-treatment stands with a range of 60 percent to 90 percent canopy closure (EA p.46). Estimated timber volume harvested is between 5.2 and 10.1 MMBF (EA p.200).
Jacob Groves	Gap openings for deer and elk	"AFRC is disappointed that the Upper South Fork Skokomish Management Project will not include any gaps cuts in the silvicultural prescriptions. Gaps can provide early successional habitat for deer and elk."	The thinning prescription does include gaps (small openings), and heavily thinned areas to provide increased structural and spatial heterogeneity within the stands proposed for treatment.
Jacob Groves	Thinning in Riparian Reserves	"By prescribing smaller no cut buffers to be left to maintain stream temperatures and thinning the remaining acres inside the riparian reserves you can achieve the management objectives of moving them into late seral habitat faster. Also by reducing the no cut buffers and thinning closer to the streams, the forest also harvests more volume during the sale thus reducing unit cost."	No-cut buffers are developed to protect stream temperature, riparian vegetation, and other resource values. Outside of these buffers, thinning prescriptions are intended to accelerate the development of late-successional habitat conditions.
Jacob Groves	Seasonal restrictions	"Seasonal restrictions often make timber sales extremely difficult to complete within the contract timelines. All these restrictions have a cost to the purchaser and result in lower bids on timber sales."	Seasonal restrictions are in place for resource protection. A purchaser may propose the use of different equipment or an alternative logging system that might allow modifications to the operating seasons.

LIST OF ACRONYMS AND ABBREVIATIONS

ACS	Aquatic Conservation Strategy
AMA	Adaptive Management Area
ATM	The Olympic National Forest's Access and Travel Management plan
BA	Biological Assessment
BLM	Bureau of Land Management
BMP	Best Management Practice
BO	Biological Opinion
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CHU	Critical habitat unit
CO2	Carbon Dioxide
CWA	Clean Water Act
CWD	Coarse Woody Debris (on the ground)
CY	Cubic Yard
dB	Decibel (a logarithmic measure of power or intensity, in this case of noise or sound)
DBH	Diameter at Breast Height (4.5 feet)
DecAID	The Decayed Wood Advisor for Managing Snags, Partially Dead Trees, and Down Wood for Biodiversity in Forests of Washington and Oregon
EA	Environmental Assessment
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
ESA	Endangered Species Act
EUI	Ecological unit inventory (soils)
FSH	Forest Service Handbook
FSR	Forest System Road
GHG	Greenhouse Gas
GIS	Geographic Information System
GMU	(Soils) Geomorphic Map Unit
GMU	(Wildlife) Game Management Unit
GNN	Gradient Nearest Neighbor
HDS	Habitat Development Study
IDT	Interdisciplinary Team
IRA	Inventoried Roadless Area
ITS	Incidental Take Statement
LRMP	Olympic National Forest Land and Resource Management Plan (1990)
LSR	Late-Successional Reserve
LSRA	Late-Successional Reserve Assessment
LT	Legacy Tree (large live tree left in place during past timber harvest activities)
LWD	Large Woody Debris (in stream course or river)
MBF	Thousand board feet (one board foot is the volumetric equivalent of a piece of lumber one foot wide by one foot long by one inch thick.)

MIS	Management Indicator Species
ML	Road Maintenance Level
MMBF	Million board feet (1,000 MBF)
MOA	Memorandum of Agreement
MOU	Memorandum of Understanding
NAIP	National Agricultural Imagery Program
NEPA	National Environmental Policy Act
NFMA	National Forest Management Act
NFS	National Forest System
NOAA	National Oceanic and Atmospheric Administration
NPV	Net Present Value
NRCS	National Resource Conservation Service
NTU	Nephelometric Turbidity Unit
NWFP	Northwest Forest Plan
OHV	Off-Highway Vehicle
PCE	Primary Constituent Element
PDC	Project Design Criteria
PE	Project Element
PNPTT	Point-No-Point Treaty Tribes
PWA	Potential Wilderness Area
QMD	Quadratic Mean Diameter
RACR	Roadless Area Conservation Rule
RARE	Roadless Area Review and Evaluation
RAWS	Remote Area Weather Station
REO	Regional Ecosystem Office
RM	River Mile
ROD	Record of Decision
RR	Riparian Reserve
SDI	Stand Density index
SMU	Soil Map Unit
SWAT	Skokomish Watershed Action team
TMDL	Total Maximum Daily Load
TPA	Trees Per Acre
TRI	Timber Resource Inventory
USC	United States Code
USDA	United States Department of Agriculture
USDI	United States Department of the Interior
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
VQO	Visual Quality Objective
WAC	Washington Administrative Code
WDFW	Washington State Department of Fish and Wildlife
WDOE	Washington State Department of Ecology

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