Chapter 3 – Affected Environment & Environmental Consequences

The chapter is organized according to the resources of silviculture and forest stand development, wildlife, soils, fisheries, botany, economics, and heritage. The chapter concludes by addressing the specifically required disclosures required by federal statutes and executive orders. Information supporting the analysis in this chapter may be found in resource specialist reports contained in the analysis file. Many components of the ecosystem that cannot be precisely quantified are described in relative terms or estimated values.

Each section presents the scientific and analytical basis for the comparison of the alternatives displayed in Chapter 2. Following a description of the affected environment for a given resource, probable effects are disclosed for each alternative. The probable effects described include direct effects, indirect effects, and cumulative effects.

Direct and Indirect Effects

"Direct effects" are effects which are caused by the action and occur at the same time and place, and "indirect effects" are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable. Indirect effects may include growth inducing effects and … related effects on air and water and other natural systems, including ecosystems" (40 CFR 1508.8)

Cumulative Effects

"Cumulative effects" is defined in the White House Council of Environmental Quality's NEPA regulations as the "impact on the environment that results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions…" 40 CFR 1508.7. The Council on Environmental Quality (CEQ) interprets this regulation as referring only to the cumulative impact of the direct and indirect effects of the proposed action and its alternatives when added to the aggregate effects of past, present, and reasonably foreseeable future actions on all land ownerships across an area that is deemed appropriate for the impacts being analyzed.

The analysis conducted for this project follows the "Guidance on the Consideration of Past Actions in Cumulative Effects Analysis" issued by CEQ Chairman on June 24, 2005. The guidance states the expectation that agencies determine what information regarding past actions is useful and relevant to the required analysis of cumulative effects and further notes that CEQ regulations do not require agencies to catalogue or exhaustively list and analyze all individual past actions.

This section summarizes activities that were considered in cumulative effects analyses included in Chapter 3. Because the geographic area of consideration varies by resource, the

analysis of cumulative effects for each resource may differ in temporal and spatial scale, as well as the activities that are considered in cumulative effects discussions for each resource.

Past:

Activities described in the Big Quilcene Watershed Analysis (USDA 1994), Dosewallips Watershed Analysis (USDA 1999), and the Quilcene Late Successional Reserve Assessment (USDA1996) make up a large component of past activities in the area. These activities include past fire history and other natural disturbances, Native American and European settlement, timber harvesting, recreation, and watershed improvement activities. These past activities have contributed to the current condition of the planning area and are discussed further in Chapter 3, as appropriate in discerning the contribution of past activities to the current resource conditions and in cumulative effects analysis. Below lists additional past activities that have occurred in the project area.

- Timber harvest and other silvicultural activities, such as precommercial thinning and fertilization (primarily on non-Forest Service lands).
- Road decommissioning (6.5 miles in last 10 years) in the Rocky Brook (Dosewallips) and Big Quilcene watersheds.
- Road repair and maintenance.
- Culvert replacement and road stabilization on FSR 2620000
- Jefferson County bank stabilization project involving placement of riprap along 170 feet of river bank at RM 1.9. Also included planting of native vegetation.
- Washington Trout – Project along lower Dosewallips River which removed 1,000 feet of dike and restored 40 acres of salt marsh. Also planted native trees and shrubs on 5 acres.
- Construction of a by-pass trail around the Dosewallips road washout.
- Use and maintenance of Elkhorn Campground.
- Use and maintenance of Olympic National Park facilities in the Dosewallips area.
- Closure of roads to the public by private landowners, WA Department of Natural Resources, and the Forest Service for security, maintenance costs, and liability reasons

Present:

- Use and maintenance of transportation system below the Dosewallips washout.
- Dispersed camping along the Dosewallips River.
- Harvest of second growth timber on private land in the Mt. Jupiter area and resulting lack of access to the Mt. Jupiter Trail.
- Harvest of second-growth timber on private land in the Mt. Walker area
- Current hiker use and blocked vehicle access to the Elkhorn Campground and Olympic National Park facilities in the Dosewallips area.
- Trail system accessed by FSR 2610.

Future:

- Placement of large woody debris (LWD) in the lower mainstem of the Dosewallips river off forest.
- Riparian rehabilitation of dispersed camp sites in the Dosewallips and Big Quilcene River watersheds.
- Future treatment of danger trees along the transportation system.
- Forest Service road maintenance of FSR 2620, 2650, and 2630 and associated spur roads.
- Washington Trout – Project will install up to 6 logjams along the lower Dosewallips River.
- Timber harvest on state and private land with associated road development.
- Road decommissioning (planned summer 2007) on FSR 2610-012 (MP 0.7 to 2.7).
- Upgrade culvert on FSR 2740000 (planned summer 2007)
- Culvert removal South Fork Tunnel Creek and stabilization/upgrading of approximately 3 miles of FSR 2740-000 (planned summer 2007).
- Riparian rehabilitation at three sites in the upper Tunnel Creek and Townsend Creek
- Dosewallips Riparian Rehabilitation (planned summer 2007) which would rehabilitate dispersed recreation sites adjacent to streams and river through treatment of about 0.75 acres of invasive species, soil improvement, and seeding/planting within these areas.
- Repair of the washout along the Dosewallips road.

Silviculture and Forest Stand Development

Many aspects of the stands proposed for treatment were evaluated, including landscape features, soil types, vegetation, and snags and coarse woody debris. The following sections highlight some of the major findings, and where appropriate, references data tables provided in the Appendix. Additional information is contained in the silvicultural specialist report contained in the project analysis file.

Past clearcutting activities in the project planning area

According to the Olympic National Forest's Total Resource Inventory (TRI) database, 6,118 acres (58%) within the general 10,531 acre Jackson planning area have regenerated after clearcutting. Regeneration or clearcut harvesting on National Forest land in the project area seems to have begun in the 1920s and reached a peak in the 1930s before declining again until their conclusion in the late 1980s. Regeneration harvests occurred throughout most of the Jackson planning area, with the exception of the Mt. Walker area, which had only two small patch cuts of 20 and 5 acres in 1982 and 1984 between Forest Service Road 2730011 and Highway 101.

Stands resulting from regeneration harvests in the planning area range from 100+ foot-tall second growth Douglas-fir and hemlock, to young plantations that are still in the process of closing their canopies. Except for three or four small patches (less than 1/10 acre to ¼ acre) of Unit 6, these stands are simplified, second growth forest stands, though they do generally

contain a shrub layer and the 50+ year-old stands contain varying degrees of an understory tree layer.

Past Commercial Thinning Activities

Significant commercial thinning activities occurred in the Jackson Planning area during the 1970s and 1980s. Minor acreages of commercial thinning seem to have occurred in the 1940s and 1960s, as well as several experimental commercial thinning plots along Forest Service Road 2730011 at the base of the west side of Mt. Walker that were installed in the 1930s (not shown in the TRI inventory system) as part of a 15-acre thinning area. A total of 821 acres of commercial thinning have been completed in the Jackson planning area, according to the TRI database, mainly in the Mt. Walker area in the mid 1970s and early 1980s, and in the Turner/Jackson Creek area in the mid 1980s.

Past Precommercial Thinning Activities

Precommercial thinning (PCT) is a silvicultural treatment designed to control high stocking levels in young stands, generally 15-20 years old, 10-20 feet tall, and 1-6 inches in diameter. Only a little over one third of the stands established by clearcut harvesting in the Jackson planning area have been precommercially thinned, totaling 2,146 acres scattered through most of the planning area except for Mt. Walker. PCT began in the area in the 1960s and peaked in the 1980s, but none has been done since 1998.

Precommercial thinning has been utilized on the Hood Canal Ranger District to prevent young stands from becoming “doghair,” a term that refers to a stagnated condition to which stands in a portion of the district are susceptible. Demonstration areas in the Hood Canal Ranger District have shown the success of this technique. Generally the Jackson planning area doesn’t seem prone to the doghair phenomenon, however an area of dense, partially stagnated trees can be seen in an area of about 10 acres on the upper southeast slope of Unit 5. More generally, PCT’ed stands have more open understories, have larger average diameters at a younger age, contain more red huckleberry, and have been found to have more similarities to late successional forests than stands that have not been PCT’ed (Lindh and Muir 2004).

Past Fertilization Activities

A total of 3,131 acres of the Jackson planning area have been fertilized, mostly in 1975, with smaller projects in 1979, 1982, and 1984. Fertilization was done to enhance timber stand growth and yield and was done with aerial applications of nitrogen fertilizers, usually at the rate of 200 pounds of nitrogen per acre in the form of urea (440 lbs/ac). Nitrogen fertilizer had the intended effect of increasing the growth of conifers for several years, but also may have stimulated the growth of salal and other vegetation in the stands. Most of the stands within the planning area were fertilized, with the exception of Mt. Walker.

Past Salvage Activities

Only two stands totaling 131 acres have been salvage-logged in the Jackson planning area, both in the Mt. Walker area a few years after commercial thinning. This likely was to salvage blowdown that occurred during winter storms in the year or two following thinning.

Past Vegetative Activities in Stands Proposed for Thinning

The planning area has generally been highly managed in the past, with at least one management activity (i.e., clearcut harvesting, commercial thinning, precommercial thinning, fertilization, or salvage logging) in most of the units, and multiple activities in many units. The exceptions would be Units 20 through 24 on Mt. Walker.

Table 4 shows completed vegetation activities within stands proposed for thinning in the Jackson EA. All proposed treatment stands were regenerated following clearcutting and burning, except for those on Mt. Walker, which apparently regenerated naturally following wildfires that burned over most of the mountain in 1864 and 1891. Units 1-9, 11, and 16-18 may have underburned in 1918 and were subsequently harvested sometime later. The exceptions may be Units 10 and 17, which may have escaped fire in 1918, but probably were broadcast burned following logging, as were the other units. This could not be confirmed, but a fire plan map provided by Fire Management shows most of the Rocky Brook, Jackson and Marple Creek areas having been burned in 1918, but with a question mark appended to the date. All second growth stands in this area contain charred stumps, logs, and snags resulting from a combination of cutting and burning, with the exception of the easternmost end of Stand 11 (which was dropped from consideration because of numerous snags and live old-growth trees) that was burned, but apparently not logged, since charred logs and snags can be found, but not cut stumps.

Six of the 19 proposed Jackson units have been precommercially thinned, wholly or in part, as shown, between 1967 and 1984. Finally, 13 Jackson units have been fertilized, mostly in 1975, though part of Unit 2 was fertilized in 1979, and Unit 1 was fertilized in 1984.

Table 4. Past activities within Units proposed for treatment.

Unit	Section/ Cellkey	Acres	Year of Activity			Unit	Section/ Cellkey	Acres	Year of Activity		
			HCC[1]	PCT[2]	SFL[3]				HCC[1]	PCT[2]	SFL[3]
1	20010001	246.0	1940		1984	5	20010014	215.4	1937		1975
2	20010002	130.8	1944	1967	1975	5	20010015	55.9	1937		1975
2	20010003	56.0	1952	1979	1979	5	20010017	7.5	1959		1975
2	20010108	4.2	1952	1984	1975	6	20010020	158.3	1920[4]		
2	20020009	45.3	1946	1964		6	20010078	17.4	1920[4]		
2	20020017	67.2	1958	1975	1975	7	20010026	34.5	1950		1975
2	20020035	61.8	1946	1969	1975	8	20010046	75.6	1949	1972	1975
2	20020058	57.7	1935			9	20010031	4.1	1930		1975
2	20020059	42.6	1935			9	20010048	77.1	1935	1981	1975
3	20010008	40.6	1948		1975	9	20010062	14.7	1935		1975
3	20010011	192.6	1944		1975	10	20010050	66.6	1935		1975
4	20010012	30.5	1937	1981	1975	11	20010055	83.5	1935		1975
4	20010013	13.0	1958	1976		16	20010118	38.7	1935	1969	1975
4	20010016	87.0	1940	1979	1975	17	20010134	76.0	1935	1968	1975
4	20010117	20.9	1935	1971	1975	18	20010136	8.8	1935		1975
						18	20010152	123.3	1935		1975

Notes: 1. *Harvest: Clearcut*
2. *Pre-Commercial Thinning*
3. *Fertilization*
4. *The Total Resource Inventory (TRI) database lists 1920 as the date Unit 6 was clearcut, and also its year of origin, but tree data in the stand exam indicates 1930 as the year of origin for the majority of the stand.*

Past Fire Activity

The planning area has had approximately five large fires since 1860 of 1,000 acres or larger usually resulting in stand replacement. Stand replacement fires are characterized by fire moving through the canopies killing off the tree needles or a surface fire burning through the duff damaging and/or killing the root system of trees. Some fires like the Ludlow-Quilcene fire that reached Mount Walker were caused by slash burning, while others had their intensity increased by untreated slash. Most fires appear to be human caused or have unknown causes.

As a result of the past activities described above, approximately 64% of the stands in the planning area are under 80 years old. Forest stands between 41 and 80 years of age comprise more than half of the planning area (approximately 5,483 of the 10,531 acres), compared to stands between the ages of 171 and 400 years old, which only make up approximately 7% of the planning area (about 733 acres).

Current Stand Conditions

Most of the stands proposed for thinning have two significant tree layers: an overstory and an understory that could be separated, assessed, and summarized. See Table 35 in the Appendices for specific data on stand tree layers.

Overstory: Most stands were found to be dominated by Douglas-fir except Units 7, 10, and 11, which have western hemlock as their most dominant overstory species by basal area. Basal area is the average sum of cross sectional areas of all live tree boles at 4.5 feet above ground level (breast height) on a per acre basis. All stands have varying mixes of Douglas-fir and western hemlock in the overstory, though some units (1, 5, 21, 22, and 24) have only a minor basal area of hemlock, which was defined to be less than 10% of the total. Most stands were found to have at least a minor basal area of western redcedar in the overstory. Hardwoods, including red alder, bigleaf maple, northern black cottonwood, and bitter cherry, were recorded in twelve stands. Three units (8, 10, and 17) had minor mixes or scattered individual Pacific silver fir, and individual western white pines were observed in two units, 8 and 17. In general, overstory basal areas commonly range from 230 to over 360 square feet per acre. Overstory tree diameters mostly range from 6-8 inches up to 22-24 inches at breast height (dbh), but can be found up to 34-48 inches in the Mt. Walker units, while parts of Units 1 and 6 have trees up to 30-34 inches DBH, and trees in Unit 4 range from 6 to 16 inches dbh.

Understory: The Jackson units have varying numbers, sizes, and distributions of understory trees, mainly dominated by western hemlock and western redcedar, but also including Douglas-fir in some areas where root rot or other disturbances have opened the overstory canopy. However several units have fairly "light" understories, defined here as less than 100 stems per acre, including Units 5, 9, 16, 21, 22, and 24. In most units the understories are slowly growing and developing, but in Units 9 and 10, and in portions of stands 11 and 18 they are being suppressed and are dropping out of the stands through competition that reduces tree crowns (i.e., ability to photosynthesize) to the point of mortality. Understory trees range from zero to a few thousand stems per acre, 0-8 inches dbh, and 1 foot to over 40 feet tall.

The stands proposed for treatment are even-aged and in the competitive exclusion (i.e., mortality due to competition for sunlight and growing space) (Carey and Curtis 1996) or stem exclusion stage (Oliver and Larson 1990), but also with elements of the understory reinitiation stage and possibly the developed understory stage (Carey and Curtis 1996) in some stands. Many of the Jackson stands exhibit a developing understory tree layer and often an extensive ground vegetation (shrub) layer. Some of these appear to have entered the developed understory stage, where "understories of forbs, ferns, shrubs, and trees have developed following death (or harvest) of some dominant canopy trees; (but) there has been insufficient time for diversification of the plant community." None of the stands appear to have reached the botanically diverse stage (Carey and Curtis 1996), in which "organization and structure of the living plant community becomes complex with time and as the canopy opens further. Absence of coarse woody debris and other elements precludes a fully developed, complex biotic community." Thus, these stands can be said to be simplified, second growth stands.

Stand diversity can be enhanced through appropriate silvicultural treatments, i.e. thinnings (Carey and Curtis, 1996; Bailey and Tappeiner, 1997; Tappeiner, et al, 1997; Curtis, et al, 1998; Carey, Lippke, and Sessions, 1999; Zaborske, et al, 2000; Carey and Wilson, 2001; Garman et al, 2003; Beggs, 2004; Harrington, et al, 2005; Zenner, 2005), that have the effect of opening the stands and moving them along into the understory reinitiation, developed understory, or botanically diverse stages, as the case may be. Carey and Curtis (1996) recommend "minimizing area and time in the competitive exclusion stage through

precommercial and variable density (commercial) thinning," and "ensuring diversity and niche diversification in later stages through subsequent thinnings and coarse woody debris management." Thinning may be needed in dense young stands where the management objective is to speed development of old-growth characteristics (Tappeiner et al, 1997).

Snags and Coarse Woody Debris

DecAID stand classifications of snags and coarse woody debris levels in the project area are mostly small/medium (quadratic mean diameters between 10 and 19 inches), although Units 20, 21, 22, and 24 may be closer to the large tree category (quadratic mean diameters of 20+ inches), since their biggest 90-130 trees per acre averaged over 20 inches dbh.

Exam statistics for snags are not completely reliable at the individual stand level, but are better viewed on a project basis, where one can interpret the data more reliably as indicating relatively large numbers of small snags 5.0-10.9 inches dbh (39.8 snags/acre), and fewer numbers of larger snags, 5.1 snags/acre 11.0-18.9 inches dbh, and 1.4 snags/acre 19.0+ inches dbh. Snags in the 19+ inch category include legacy snags remaining in the stands from the old-growth that preceded the current stand. Legacy snags were estimated during walk-thru exams in winter 2006. While the stands proposed for thinning in the project area average approximately 1.1 snag/acre overall, neither the 2002 stand examinations nor the 2006 walk-thru exams found any legacy snags in Units 1, 10, 21, 22, or 24. In the last three units, the lack of legacy stands can be attributed to the two wildfires that burned Mt. Walker in 1864 and 1891, the first having killed most large trees, and the second having consumed most of the remaining snags and down logs. This interpretation seems to be confirmed by the two oblique aerial photos in Figure 14 that were taken in 1928, which seem to indicate legacy snags remaining only in one draw on the southwest side of the mountain, in several draws on the east face, and low on the northern slope.

Figure 14. Mt. Walker, 1928.

Coarse woody debris (CWD) cover indicates productivity for northern spotted owl prey species and was estimated from ocular and measured transects during walk-thru exams in the winter of 2006. Average CWD cover for the Jackson units is estimated at 6.3% overall. Remant old-growth trees also were noted during walk-thru exams, as were ground vegetation cover and probable plant associations (Henderson, 1989), based on shrub and herb species observed throughout each unit. Ground vegetation cover averages 41%. Many soil, productivity, successional, and wildlife interpretations can be found for these plant associations in the *Forested Plant Associations of the Olympic National Forest* (Henderson et al. 1989).

Residual old-growth trees are important legacies of the previous stand that help late successional elements carry over into the new stand.

Table 37 in the Appendix summarizes decadence and ecological factors, including plant associations, and DecAID stand types.

No Action Alternative

Direct and Indirect Effects

Under the No Action Alternative, none of the approximately 2,313 acres of second-growth stands would be commercially thinned.

The No Action Alternative would have no direct effects on stand development. The indirect effect of the No Action Alternative, however, is that stands would continue through the stand development process without intervention, and late-successional habitat for old-growth dependent species would not be accelerated.

Current stand relative densities (RDs) of 66 to 85 (0.58 to 0.66 for hemlock in hemlock dominated stands) indicate that the forest stands considered for thinning in this project are well into the zone of competition-related mortality. The canopy is at full or nearly full closure, growing space is fully occupied, trees are jockeying for position at their neighbors' expense, and crown recession parallels height growth. As crown ratios fall below 30-40%, diameter growth would taper off. When crowns recede to about 20% or less, height growth would also become suppressed. Vigor declines throughout this process and the trees become more susceptible to insects and root diseases. Height/diameter (H/D) ratios increase and can approach 100, where trees are at risk of succumbing to the "wet noodle effect" (Oliver and Larson, 1990), bending over or breaking under moderate wind loads.

According to Oliver and Larson (1990), the stem exclusion stage tends to be one of relative structural uniformity and simplicity. There are few late-successional habitat components such as large crowns and limbs, cavities, and other tree "defects", large snags, or CWD. Carey and Curtis (Carey and Curtis, 1996) refer to an "ecological crunch that competition among trees in closed-canopy forests exerts on an ecosystem." Competition-related mortality produces numerous small-diameter snags of relatively limited wildlife habitat value. Three snags per acre >15 inches dbh are needed to provide adequate snag habitat to support cavity nester populations of red breasted sapsuckers, hairy woodpeckers, and downy woodpeckers, at the 100% level (Brown 1985). Of the units considered for treatment in any of the alternatives, only 7 of the 19 units averaged 3 snags per acre or more over 15 inches dbh (Units 1, 6, 9, 18, and Mt. Walker Units 20, 23, and 24). Except for Mt. Walker Units 21, 22, and 24 (averaging 25.8 trees per acre >25 inches dbh), there are few large (>25 inches dbh) trees in these units at present to produce snags of sufficient size for pileated woodpecker nesting habitat (2.2 trees per acre >25 inches dbh).

In the stem exclusion stage there is 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 units, 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.

The No Action Alternative would not violate any LSR standards and guidelines, but would forego opportunities to use commercial thinning to meet habitat objectives. Since none of the

proposed units would be treated, the No Action Alternative would not fulfill the purpose of and need for increasing the structural and species diversity of forest stands.

Cumulative Effects

As detailed earlier, there have been a significant amount of past vegetation management activities in the planning area, as well as periodic historic intense fires. Approximately 60% of the planning area was previously clearcut. Although considered within the historic range of natural variability due to fire history, less than one-third of the Quilcene LSR, which includes the northern half of the planning area, have stands over 170 years old (the age that generally correlates to an old-growth ecological stage) (USDA 1996a). The Hood Canal North LSR Assessment provides acres by vegetation age classes of the LSR, as well as portions of the Olympic National Park and wilderness lands that are in the same watersheds as the Hood Canal North LSR. Vegetation age classes differ significantly. Where the 97% of national park portion and 76% of wilderness portions of those watersheds contain vegetation over 170 years old, only 45% of the acres within this LSR, which includes the southern half of the planning area, has stands that are at least 171 years old (USDA 1996b).

The No Action Alternative would not accelerate any forest stands towards late-successional/old-growth conditions, including in the LSRs, which are designated specifically to preserve and enhance late-successional and old-growth forests (USDA and USDI 1994b). The stands would be left to develop naturally.

Alternative A

Direct and Indirect Effects

Alternative A would commercially thin about 2,313 acres. Variable density thinning would promote the development of late-successional characteristics identified as priorities in the both the Quilcene and Hood Canal North Late Successional Reserve Assessments (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
- Increase specific components of functional late-successional forest ecosystems, such as canopy gaps, understory and multi-canopies, as well as create opportunities to create additional wildlife trees, snags, and coarse woody debris through funds generated from the commercial thinning.

Stand diversity can be enhanced through appropriate silvicultural treatments (Washington State Working Subgroup of the Silviculture Committee 1991; Carey and Curtis 1996; Bailey and Tappeiner 1997; Tappeiner et al. 1997; Curtis et al. 1998; Carey et al. 1999; Zaborske et al. 2000; Carey and Wilson 2001; Beggs 2004; Zenner 2005) that have the effect of moving the stand along into the understory reinitiation stage. Structural and compositional diversity can be increased by thinning the overstory to allow the release or introduction and growth of understory vegetation and the development of relatively large diameters, crowns and limbs.

Flower and fruit production of understory shrubs can be enhanced by thinning (Wender et al, 2004). With more sunlight available to remaining trees, trees can be grown to large diameters at a faster rate (Harrington, et al. 2005) to provide late-successional stand characteristics earlier in the life of the stands. Snags of target sizes for cavity nesting wildlife can likewise be recruited earlier as well. At the same time care would be taken to preserve existing snags and CWD, which could be reduced by thinning if not protected. Snags and CWD can be actively created during or after thinning treatments. Through repeated thinning treatments, a multi-story stand condition can be created.

Variable density thinning would also enhance spatial diversity by leaving some areas unthinned while creating gaps in the canopy in others. A number of researchers emphasize the inclusion of "skips" (unthinned patches), "gaps" (small openings), and heavily thinned areas in thinning treatments, otherwise known as "variable density thinning" (Carey and Curtis, 1996; Muir et al, 2002). Skips provide undisturbed areas within thinning operations that continue to suppress the development of an understory and maintain a component of dense overstory lacking much understory vegetation, and thus can provide for species of birds and small mammals that need closed canopy forest. These areas can also be used to provide protection to existing snags and CWD during thinning, and their location around existing snags or CWD concentrations adds an element of randomness in their placement. Gaps can allow the development of very large crowns and stems on edge trees that are able to occupy additional growing space and can allow the rapid introduction and development of a mid-level canopy of conifers and hardwood trees and shrubs. Gaps range in size from 250 square feet up to 4,100 square feet (Spies, et al, 1990) in a 450 year-old Douglas-fir stand at the H.J. Andrews Experimental Forest, but the most prevalent size was 1,076 square feet. These gaps can be mimicked in managed stands by creating gaps at the lower end of the scale through thinning, the upper end of the scale through group selection cutting, and allowing natural processes to take care of creating those in the middle of the scale (root rot, wind throw, etc.). Heavily thinned areas (as low as 20 trees per acre according to Muir et al, 2002) would encourage development of trees characteristic of those found in old-growth stands.

Various slash treatments, and snag and CWD creation, bird and small mammal box installation, and understory shrub plantings are additional treatments that have been applied in various situations. All may be considered as treatments that can add additional increments of diversity to a simplified, second-growth stands.

Relative densities of 40-55 (western hemlock) or 35-50 (Douglas-fir) are said to maximize stand vigor and growth (Ellen, unpublished paper; Curtis, 1982; Flewelling et al, 1980). Relative densities under 35-40 maximize individual tree growth. Flewelling, Wiley and Drew (1980) state that "most of a site's (growth) potential is captured if relative density is maintained at 40% or higher, and over 90% of the site's potential is captured (in trees) if the relative density is maintained at 30%."

The Hood Canal North Late Successional Reserve Assessment (Olympic National Forest, 1996), on the other hand, specifies that stands should exceed the Curtis Relative Density for Douglas-fir (RDDF) 60 before commercial thinning is prescribed. All units proposed for

treatment in the Jackson planning area exceed this density. The LSRA specifies further that stands should be thinned to RDDF 30.

The thinning treatment proposed would open the canopy, allowing sufficient light to penetrate to the forest floor to stimulate the growth of understory seedling/saplings, shrubs and herbs. Second, as stated above, thinning to this level would increase individual tree growth by providing additional growing space to selected dominant and codominant trees, allowing them to enlarge their crowns and increase their diameter growth. This can produce more vigorous stands, more resistant to damaging agents, with larger diameter trees, deeper crowns, and larger limbs. Removal of 33-50% of the stands' basal area by thinning from below would maintain at least 60% canopy closure.

In Units 1, 6, and 8, stand exams found root rot indicators on 25%-33% of plots, mainly laminated and Armillaria root diseases, so care would be exercised in management activities to avoid excess windthrow. Though the 2002 stand exams did not record root rot indicators in Units 21, 22, and 24, the walk-thru exams done in winter 2006 found considerable evidence of laminated and Armillaria root disease in all three stands, particularly in Unit 22. The proposed thinning would take this aspect into account. Damaging agents at moderate levels, including root rots in association with wind, bears, and hemlock mistletoe can help diversify the structure and species composition of stands within Olympic National forest. At high levels, however, these agents can severely understock stands, stunt stand growth in the case of mistletoe, and limit management options. In most of the Jackson stands, these agents are present at low to moderate levels such that they would tend to further development of late successional characteristics. Evaluation of the project units in relation to risk factors for windthrow is summarized in Table 38 in the Appendices. Overall, the blowdown risk is considered low to moderate in these stands, such that some blowdown may occur, but it would serve to add additional structure to the existing stand and would not likely be extensive in nature.

Additional project design features detailed in Chapter 2 would adequately minimize risk of any adverse effects on late-successional habitat elements.

Cumulative Effects

As detailed earlier, there have been a significant amount of past vegetation management activities in the planning area, as well as periodic historic intense fires. Approximately 60% of the planning area has been previously clearcut harvested, and less than half of the LSR lands in the planning area are in an old-growth condition. This alternative would promote the development of forest stand structural and species diversity characteristic of late-successional/old-growth characteristics on approximately 2,313 acres, of which 1,370 acres are in LSR.

Alternative B

Direct and Indirect Effects

Alternative B would commercially thin about 1,606 acres. Alternative B would have the same effects as Alternative A, but on approximately 707 fewer acres. In particular, the units on Mt. Walker and Unit 6 would remain untreated.

Cumulative Effects

Alternative B responds to the same landscape conditions as Alternative A, except it would treat fewer acres.

Alternative C

Direct and Indirect Effects

Alternative C would commercially thin about 2,313 acres. Alternative C would have the same effects as Alternative A.

Cumulative Effects

Alternative C responds to the same landscape conditions as Alternative A.

Alternative D

Direct and Indirect Effects

Alternative D would commercially thin about 1,956 acres. Alternative D would have the same effects as Alternative B, but on approximately 357 fewer acres.

Cumulative Effects

Alternative D responds to the same landscape conditions as Alternative A, except it would treat fewer acres.

Wildlife

Wildlife habitat in the Jackson project area 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 elevation temperate rainforest and the effects of past human activity, primarily logging and road building, as well as natural disturbances such as fire. The project area lies within the Lower Dosewallips River subwatershed, the Spencer-Marple Creek subwatershed, and a small proportion in the Lower Big Quilcene River subwatershed. The Dosewallips Watershed Analysis (USDA 1999) and the Big Quilcene Watershed Analysis (USDA and WDNR 1994)

both describe wildlife habitat characteristics that encompass portions of the Jackson project area and these 3 subwatersheds collectively.

The Dosewallips Watershed Analysis cites the following general conditions for wildlife habitat (These include the Rocky Brook Creek and Turner Creek portions of the project area):

- Limited suitable northern spotted owl (*Strix occidentalis caurina*) and marbled murrelet (*Bachyramphus marmoratus)* habitat in the lower Dosewallips subwatersheds, including scattered remnant trees,
- Habitat fragmentation in the Rocky Brook Creek subwatershed/catchment,
- Spotted Owl Site #409 is just below the management threshold for suitable habitat acres within a 2.7 mile radius, due to past management activities,
- Low levels of snags and coarse woody debris in managed stands,
- The value of deciduous forest for neotropical landbirds and other species,
- Limited elk foraging habitat on National Forest System lands, and
- Road densities above the 1.5 mi/mi^2 threshold used by the state in evaluating elk habitat in the Rocky Brook Creek and Turner-Walker subwatersheds.

To address concerns or deficiencies in these habitat conditions, the Dosewallips Watershed Analysis recommends activities that will:

- Protect and enhance existing suitable habitat, especially remnant trees, and encourage development of young stands into dispersal and suitable nesting habitat;
- Provide large contiguous blocks of suitable habitat connected by dispersal habitat;
- Through careful evaluation, ensure that management activities will improve habitat conditions within 2.7 miles of the Rocky Brook spotted owl site, and not further reduce habitat availability;
- Retain snags and coarse woody debris where possible and enhance snags and cavities in stands with depleted numbers;
- Retain alder in stands to provide and promote patches of deciduous habitat along stream habitats and/or retain a portion of existing upland deciduous habitats for neotropical migratory birds and other deciduous forest users;
- Create small pockets of elk forage interspersed with cover, especially in the Rocky Brook and Turner Creek areas; and
- Reduce road densities in key elk habitat and travel ways.

The Big Quilcene Watershed Analysis cites the following general conditions for wildlife habitat: These include the Lower Big Quilcene, Spencer-Marple, and Jackson Creek areas.

- Fragmentation and the limited quality, quantity and distribution of mature and old-growth forest;
- Road-related impacts;
- Limited coniferous stand diversity in some subwatersheds;
- Limited deciduous shrub and tree species diversity;
- Low number of snags in managed stands; and
- Quality and quantity of ungulate forage.

To address concerns or deficiencies in these habitat conditions, the Big Quilcene Watershed Analysis recommends activities that will:

- Restore habitats for northern spotted owl, marbled murrelet, and others in stands less than 80 years old and reduce fragmentation effects in ecologically significant old-growth stands by planting of trees, thinning to promote growth and road obliteration;
- Reduce road densities, especially in big game winter range, northern spotted owl core areas, marbled murrelet occupied sites, and mitigate effects of roads on identified wildlife movement corridors;
- Improve horizontal and vertical diversity through strategic stand thinning and gap creation in early mid-seral and late mid-seral stands to achieve dual objectives of promoting late-seral characteristics and short term forage enhancement;
- Enhance and maintain hardwoods in emphasis areas through plantings, thinning and harvest prescriptions, as well as emphasize the use of native deciduous trees and shrubs in all appropriate watershed restoration areas;
- Inventory and create new snags and coarse woody debris while including the testing of new techniques; and
- Create a canopy closure less than 70% (through commercial thinning) and plant forage species on decommissioned roads.

Much of the project area is within Late-Successional Reserve (LSR) land allocation. The LSR area within the Dosewallips watershed portion of the project area is part of the northern extent of the Hood Canal North Late-Successional Reserve (RW105) (USDA 1996b). According to the Programmatic Biological Opinion (PBO) issued by the U.S. Fish & Wildlife Service on activities proposed for the Olympic National Forest (USDI 2003), approximately 46% of LSR RW-105 has been identified as suitable habitat for marbled murrelets, and 44% identified as suitable nesting, roosting foraging habitat for the northern spotted owl (USDA 1996b), some of which is highly fragmented.

The LSR area within the Big Quilcene watershed portion of the project area is part of the southern extent of the Quilcene Late Successional Reserve (RW106) (USDA 1996a). Approximately 40% of LSR RW-106 is considered suitable habitat for marbled murrelet and northern spotted owl (USDI 2003).

Beyond these numbers, it is also important to consider the spatial distribution of suitable habitat within and surrounding the project area in order to address issues of landscape-level connectivity for the variety of species being discussed here. As alluded to in these watershed analyses, the remaining suitable habitat is highly fragmented. In the project area, the largest contiguous block of suitable habitat begins at the upper end of Rocky Brook Creek. There are several other smaller blocks of suitable habitat lower down in the Rocky Brook drainage and lower Jackson and Marple Creeks and scattered blocks along the divide between those two areas. The Mount Walker area has only several very small and scattered pieces of suitable habitat and the nearest larger block is across the Big Quilcene River, outside of the project area boundary. In addition, the Big Quilcene Watershed Analysis (USDA and WDNR 1994) identified wildlife movement corridors that connect low-elevation shoreline areas to upland areas in the Marple Creek area as well as connecting that area to Spencer Creek and Mount Walker. Much of the area in the potential movement corridor between Marple Creek and Spencer Creek or Mount Walker is in early successional habitat or private ownership. These particular movement corridors relate to areas with proposed thinning. Figure 15 shows the distribution of suitable northern spotted owl and marbled murrelet habitat in the project area.

The Olympic National Forest Strategic Plan (USDA 2004b) was developed to prioritize aquatic and terrestrial restoration efforts across the Olympic National Forest. Terrestrial wildlife strategies focused on enhancing the habitat of the northern spotted owl, marbled murrelet, and Roosevelt elk. Restoration activities were prioritized by watershed and subwatershed, land management status or habitat status, and by type of potential restoration activity. The Strategic Plan identified the Lower Dosewallips subwatershed as a high priority for habitat restoration for all three species of wildlife. The Spencer-Marple Creek and Lower Big Quilcene subwatersheds were both identified as moderate priority areas for restoration. The plan specified the following general habitat restoration strategies that are relevant in light of the Jackson project:

- Thinning activities are recommended and are of higher priority in Designated Critical Habitat for northern spotted owl and marbled murrelet.
- Commercial and pre-commercial thinning designed to accelerate late-successional habitat characteristics should be a higher priority in:
    - Dispersal and non-dispersal habitat 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 stands between fragmented patches of murrelet habitat.
- Maintain or create snag and coarse woody debris patterns that closely mimic natural conditions,

- Enhance elk forage,
- Reduce road densities through road obliteration or seasonal closures (USDA 2004b).

This 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's Region Six Sensitive Species List, Management Indicator Species (from the Olympic National Forest's Land & Resource Management Plan), Survey & Manage species (from the 1994 Northwest Forest Plan and its 2001 amendment regarding survey and manage species), and forest landbirds. An analysis of dead wood (snags and down logs) using DecAID and locally obtained information is contained in a separate report that is located in the project record and summarized here in the pertinent sections.

For purposes of analyzing road-related effects, this analysis uses the total miles of temporary roads from Table 14 to compare road effects on wildlife species across alternatives. For this purpose, "temporary roads" is meant to indicate both new construction and the re-opening of old unclassified roads. It takes a biologically conservative stance in not distinguishing between the two categories in a tacit recognition that the terrestrial wildlife effects from new construction and re-opening are often indistinguishable. The terrestrial effects of re-opening old roads can, though, vary along a continuum depending on how long the road has been allowed to re-vegetate. For example, a section of road proposed for re-opening in Unit 10 was dropped early in the planning process to protect a number of trees growing directly in the recovering road prism that were actually larger and more ecologically valuable than many others in that unit. On the other end of the spectrum, the portion of the 2630-020 proposed for re-opening was only recently closed and has little vegetation that would be lost as a result.

Federally Listed Species

The project area provides habitat for two wildlife species listed as threatened under the Endangered Species Act: the marbled murrelet (*Bachyramphus marmoratus*) and the northern spotted owl (*Strix occidentalis caurina*). "Threatened" status means the species is likely to become endangered within the foreseeable future. The table below shows these species' potential occurrence in or adjacent to the analysis area. The Final Rule to de-list the Pacific bald eagle (*Haliaeetus leucocephalus*) was published in the Federal Register on July 9, 2007, and becomes effective August 8, 2007 (USDI 2007). The bald eagle will, therefore, be addressed as a sensitive species in the subsequent section.

Table 5. Federally listed wildlife species.

Common Name	Species Name	Federal Status	Suitable Habitat Present in Project Area	Documented Sightings in Project Area
Northern Spotted Owl	*Strix occidentalis caurina*	Threatened, listed in June 1990	Yes	Yes
Marbled Murrelet	*Bachyramphus marmoratus*	Threatened, listed in September 1992	Yes	Yes

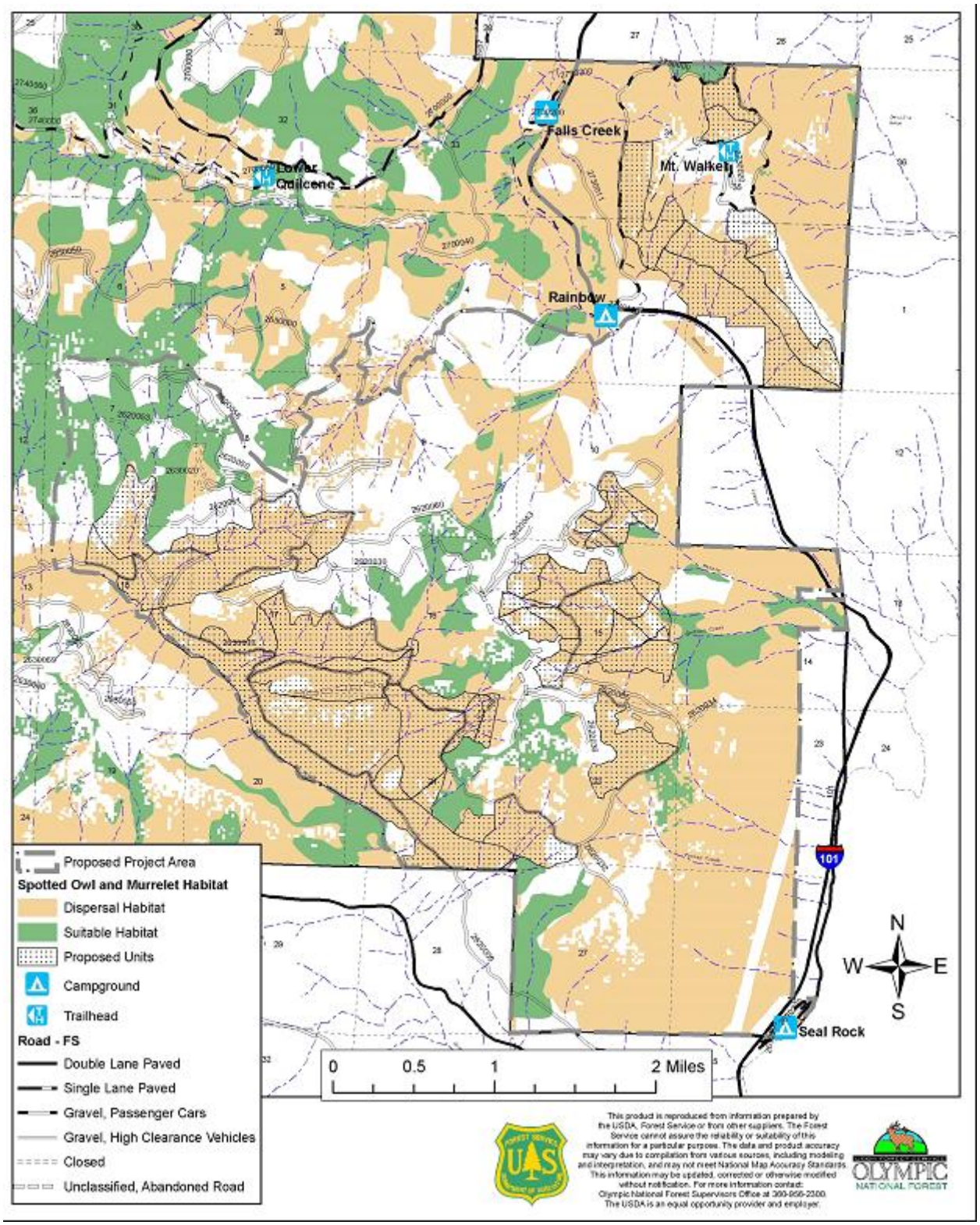
Northern Spotted Owl (Strix occidentalis caurina)

The rational behind listing the spotted owl was "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 facets of the spotted owl's life history such as nesting, roosting, and in general, foraging. Nesting and roosting habitat generally includes attributes such as a moderate to high canopy closure (60-80%); 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 habitat that functions to assist juvenile dispersal and breeding dispersal of adult spotted owls. It is also habitat that 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. The general rule for classifying dispersal habitat is to have a stand with an average tree diameter of 11 inches dbh within a canopy cover of 40% (Thomas et al. 1990).

In Washington, flying squirrels (*Glaucomys sabrinus*) make up the overwhelming bulk of the spotted owl diet in terms of the percent of prey taken and overall biomass. A variety of other small to medium mammals can also form a major portion of the diet (Forsman et al. 2001). On the Eastern Olympic Peninsula specifically, the flying squirrel was reported to comprise approximately 45% of the prey items, with the bushy-tailed woodrat (*Neotoma cinerea*) and red-backed voles (*Clethrionomy* spp.) each comprising approximately 10% of the prey items taken by spotted owls. Deer mice (*Peromyscus* spp.), voles (*Microtus* spp.) and other mouse species, rabbits (Leporidae spp.), other miscellaneous mammals, and birds make up the remainder of the spotted owl's varied diet on this portion of the Olympic Peninsula (Forsman et al. 2001).

While habitat quality within the project area varies, the proposed Jackson units are generally in single layer canopy forest which would likely only function as dispersal habitat. The proposed units are mapped in GIS as dispersal and field review has confirmed structural conditions that coincide with dispersal habitat function overall. Dispersal habitat capability would be retained under all alternatives. In some cases, suitable nesting, roosting or foraging habitat is adjacent to these areas. Suitable habitat would not be removed, degraded, or down-graded under any alternative. There are, however, scattered remnant trees and legacy snags in several units (Units 1-9, and 21), though the overall stands would still be characterized as dispersal habitat. A few of these trees or snags have the structural potential to be nesting trees and there tends to be increased structural complexity in the area immediately surrounding these remnant trees. On a functional basis, current use of those trees for nesting would be unlikely due to the structural conditions of the surrounding forest. As mentioned previously, however, under all alternatives proposed for this project individual suitable habitat trees would be protected from damage or removal. As with the marbled murrelet, any nearby or adjacent suitable habitat blocks are considered occupied for the purpose of applying disturbance buffers (in the absence of surveys to protocol) (USDI 2003).

Figure 15. Distribution of dispersal and suitable habitat for northern spotted owl and murrelet in the project area.



Standing (snags) or fallen (down) dead wood plays an important role in the overall ecosystem health and soil productivity, and is an important part of certain species habitat, including the spotted owl. Information pertaining to the use of snags and down woods was obtained for species such as the spotted owl using the DecAID advisory tool (Mellen et al. 2006) in combination with local information about the abundance and distribution of snags and down wood. This information is given more fully in a separate report in the project record. For this project, the analysis encompassed the three subwatersheds, and is consistent with recommendations made by the DecAID team. Overall, the analysis of available information found a low abundance of larger size snags and down wood in proposed units and even at the scale of the three subwatersheds as a whole. Larger snags tend to be preferred by the spotted owl (Buchannan et al. 1999) and important prey species such as the northern flying squirrel. Smaller diameter snags were much more abundant in the proposed units.

DecAID provides species-specific information relative to three different “tolerance levels”: 30%, 50%, and 80%. These tolerance levels represent the percent of that species’ population that would be expected to use that particular habitat feature in that configuration. The 30% tolerance levels for snag size, and snag density in the smallest size class are likely being met under current conditions, for species such as northern flying squirrel when considering that the estimated levels in the managed stands are likely much lower than remnant, unharvested stands. But tolerance levels for larger snags or higher tolerance levels in general, are not likely being met. This is important because DecAID tables show the proportionately greater importance of larger diameter snags to wildlife, in addition to just snag density. For example, Carey (1995) found the abundance of large snags to be one of three variables important in predicting flying squirrel abundance. Buchannan et al. (1999) found significantly higher snag densities in northern spotted owl use areas when compared to other areas, and a general association with snags greater than 20 inches (51cm) in diameter.

Lower percent cover of down wood tends to follow the trend in lower numbers of larger snags. However, it appears that the 30% tolerance level for down wood may be met for species such as the northern spotted owl, and the 50% level may even be met when considering the larger area and certain units. This is entirely based on limited field estimates since the watershed analyses did not attempt to quantify this habitat element. It can be assumed, though, that percent cover in the unharvested areas in remnant suitable habitat and the upper portions of the two subwatersheds would be higher than that of the managed stands.

Several recent reports 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. 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, suggests that other factors are responsible for the declines (Courtney et al. 2004). While a number of possible reasons exist for the downward trends, nothing definitive can be directly attributed to the decline. Anthony et al. (2004)

noted declining populations in areas without timber harvest and populations remaining stable in areas with harvest of mature forest.

No surveys were conducted specific to this project. However, there are two historic spotted owl activity centers near or in the Jackson project area, both of which are located on National Forest land. Surveyors with the Pacific Northwest Research Station's (PNW) Olympic demographic study have been monitoring these and other activity centers for a number of years.

The historic nesting site for site 781 is along the Big Quilcene and has been surveyed repeatedly since the 1990s, up through the 2006 season, and no spotted owls have been detected since 1995. There were 7 years of pair occupancy at this site, during which the pair produced young only for three years (1989-1991). The last spotted owl pair occupancy of this site was in 1995. In fact, according to research personnel, the first barred owl was detected in the core area of this site in 1996 and has appeared to have taken up residency in this territory since that time. Researchers also reported that the historic nest trees have fallen down (D. Kelso 2006, pers. comm.)

Site 781 is often associated with the northeast portion of the project area (Mount Walker). This, however, is somewhat of a misnomer and has lead to some confusion since no nesting has been documented on Mount Walker-proper. The documented spotted owl nesting activity associated with this territory actually occurred across the Big Quilcene River, approximately 1.5 miles away from any unit on Mount Walker and further from proposed units in the other portions of the project area.

The banded male associated with site 781 was documented using Mount Walker-proper on one occasion in 1994. Because of the timing and location relative to where the known nesting activity occurred, it was likely that the owl was simply foraging in this area, given that the known nesting area was located elsewhere. Given that dispersal habitat is described as having limited foraging potential, the detection is not inconsistent with the dispersal habitat rating assigned to this area. There was also a detection of a subadult female on Mount Walker in 1997. The owl was banded and not located on subsequent surveys, so was assumed to have been a disperser (D. Kelso 2006, pers. comm.). Nonetheless, a 100 acre core area was retained and excluded from potential treatment where the detection occurred near proposed units on Mount Walker (K. Holtrop 2006, pers. comm.). That particular area has dispersal habitat characteristics and lacks the characteristics of suitable nesting, roosting or foraging habitat. Barred owls have also been located on Mount Walker-proper in more recent years, including 2006 (D. Kelso 2006, pers. comm.).

For the Olympic Peninsula, the nesting core and home range core areas are defined by 0.7 and 2.7 miles radii circles, respectively, around an activity center. This is based on research on the Olympic National Forest which showed owls using median core areas approximated in area by circles of those radii. Of the 14,657 acres contained within a 2.7 mile radius, a minimum of 40% (5,863 acres) are to consist of suitable habitat in order to stay above "take"thresholds for suitable habitat. The 0.7 mile radius nesting core is to contain a minimum of 500 acres of suitable habitat.

Site 781 currently contains 5,438 acres of suitable habitat within a 2.7 mile radius and is therefore below the "take"threshold for suitable habitat required at the home range scale. Units 20, 22 and portions of units 2, 8, and 21-24 are within the 2.7 mile radius home range for this site. The site is below the 500 acre threshold for the 0.7 mile radius nesting core as well. No proposed units are within the 0.7 mile radius of the historic nesting location for site 781.

Site 409 has been surveyed by research personnel repeatedly since the 1990s as well, up through the 2006 nesting season. The last spotted owl detection at this site occurred in 2001 (banded female), though the last pair occupancy was in 1998. The 5,693 acres of suitable habitat within the 2.7 mile radius home range of site 409 are below the 40% minimum acres of suitable habitat required. As such, site 409 was identified as a site that is below the "take" threshold of suitable habitat quantities necessary to sustain an owl or pair of owls (USDA 1999) Units 2, 3, 4, and a portion of Units 1 and 5 fall within the 2.7 mile radius home range for this site. The site meets the minimum acreage requirement for the 0.7 mile radius nesting core. The only area proposed for harvest that falls within the 0.7 mile radius nesting core for this site is a small portion of one unit.

There is ample evidence that barred owls (*Strix varia*) have had a negative effect on spotted owls. Courtney et al. (2004) devote an entire chapter of the status review to the interactions and potential threats to northern spotted owl populations posed by barred owls. Drawing from a number of studies and other observations, they describe the general agreement that barred owls have undergone range expansion and population increase throughout the range of the northern spotted owl. Barred owls use similar habitats in addition to some habitats not used by spotted owls, including second-growth dominated or more fragmented landscapes. There is overlap in the diet of the two species, but barred owls general 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. Given the above, 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 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 spotted owl (Gutierrez et al. 2007).

Barred owls have been noted in a number of former spotted owl territories in the greater Quilcene Study area, including site 781. Barred owls have also been detected on Mount Walker proper, along the Big Quilcene River between sites 781 and 411, in Unit 6, and in the lower reaches of Turner Creek (a unit dropped from detailed consideration). In all these cases the sex or nesting status of the barred owl was unknown. The barred owl detection in the vicinity of site 411 in 2005 may have overlapped with be the same barred owl as the one detected in the territory of 781.

Designated Critical Habitat for Northern Spotted Owl

As required by the Endangered Species Act, the US Fish and Wildlife Service has designated critical habitat for the northern spotted owl. Critical habitat for the spotted owl was designated on January 15, 1992 (USDI 1992) on National Forest lands outside congressionally designated wilderness. The conservation principles in developing critical habitat are 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 owl critical habitat consist of habitat features that support nesting, roosting, foraging, and dispersal, as defined previously. On the Olympic National Forest, there are 10 designated Critical Habitat Units (WA-43 through WA-52) totaling over 398,000 acres that are identified that are considered essential for the conservation of the listed species.

The critical habitat unit (CHU) in the Jackson project area is designated WA-49. The CHU is 69,207 acres in size, of which 25,579 acres (37%) is suitable habitat for nesting, roosting and foraging spotted owls and 20,822 acres (30%) is in dispersal habitat. The Tunnel Creek and Rocky Brook Creek drainages connect the CHU to the Dosewallips Watershed. The CHU then follows the river upstream until it meets the boundary of Olympic National Park. Eighty percent of the CHU is within Late Successional Reserve (USDI 2003).

Ideally, the CHU should support clusters of owl pairs by providing large, contiguous blocks of suitable and dispersal habitat (USDI 1992). Less than 25 percent of the Jackson project area falls within WA-49. This includes all or portions of proposed Units 1-3 and 22. Proposed Jackson Project units in spotted owl CHU all together constitute less than 1% of the total CHU acres and approximately 2% percent of the presently suitable acres in this CHU.

Table 6. Summary of Acres Treated in Northern Spotted Owl Habitat.

Alternative	Total Acres Treated	Acres Treated in CHU WA-49 (out of 69,207 acres)	Acres Treated within 0.7 mile of Historic Activity Center (Site 409 only, total 985 acres)[15]	Acres Treated within 2.7 miles of Historic Activity Center (out of 14,657 acres)[15]
No Action	0	0	0	0
Alternative A	2,313	469	48	1,291
Alternative B	1,606	397	48	892
Alternative C	2,313	469	48	1,291
Alternative D	1,956	469	48	1,204

Marbled Murrelet (Bachyramphus marmoratus)

The primary reason for the listing of the marbled murrelet was extensive harvest of late-successional and old-growth forest, which provides nesting habitat for the murrelet. Attributes that provide nesting platforms for murrelets are trees with large (> 5 inches) diameter or forked branches, deformities, mistle-toe infections, and "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 forests (USDI 1996). Suitable nesting habitat for marbled murrelet can generally be approximated by northern spotted owl suitable (nesting, roosting, foraging) habitat. By contrast, dispersal habitat for northern spotted owl is not suitable nesting habitat for marbled murrelet.

There is no suitable habitat that was identified by GIS analysis to be within any of the Mount Walker units. The nearest mapped suitable habitat (outside of proposed units) was reviewed and found to have little if any nesting potential for murrelets. It would be, however, the most likely location for nesting on Mount Walker if indeed nesting were occurring. Field review also failed to find any potentially suitable nest trees in any of the proposed Mount Walker units, other than several of the remnant old growth trees found in Unit 21.

All the units proposed within the Jackson project area are classified in GIS as dispersal habitat, which is not suitable nesting habitat for marbled murrelets. Project-specific field reconnaissance has verified them to be dispersal habitat, although Units 1-9, along with Unit 21, each contain one or more remnant old-growth trees within their boundaries, a few of which could be classified as suitable nesting trees because of their limb structure and the presence of potential nesting platforms. However, the structural condition of the surrounding forest 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.

[15] *only applies to the documented historical nesting sites*

Nonetheless, these remnant trees would be protected under all action alternatives. There is a very low likelihood that any trees harvested with the activities proposed would be occupied or contain the necessary components, such as large limbs, moss, and cover to be potential nest trees. Because specific surveys for either species have not been conducted in the project area to established protocols, 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).

The Dosewallips watershed contains 22,586 acres of suitable marbled murrelet habitat (29% of watershed) (USDA 1999). Of the 22,586 acres suitable habitat, 9,745 acres (43%) are in Olympic National Forest, and 12,790 acres in Olympic National Park (57%). Suitable habitat is available in large contiguous tracts only in the upper watershed. The suitable habitat in the middle Dosewallips and Rocky Brook Creek areas has been fragmented by timber harvest and by fires. In the lower Dosewallips River Watershed, suitable habitat is very limited due to timber harvest, agriculture and urbanization. The Big Quilcene River Watershed has incurred extensive fragmentation to suitable habitat due to past harvest activities, especially at lower elevations.

No marbled murrelet surveys were conducted specific to this project. However, surveys for marbled murrelets were conducted in various parts of the Dosewallips and Big Quilcene watersheds through formal efforts in the 1990s. The state priority species database contains several detections of marbled murrelets in the project area. Occupancy was recorded in the lower Marple Creek area in the early 1990s, approximately 0.65 mile from Units 11 and 18. Another murrelet was detected in the Mount Walker area in 1993. The observation was labeled as “questionable” with the behavior described as “circling above at 1.5 [times the] canopy [height].” This detection was located outside any proposed units, but within 0.35 mile of Unit 22 and within 0.5 mile of Unit 20. In 1994, a detection was recorded from the same survey site. The database also showed numerous marbled murrelet detections much further up the Big Quilcene River or its tributaries, in blocks of suitable habitat, so it is likely the Big Quilcene is used as a flyway. Nonetheless, both documented murrelet locations should be treated as occupied for the purpose of applying seasonal restrictions on disturbance activities. Radar studies have also detected murrelets at the mouth of the Dosewallips River (Cooper et al. 2001).

In March 2004, the 5-Year Status Review (McShane et al. 2004) was published to examine the best available scientific and commercial information on the marbled murrelet. One section of the Status Review that is particularly pertinent to this project is one that addresses potential future habitat gains. In second-growth stands, silvicultural systems such as small group selection or selective logging with variable retention, are recommended to facilitate habitat development (Manley and Nelson 1999). Development of suitable nesting habitat is dependent on trees attaining a size that will support large, lateral branches. Carey et al. (2003) suggest silvicultural treatments be applied at the individual tree, stand, and landscape level to improve the potential for trees to produce nesting platforms as well as improve the nesting habitat at the larger scale. Though thinning activities can produce large trees and develop stand structure and old-growth attributes (Curtis and Marshall 1993, Newton and Cole 1987), the rate at which murrelet habitat characteristics in younger stands can be

developed is a long-term outcome. Thus, the loss of habitat may still be a threat even while implementing habitat specific silvicultural techniques. However, Carey et al. (2003) suggest that appropriate silvicultural treatment can appreciably reduce the time required for habitat to develop suitable habitat characteristics. Recent demographic modeling efforts suggest that marbled murrelet populations are declining in all conservation zones (McShane et al. 2004).

The 5-year status review also focused on the vulnerability of marbled murrelets to nest predation. Information summarized in the review showed that many murrelet nests that were monitored had failed due to nest predation. Implicated in these cases are common ravens (*Corvus corax*), stellers jay (*Cyanocitta stelleri*), and other members of the corvidae, as well as raptors (hawks, etc.). Squirrels and other rodents are also suspected to be potential nest predators on marbled murrelets (McShane et al. 2004). In fact, suitable nesting trees that are surrounded by younger forest generally are not suitable to murrelets due to high nest predation (Manley 1999 as cited in McShane et al. 2004). This would especially apply to the remnant old trees and other potential nest trees in Units 1 and 6 that are close to the National Forest boundary along their eastern edge. Carey et al. (2003) also discuss habitat development strategies in areas where nest predation is a concern and where increases in understory development could improve conditions for nest predators such as jays.

Designated Critical Habitat for Marbled Murrelet

The US Fish and Wildlife Service designated critical habitat for the marbled murrelet in 1996 (USDI 1996). Critical habitat is defined as those "lands that are considered essential for the conservation of a listed species" (USDI 2003). The Service identified two habitat features, referred to as primary constituent elements, associated with the terrestrial environment that support the requirements for nesting, roosting, and other normal behaviors. Both constituent elements are present within the project area.

The primary constituent elements include 1) individual trees with potential nesting platforms 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 (USDI 1996).

The only units within critical habitat that contains potential constituent elements are Unit 6 and a small adjacent portion of Unit 1. They contain several small pockets of scattered remnant trees which includes both of the preceding elements.

Designated marbled murrelet critical habitat in Washington State is 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% if suitable habitat. These CHUs served as part of a network of marbled murrelet habitat on the Olympic Peninsula, along with habitat available in Olympic National Park and wilderness areas. The marbled murrelet critical habitat unit (CHU) that encompasses the Jackson project area (East Olympic Peninsula; WA-06-a) is described in the 2003 Programmatic Biological Opinion (PBO) as the following:

"This CHU contains federal lands in LSRs. Large blocks of old-growth forest are present in the CHU, as well as in the adjacent ONP. Habitat conditions in the CHU are expected to slowly improve as the forests within the LSRs continue to develop" (USDI 2003).

CHU WA-06-a encompasses the majority of the Jackson project area, consists of 71,600 acres, falls within Marbled Murrelet Conservation Zone 1 (USDI 1997) and contains about 26,640 acres, approximately 40%, suitable habitat overall (USDI 2003). Approximately 7,360 acres of the Jackson project area is within WA-06-a. Proposed units 1-8 and 16 are wholly within CHU WA-06. All together, units proposed in this marbled murrelet CHU under all alternatives constitute approximately 2% of the total CHU acres and 5%-6% of the presently suitable acres in this CHU.

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, and
- adequacy of existing protection and management (USDI 1996, USDI 2003).

Specific attributes of each CHU are not indicated in the PBO beyond the description above. However, it is likely that proximity to the marine environment (For example, units of the Jackson project area vary between 1 and 5 miles from the Hood Canal) and the adequacy of existing protection and management (a large amount of land managed by USFS under the NWFP or by the NPS) figured more into this area's inclusion than survey data or the amount or distribution of current suitable nesting habitat.

Table 7. Summary of acres treated in relation to potential/existing marbled murrelet habitat.

Alternative	Total Acres Potential Suitable Habitat Created	Acres Treated in CHU WA-06-a	Acres treated within 300 feet of National Forest boundary or inholding
No Action	0	0	0
Alternative A	2,313	1,381	77
Alternative B	1,606	1,199	9
Alternative C	2,313	1,381	77
Alternative D	1,956	1,203	16

No Action Alternative

Direct and Indirect Effects

Under the No Action Alternative, current conditions would be maintained. From approximately 1,606 to 2,313 acres of relatively simplified forest that meet treatment criteria would not be commercially thinned. These stands would remain in early- or mid-seral conditions longer, generally overstocked with a single canopy layer, fewer than optimal large-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 habitat for northern spotted owl, but not nesting habitat for marbled murrelet or spotted owl. 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; these stands proposed for treatment would continue to provide little in terms of murrelet nesting potential, but would be available as dispersal areas for spotted owls.

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.

Cumulative Effects

Activities in the project area that have had the greatest impact from habitat removal or habitat alteration that favors competing species and human disturbance on these two threatened species include previous timber harvest, road building, and, to a lesser degree, catastrophic fire events. Large-scale clearcutting that occurred in the past on federal lands are not expected in the foreseeable future. However, even-aged, regeneration harvesting still is occurring in many areas on private or state lands around the project area, especially surrounding the Mount Walker units. In fact, recent harvest has created abrupt changes in habitat with the potential for edge effects along the edges of several units, even under a no-action alternative. It can be assumed that most private lands surrounding the Jackson project area will not be available as either dispersal or suitable habitat in the next several decades. This fact will make the continued existence of habitat on federal lands even more critical, particularly if they can be utilized as nesting areas.

Alternative A

Direct and Indirect Effects

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 in approximately 2,313 acres. Treated stands would continue to function as dispersal habitat by maintaining more than 40 percent canopy cover with trees larger than 11

inches dbh (Thomas et al. 1990). These areas would not automatically 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, but seasonal and daily restrictions would minimize impacts from disturbance. There would be approximately 6.2 miles of temporary new and unclassified road construction associated with this alternative. This includes 0.7 mile of new construction and 0.4 miles of reconstruction of unclassified roads in riparian reserve (See Aquatic Habitat and Fisheries section).

Road construction and the opening of partially re-vegetated roads would temporarily remove dispersal habitat on a small scale, but would not degrade or down-grade habitat function. The immediate decommissioning and revegetation of these temporary roads would help to mitigate the effects of this as these areas are allowed to grow in, but the benefits would not be immediate.

For murrelets, the inclusion of Units 1 and 6 entails the implementation of a buffer around potential nest trees. This is due to the presence of constituent elements in a stand that is surrounded by trees that are at least ½ the site potential tree height of that stand in a marbled murrelet CHU (USDI 1996). This applies to Unit 6 and the adjacent section of Unit 1 because of the condition of the remnant old-growth trees, as well as age and height of the stand. Protection would involve a 100-foot no-harvest buffer (or one-half site-potential tree height, whichever is greater) around each remnant old-growth tree/potential nest tree or patch thereof. This would protect the individual trees as well as other components of diversity immediately surrounding them. The other units with remnant trees do not meet these constituent element criteria, although the remnant old-growth trees themselves would continue to be retained, and a buffer would still be applied to protect other wildlife values.

For the marbled murrelet critical habitat block, which currently contains approximately 28,640 acres classified as suitable nesting habitat, the accelerated development of approximately 2,313 additional acres of suitable habitat (1,381 acres of which would fall in the CHU) represents a potential increase of approximately 5% for suitable habitat in the CHU. While the increase is small in proportion, it would provide future suitable nesting habitat within just a few miles of marine foraging areas on the Hood Canal, which is a feature important to CHU function (USDI 1996, USDI 2003).

Given that the northern spotted owl CHU contains about 25,579 acres classified as suitable for nesting, roosting or foraging, and only about 469 acres proposed for treatment fall in the CHU under this alternative, the additional suitable habitat developed (accelerated) through this project would represent an increase of just under 2% in suitable habitat. However, given that only 37% of the CHU is currently suitable for nesting, an additional 2% would still be beneficial, particularly given the specific concerns faced by the owl population on the Olympic Peninsula (e.g., fragmentation, isolation, low reproductive success).

More importantly, this alternative would treat approximately 1,291acres within the 2.7 mile activity centers of the two historic sites (The circles overlap in Rocky Brook drainage), which represents approximately 56% of the total acres being treated. The development of additional

suitable habitat acres would help meet the objectives for the minimum numbers of suitable habitat acres within the 2.7 mile radius home range of both sites 409 and 781. There are approximately 864 acres to be treated within the 2.7 mile radius of 409 alone and approximately 594 acres that would fall within the 2.7 mile radius for site 781, though 167 of those acres overlap with the 2.7 mile radius for site 409. Given that harvest prescriptions are designed to accelerate the development of late-successional forest conditions, and the nesting cores are not currently occupied, this would meet the intent of constraints on activities within this area that were suggested in the Strategic Plan (USDA 2004b).

The acres being treated in the 2.7 mile radius of site 409 represent a substantial proportion of the total acres treated under all alternatives, which is consistent with management direction given in several guidance documents (USDA 1999, USDA 2004b). The small number of acres treated within the 0.7 mile radius nesting core of site 409 (approximately 48 acres) is similar across all alternatives.

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). Therefore, there would be minimal effects on current snag and downed wood levels under all action alternatives. 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 4-12 inch diameter in their study) and medium (13 to 19 inch diameter) downed wood. This likely would reduce the numbers of small snags and logs that would be naturally produced in the Jackson project area in the future, which includes snags that would be beneficial to the spotted owl in terms of potential nesting sites 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 larger legacy snags. The prescriptive measures that retain existing snags or down trees and allow for future recruitment would minimize any short term negative effects to rodents (spotted owl prey species) under all action alternatives.

Indirect effects would include both positive and negative elements. Given the paucity of suitable habitat in the critical habitat block, thinning would improve habitat conditions for those species dependent on forests with late-successional characteristics. 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. Road decommissioning in addition to that of temporary and unclassified roads would lead to eventual reduction in their effects to habitat as these areas are allowed to revegetate. These activities could potentially occur under any action alternative. However, because the extent to which these additional activities would occur is dependent on the availability and prioritization of these other funds, their effects are not included in this analysis.

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. The effects of developing habitat from opening up travel corridors (roads), even though ultimately closed, may include enhancing these areas for corvids, which are predators on nests and chicks. The proximity to the community of Brinnon, where corvids likely have an established presence, could increase the risk of subsequent nest predation for murrelets under any action alternative, but is likely increased under alternatives with thinned units along forest edges (Units 6, 21, and smaller portions of Units 1, 20, 23, 24) as those stands develop into suitable nesting habitat. McShane et al. (2004) summarize information suggesting that murrelets are highly sensitive to fragmentation and that increased edge effects can affect nest success through changes in microclimate conditions and predation. Predation rates on forest birds are generally higher at abrupt edges than at edges feathered by different forest type or partial harvest. 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).

The distance that potential edge effects may extend into adjacent forested habitat varies widely by species, effect type (i.e., predation versus microclimate), and other factors. A distance of 300 feet has been used to buffer the effects of abrupt habitat edges where adjacent to *currently* suitable marbled murrelet nesting habitat (McShane et al. 2004). While proposed units do not offer suitable murrelet nesting habitat on the whole at the current time, the goal of silvicultural treatments is to accelerate the development of suitable habitat in the future. Using that logic, and for the purpose of discussing potential future effects of proposed activities, it was assumed that the forested area within 300 feet of the National Forest boundary or in-holding, when it had achieved the structural characteristics of nesting habitat, would have lower nesting success (due to increased predation potential) than surrounding interior forest. This applies to portions of Units 1, 6, 20, 21, 23, and 24. The amount of future habitat included in this edge-affected area was then estimated using GIS analysis. While distances impacted by edge effects vary in the scientific literature (McShane et al. 2004), the primary utility of this measurement is for relative comparison across alternatives. For example, an estimated 77 acres of future nesting habitat would occur in this zone under this alternative, with the majority occurring in Unit 21, followed by Unit 6 and Unit 1. Smaller amounts would occur in Units 20, 23 and 24. This total amount is equal to that which would occur under Alternative C, but greater than that of Alternatives B and D. It should also be noted that this potential effect of suitable habitat near areas of high nest predation risk could also occur to some degree under the no action alternative, but those areas would take longer to develop into suitable habitat.

This information suggests there are risks, or at the very least that caution should be exercised, when attempting to accelerate the development of murrelet or spotted owl nesting habitat in areas that could be perennially bounded by or in close proximity to abrupt changes in habitat. This is especially relevant to the eastern portions of Units 1 and 6 given their proximity to the community of Brinnon and the likelihood of higher corvid densities surrounding this community. Nest predator densities have also been reported to be higher at lower elevations (Bradley 2002 and Burger et al. 2000 as cited in McShane et al. 2004), which would also place Unit 1 at higher relative risk for predation given its relatively low elevation.

Courtney et al. (2004) summarize studies which suggest that although spotted owl prey and foraging efficiency can potentially increase along early successional areas that are bordered by suitable habitat, there is also the potential for increased risk of nest predation as noted above, reduced truffle abundance (food for flying squirrels), and habitat conditions that may favor barred owls.

Thinning may cause a short-term impact on the food source (truffles) of flying squirrels, which could in turn, lead to a short term (<5 yrs) decline in flying squirrel numbers (Carey 2004 in Appendix of 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 thinned stands (Carey et al. 2002). Regardless, given that both sites with home ranges overlapping harvest units are currently unoccupied, spotted owls in those two territories would not be affected by a short term decline in truffle abundance. In fact, that would also be a good reason to treat the areas now while owls are absent from the area. Thinning may also reduce potential or actual flying squirrel den trees (Carey et al. 1997), although conservation measures drafted for this project would protect trees with defects, cavities and other features that could provide suitable dens, wherever possible. Thinning appears to increase the abundance of other small mammals in the longer term (7-24 years), especially those associated with understory cover, although short term effects are less clear or less consistent (Suzuki and Hayes 2003). Over the long-term, variable density thinning would likely provide adequate prey for northern spotted owls (Carey 2004 in Appendix of Courtney et al. 2004). Measures prescribed under all action alternatives to retain existing seed-source trees and shrubs for rodents would also benefit spotted owls.

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 do have a wider breadth in habitat use and prey species. As mentioned previously, barred owls have already been recorded in the project area, including one territory previously occupied by spotted owl (Site 781). In that case, displacement appears to have already taken place. Additionally, a variety of reference documents (USDA and USDI 1994a, USDA and WDNR 1994, USDA 1999, USDI 2003, Courtney et al. 2004) recommend habitat manipulation to improve habitat for spotted owls. To reduce the risks to occupied activity centers, the Olympic National Forest Strategic Plan (USDA 2004b) recommended that treatments avoid occupied activity centers. Both activity centers are currently not occupied by spotted owls.

In summary, the issue of edge-related effects for a number of units has the potential to cause negative effects that could minimize habitat gains for marbled murrelets or spotted owls using those particular units. While there may be minor direct and indirect negative effects in the short term, however, the longer term and net effects would be expected to be beneficial to both the spotted owl and marbled murrelet under this alternative. 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 non-USFS lands.

Cumulative Effects

Endangered species restrictions and Northwest Forest Plan requirements have curtailed clearcut logging and road building on Federal lands of late-successional forest stands in the Lower Dosewallips River, Spencer-Marple Creek, and Lower Big Quilcene River subwatersheds since 1993. Timber harvest and fire were the biggest landscape-level impacts to spotted owl and murrelet habitat before 1993, and the effects of these activities has shaped the resulting quantity, quality and distribution of wildlife habitat in both the Big Quilcene and Dosewallips watersheds in general.

The Silviculture and Forest Stand Development section 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 and non-National Forest lands in both the Big Quilcene and Dosewallips watersheds has resulted in large areas of young, simplified forest and fragmented remnants. Other activities that have influenced habitat development include commercial thinning, pre-commercial thinning, and fertilization, all within the project area boundary between the 1920s and the late 1980s. Since the designation of Late Successional Reserves in 1994, activities on that land designation have sought to protect and enhance late-successional habitat characteristics.

It is assumed that logging and road building on state and private lands will continue in all 3 subwatersheds. Therefore, few non-National Forest lands are expected to provide additional late-successional habitat, making the habitat remaining on federal land key to population health. Actions on those lands may also affect conditions for wildlife on adjacent federal lands. There are landownership boundaries bordering or in close proximity to units in each of the three subwatersheds (see Figure 10). Therefore, it can be expected that the Mount Walker units, especially Unit 21, and Unit 6 in Rocky Brook (along with a portion of Unit 1) may have abrupt early successional edges along or in close proximity to their boundaries. In fact, such edges already occur along portions of Units 1, 6, and 21.

Treatment of the Rocky Brook and Marple Creek units is consistent with the recommendations to create large contiguous blocks of suitable habitat, connect the remnant blocks of suitable habitat, and enhance/increase suitable habitat within the home range of historic spotted owl sites (USDA 1999 and USDA 2004b). The Mount Walker units (20-24) would serve to increase the amount of suitable habitat around the spotted owl historic nest site 781 and connect a small piece of marbled murrelet CHU that would otherwise be isolated on the east flank of Mount Walker. However, landownership patterns and resulting management have left little in the way of potential connectivity between the Mount Walker units and the Marple Creek area. While recommended for treatment in the Big Quilcene Watershed Analysis (USDA and WDNR 1994), the Mount Walker stands are less consistent with idea of developing contiguous tracts, given that they would likely become isolated on 3 sides due to activities off National Forest lands. The Mount Walker units are expected to contribute least to the future needs for these species on the local or landscape scale, irrespective of the action alternative.

Alternative B

Direct and Indirect Effects

The general effects of this alternative would be similar to A, with the exception of approximately 31% fewer acres being treated and slightly less total temporary road construction (11% less). Of the total temporary road construction, there would be no new construction in Riparian Reserve, and reconstruction in Riparian Reserve would remain the same as Alternative A. Otherwise, road-related effects would be similar to those described in Alternative A.

While treating the fewest acres of any alternative, this alternative would treat only slightly fewer acres in murrelet (13% less) and spotted owl (15% less) CHUs, making a similar relative contribution to the CHU despite substantially fewer overall acres. This is primarily because most of the Mount Walker units occur outside of the CHU and, therefore, contribute much less to the goal of habitat development in CHUs. Acres treated within the 0.7 mile radius and 2.7 mile radius of activity center of site 409 remain the same (across all alternatives in fact). However, the acres treated within the 2.7 mile radius of site 781 are greatly reduced under this alternative since much of Units 20-24 were inside this 2.7 mile radius. Still, the acres treated within the 2.7 mile radii of historic sites in total represents 56% of total acres being treated under this alternative.

The exclusion of Unit 6 (Rocky Brook) and Units 20-24 (Mount Walker) from this alternative also substantially reduces the concerns mentioned under Alternative A with respect to thinning units adjacent to abrupt forest edges and the potential for the Mount Walker area to be isolated. For example, using the distance mentioned under Alternative A, the acres of habitat that would be treated within 300 feet of the National Forest boundary would be reduced to 9 acres, all of which would occur along the eastern-most border of Unit 1.

This alternative was developed in response to concerns over the values of allowing fire-regenerated stands to develop without intervention. As such, Units 6 and 20-24 would not be thinned under this alternative. As previously mentioned, Unit 6 has a small amount of remnant forest scattered throughout the unit, which adds to the habitat value of the stand and is qualified as constituent elements of marbled murrelet CHU. Interestingly, the fire-regenerated stands on Mount Walker tend to have an overall paucity of snags and coarse woody debris which has been verified by field estimates, an apparent contradiction to what the DecAID analysis would have predicted.

Cumulative Effects

The general cumulative effects from this alternative are similar to Alternative A, except for the changes as a result of the reduction in the number of acres that would be enhanced, as well as the amount of habitat that would be treated within 300 feet of the National Forest boundary.

Alternative C

Direct and Indirect Effects

This alternative would treat the same number of acres as Alternative A. However, as per the purpose of this alternative, it results in markedly less temporary road construction than any of the other action alternatives, with no new construction in riparian reserves and only a small amount of reconstruction in riparian reserve. This has the potential to reduce short term impacts to dispersal habitat also discussed under Alternative A.

The number and percentage of acres treated in spotted owl and murrelet CHU is the same as Alternative A and slightly greater than Alternative B. The percentage of acres treated within the 0.7 mile and 2.7 mile radii of historic owl activity centers is also the same as under Alternative A (56% of total acres treated). While there would be some helicopter yarding under other action alternatives, the heavy reliance on helicopter yarding under this alternative requires seasonal and daily timing restrictions that affect more units than other alternatives in order to mitigate potential for harassment effects. Effectively, all units proposed under any alternative have at least some portion within 1 mile of suitable habitat for spotted owls and marbled murrelets.

Like Alternative A, this Alternative proposes to harvest Units 6 and 20-24, in addition to other units. Approximately 77 acres would be treated within 300 feet of the National Forest boundary and in-holdings. Therefore, the direct, indirect, and cumulative effects of thinning those units would be similar to those mentioned under Alternative A.

Cumulative Effects

Cumulative effects of this alternative would be most similar to Alternative A, but with fewer impacts related to temporary road construction.

The consistency of this alternative with management direction concerning the creation and maintenance of suitable habitat is similar to that of Alternative A, but with the added benefit of markedly reduced road temporary road construction.

Alternative D

Direct and Indirect Effects

This alternative treats approximately 15% fewer acres than Alternative A or C, but approximately 22% more acres than Alternative B. Total temporary road construction represents a value slightly less than Alternatives A and B but still substantially greater than Alternative C. Therefore, road-related effects and concerns would be similar to A or B, but greater than C.

Once again, the acres treated within the spotted owl CHU (469 acres) are the same as with Alternatives A and C, but slightly greater than Alternative B. This alternative treats slightly

fewer (13%) acres in the marbled murrelet CHU than Alternatives A or C, but essentially the same number as Alternative B. Nonetheless, the percentage of total CHU acres or suitable habitat for either species that would be treated under any alternative is relatively small, as discussed under Alternative A, but would still make a positive contribution. Interestingly, this alternative would treat the greatest proportion (62%) of acres within the 2.7 mile home ranges of the historic spotted owl sites, although the difference would be small.

The less quantifiable benefit of this alternative comes in the exclusion of areas that were felt to have higher existing habitat values in their current state or existing remnants of suitable trees, as discussed under Alternative B. The benefit of excluding Unit 6 from harvest comes from eliminating any harvest or disturbance surrounding the suitable habitat trees and constituent elements that, however, few and scattered, are an important legacy of remnant forest habitat present in this unit. It eliminates the need for specialized buffers around remnant trees in this unit that would be required under other alternatives that thin in Unit 6.

The exclusion of Unit 6 (Rocky Brook) and Unit 21 from this alternative substantially reduces some of the concerns mentioned under Alternative A with respect to thinning units adjacent to abrupt forest edges, and the potential negative effects to these two species. However, approximately 16 acres of habitat would still be treated within 300 feet of the National Forest boundary under this alternative. This would occur along the eastern-most border of Unit 1, as well as along small portions of Units 20, 23, and 24.

Cumulative Effects

The general cumulative effects from this alternative and consistency with management recommendations for habitat development are similar to Alternative A, except that fewer acres would be enhanced.

Common to all Action Alternatives (Alternatives A, B, C, and D)

Direct, Indirect, and Cumulative Effects

Under all action alternatives, thinning prescriptions would ensure that the treated stands retain dispersal habitat characteristics while accelerating the development of late-successional structural characteristics favorable to both species. Timing restrictions on noise-generating activities would reduce potential disturbance effects to marbled murrelets and spotted owls nesting in suitable habitat blocks adjacent to proposed thinning areas. Protection and buffering of remnant suitable nesting trees within proposed units would ensure these trees are not removed or adversely impacted and that suitable habitat is not degraded or down-graded.

Endangered Species Act (ESA) Effects Determination: May Affect, but Not Likely to Adversely Affect for northern spotted owl, marbled murrelet, and their critical habitat.

Regional Forester's Sensitive Species

The following species in Table 8 are listed on the Regional Forester's Sensitive Species List (USDA 2004a). The Pacific bald eagle has been placed on the Sensitive Species List concurrent with its federal de-listing. Designation as "sensitive" means these species are given special management considerations to ensure their continued viability on National Forest lands. Mollusks designated on this list are discussed in the subsequent section.

Table 8. Regional Forester's Sensitive Wildlife Species and their potential habitat in the project area.

Common Name	Species Name	Suitable Habitat Present in Project Area	Documented Sightings in Project Area
Pacific Bald Eagle	*Haliaeetus leucocephalus*	Yes	Yes
Olympic Mazama Pocket Gopher	*Thomomys mazama melanops*	No	No
Pacific Fisher	*Martes pennanti*	Yes	No (extirpated)
Townsend's Big-Eared Bat	*Corynorhinus townsendii*	Yes	No
Van Dyke's Salamander	*Plethodon vandykei*	Yes	No
Cope's Giant Salamander	*Dicamptodon copei*	Yes	No
Olympic Torrent Salamander	*Rhyacotriton olympicus*	Yes	In watershed
Common Loon	*Gavia immer*	No	No
American Peregrine Falcon	*Falco peregrinus anatum*	Yes[16]	No

Those species that do not have suitable habitat in the project area (Olympic Mazama pocket gopher and common loon) are omitted from subsequent discussion, given that there would be no impacts to those species under any alternative.

Bald Eagle

Suitable habitat for nesting and roosting bald eagles occurs in the Dosewallips and Big Quilcene watersheds, and along Hood Canal, but is not likely in proposed units. Suitable bald eagle nesting habitat generally involves uneven-aged (multi-storied), coniferous stands with an old-growth component that are near water bodies which support an adequate food supply (USDI 1986). Wintering eagles perch on a variety of substrates with proximity to food source being perhaps the most important factor, but perches generally represent the

[16] *Potential foraging may occur due to the proximity of potential nesting habitat outside the Project Area. Peregrine falcons were not detected nesting in this habitat in 2007.*

highest sites available. Communal night roosts are located near a rich food source and offer more protection from the weather than diurnal habitat (USDI 1986).

Eagle use of proposed units is unlikely due to the general lack of nesting and roosting trees in these stands and the lack of any known prey concentrations in or near the proposed units. Any remnant trees within proposed units that have potential as nesting or roosting trees, however, would be retained under all alternatives. There is one known nest site within the project area and it is greater than 1 mile from any proposed unit or helicopter landing. Nesting activity and the presence of at least one bald eagle nestling was documented at this site during a May 2007 aerial bald eagle nest survey by the Washington Department of Fish and Wildlife (WDFW) in proximity to the Jackson project area. Prior to that survey, nesting activity had not been recorded at this site since 2002, despite monitoring by the WDFW. The May 2007 survey route included potential nesting habitat within 1 mile of any proposed unit in the project area. While other eagles and other active nests were located along Hood Canal between Brinnon and Quilcene, no active nest were located within 1 mile of any proposed unit. No eagles or nests were noted in the Mount Walker area and a paucity of suitable nesting or roosting habitat in the proposed units was noted by the WDFW eagle biologist conducting the flight (Ament 2007, personal communication.).

Reports from various incidental sightings, mid-winter bald eagle surveys in the 1990s, and winter surveys conducted in 2005 and 2006 have confirmed bald eagle occurrence in the watersheds that comprise the project area. However, there are no indications of winter roosting within the project area or within 1 mile from any proposed units. The nearest foraging areas are also greater than 1 mile away from any proposed unit. The WDFW conducted an aerial survey of the Dosewallips River in December of 2005 (Ament 2006, personal communication). No active nests were found, and the only eagles observed were located near the mouth of the river. Previous winter surveys had reported suspicions of a winter roost much further up the Dosewallips, as well as potential activity at the base of Mount Walker, toward Hood Canal. Some of this potential activity occurs slightly greater than 1 mile from the Mount Walker units. Because this is outside of the area considered for disturbance effects, these sites were not considered further. If, however, the activity centers for any of these sites were to move to within 1 mile of selected units or landing locations, then seasonal restrictions on helicopter yarding and other activities causing harassment would be enforced, depending on the distance from the site and the type of activity.

Adequate forage resources are also a critical component of bald eagle wintering and breeding habitat, especially anadromous fisheries (USDI 1986). The greatest potential for the project to affect fisheries is through effects to aquatic habitat, primarily in the form of sediment delivery to streams from road construction and log haul (See Aquatic Habitat and Fisheries section).

Funds generated from the project or other funding sources could pay for additional fisheries projects in the project area, particularly road decommissioning and in-stream enhancement work, which would indirectly benefit eagles and provide better potential nesting territories. However, as mentioned previously, due to the indeterminable nature of these funds and activities, their environmental effects are not included in this analysis.

Pacific Fisher (Martes pennanti)

The Pacific fisher, a secretive member of the weasel family, is strongly associated with forested landscape 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 to select for stands with higher overhead canopy cover due to increased security and snow-interception that it provides, as well as those with high structural complexity on the forest floor (Wier and Harestad 2003). Seasonally, fisher 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 1994b). 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 exist in Washington, and it is thought that the species is extirpated from the state (Lewis and Hayes 2004). A plan to reintroduce the fisher to the Olympic National Park has been finalized and is starting the implementation phase. The Jackson project area, with its greater proportion of "dispersal habitat" of younger, even-aged stands of forest, likely does not contain high quality habitat for use by fisher (i.e., forested stands with late-successional characteristics such as numerous snags and downed logs), at least not in the units proposed for treatment. Habitat mapped as suitable for nesting spotted owls and murrelets is more likely to contain these features, and this habitat would be retained under all alternatives. Resting and denning habitat is more limited in managed forests or those with successive fires, due to the lower expected numbers of snags and logs. Again, information on snag and down wood abundance gathered from the DecAID analysis supports this premise, especially with respect to snags or down wood in the larger size classes preferred by fisher. Jackson was not surveyed specifically for fisher and, if they are present (however unlikely), their use of the project area is not well understood at this time.

Townsend's Big-Eared Bat (Corynorhinus townsendii)

The Townsend's big-eared bat is a cave-dwelling species that will also utilize human 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 human structures or caves in the Jackson project area that would serve as likely roosts. A bridge over the Dosewallips River, upstream of the project area, was surveyed during 2005 for day-roosting big-eared bats. No bats of any species were found at this bridge. The remnant late-successional forest in the project area contains large trees and snags that could be suitable for bat roosting. Therefore, tree-roosting bats could potentially occur within the project area. But because there are few if any of these remnant trees or legacy snags in the

proposed units, especially those that have a history of intensive management, the likelihood of this bat species roosting within proposed units is much lower than surrounding areas of remnant forest.

Van Dyke's Salamander (Plethodon vandykei)

This rare salamander, generally considered the most "aquatic" of the woodland salamanders, is usually associated with seepages and streams, but 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).

Amphibian surveys on the Olympic National Forest have been sporadically conducted in conjunction with stream or fish surveys or as a specific effort. Surveys were not done specifically for this analysis. There are no mapped sightings for Van Dyke's salamander in or near the project area. Habitat, however, does exist along many of the numerous streams within the project area. Therefore, the species is assumed to be present.

Cope's Giant Salamander (Dicamptodon copei)

This species of giant salamander is found in small, steep-gradient, permanent streams with clear, cold water (Corkran and Thoms 1996). Terrestrial Cope's giant salamanders are very rare (Leonard et al. 1993), generally remaining in their aquatic larval and neotenic forms, and spending their days concealed beneath rocks or in other hidden cavities in the stream. The few terrestrial forms found were located beneath surface debris adjacent to the water.

There are no mapped sightings for Cope's Giant salamander in or near the project area. Surveys were not completed for the project area. Potential habitat exists along the steeper, colder portions of streams, particularly in the headwater areas. Therefore, the species is assumed to be present.

Olympic Torrent Salamander (Rhyacotriton olympicus)

This is the only species of torrent salamanders that is 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, seepages, or waterfalls. Seepages running through talus slopes also provide habitat. The streams and riparian forest in the project area provide habitat for this species.

Again, no surveys for amphibians were conducted for this project. However, there are several known sightings of Olympic Torrent Salamander within the Dosewallips watershed. There are no mapped sightings for Olympic Torrent salamander in the project area itself, but it is assumed to be present due to habitat availability.

American Peregrine Falcon (Falco peregrinus anatum)

The American peregrine falcon, 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 (USDI 1999). There are no documented observations within the project area or in either watershed. Peregrine falcons need cliffs or rock outcrops to nest. There is no such suitable nesting habitat in the Jackson project area, although foraging could occur within this area due to the proximity to cliffs with potential for having suitable nesting habitat approximately 1 mile from the nearest unit in the project area. Two surveys were completed per protocol standards (Pagel 1992) in 2007 at these cliffs, and peregrine falcons were not detected. Peregrines feed on a variety of smaller birds (Hays and Milner 2004), many of which could be present in the project area.

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 eagle nesting and roosting along with habitat for species such as the Townsend's big-eared bat or fisher, would not occur and would comprise the indirect impact of no action. Ongoing effects to aquatic habitat in terms of sediment delivery, as discussed in the Aquatic Habitat and Fisheries section, could still potentially impact amphibians during their aquatic phase.

Cumulative Effects

Bald eagles have been affected by previous timber harvest (habitat loss), road building, disturbance, pesticide use, as well as declining fish populations. Timber harvest on state and private lands surrounding the Jackson project area are expected to continue, and it is assumed based on past harvest practices that most areas on these ownerships will not provide suitable nesting trees (large trees with large limbs) for eagles in the near future.

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 via commercial trapping as well as loss, degradation, and fragmentation of suitable habitat (Lewis and Hayes 2004). A similar situation exists for Townsend's big-eared bat since its forested habitat includes the sloughing bark of old-growth trees and snags, which has been harvested in great quantities in the past. The No Action Alternative would not add to these historic impacts.

Alternative A

Direct and Indirect Effects

The total of about 2,313 acres that would be thinned could potentially provide eagle nest trees in the future more quickly than if the stands were left to grow at their present successional rates. Given that these stands do not currently provide likely eagle nesting or roosting habitat, the only possible direct impact would be that of disturbance. The currently active nest is greater than 1 mile from any proposed unit or helicopter landing and therefore would not experience significant, if any, disturbance due to project-related activities. In light of its de-listing, Region 6 Bald Eagle Policy and the federal Bald and Golden Eagle Protection Act continue to provide the bald eagle protection from disturbance in a similar manner. If any active nests or roosts were found to be within 1 mile of a proposed helicopter harvest unit or helicopter landing, the appropriate seasonal restrictions would be enforced to reduce the potential for disturbance. Likewise, any roosts subsequently discovered would require seasonal restrictions as well for activities that were within the harassment distance for the type of equipment used.

Indirect impacts include the increased nesting habitat potential over the long term. In general effects to anadramous fish are not expected to be substantial, and measurable effects to fisheries habitat are not expected to occur (See Aquatic Habitat and Fisheries section). Therefore, indirect impacts to the bald eagle in terms of prey populations would likely be negligible. Overall direct and indirect impacts would be expected to be negligible for the bald eagle under this alternative, with longer term benefical impacts expected.

Thinning would also assist in the development of structural characteristics needed for fisher. The loss of small diameter snag recruitment due to self-thinning mortality could be offset by skip areas and or 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 structural diversity would benefit fisher (Zielinski et al 2004) over the time frame in which fisher would likely be returned to the landscape. Shorter term impacts, which likely would not be realized given the presumed absence of fisher, would include avoidance of areas without overhead cover (Weir and Harestad 2003), including any “gaps” created during thinning. In short, while there might be short term minor impacts, long term impacts to fisher would be beneficial.

The trees that would be harvested do not provide species’ specific microhabitat 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. There could be minor, short-term disturbance impacts to any bats roosting in residual trees or legacy snags in stands to be thinned, due to harvest activities. Longer-term impacts, would more likely be positive given that thinning would promote the growth of larger trees for roosting.

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 the stream channel). This impact could include some direct mortality, but would likely be minimal in terms of effects upon the entire population. Changes in microclimate of the thinned stands could have minor impacts of Van Dyke's salamanders in the terrestrial phase. As mentioned previously, impacts to aquatic habitat through sediment delivery are expected to be minimal under all action alternatives (see Aquatic Habitat and Fisheries section). Amphibians in the aquatic phase would likely experience minimal impacts due to changes in water quality. Additionally, the mobility of aquatic-phase amphibians could be impacted by culverts at temporary road crossings during project implementation until the area returns to pre-project levels after the roads are decommissioned. This alternative would include the most new stream crossings (5), although the number of new culverts, and resulting impacts to amphibian mobility, would be minimal under all alternatives.

The Washington Department of Fish and Wildlife's management recommendations for peregrine falcons include avoiding disturbance to peregrine falcons during the breeding season (March – June), avoiding forest practices within 0.5 miles of cliffs nested by the falcons during the breeding season, and the retention of large trees and snags in winter feeding localities (Hayes and Milner 2004). The Region 6 Peregrine Falcon Policy also places rectrictions on activities within 0.5 mile of active nest cliffs and during the breeding season. All proposed thinning units are greater than 0.5 miles from the potential nesting habitat. Seasonal restrictions on activities around suitable habitat for northern spotted owl or marbled murrelet in this particular area would also serve to overlap with the falcon's nesting and breeding season and the particular area of high nesting potential. Large tree and snag retention practices would protect this element under all action alternatives though there may be low level removal of snags due to safety concerns. Given these measures, and the lack of peregrine falcon detections at potential nesting habitat, there would be no impacts to American peregrine falcons.

Cumulative Effects

Continued harvest on state and private lands around the project area will mean continued lack of large nesting trees for eagles, and mature forest for Townsend's big-eared bat and Pacific fisher (should it ever be reintroduced or return naturally to the landscape) in those areas. Thinning approximately 2,313 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. According to the Aquatic Habitat and Fisheries section, Aquatic Conservation Strategy objectives would still be achieved, and overall effects to prey populations (salmon), and therefore to the eagle, are expected to be minimal. Previous aerial fertilization on federal and private lands may have impacted amphibian species, but no aerial fertilization is proposed under any alternatives analyzed for this project.

Alternative B

Direct, Indirect, and Cumulative Effects

The effects of this alternative would be similar to Alternative A, except for a decrease (31%) in the amount of habitat enhanced for late-successional conditions. The biggest difference would be in the exclusion of the Mount Walker units, although this area is currently greater than 1 mile from any documented eagle nests or roosts. Exclusion of this area would reduce any possibility of incidental disturbance impacts to eagles flying from roosts down by saltwater to the Big Quilcene River, even though the units are greater than 1 mile from any known nest or roost. The reduction in acres could translate to a reduced potential impact on Van Dyke's salamanders for the reasons given in Alternative A. Similarly minimal impacts from sedimentation and short term reductions in mobility from road building and log haul would be expected under this alternative (see Aquatic Habitat and Fisheries section) for bald eagle prey and aquatic phase amphibians. Otherwise, the change in impacts would be small for all other sensitive species for which there is habitat present in the project area.

Alternative C

Direct, Indirect, and Cumulative Effects

The effects of this alternative would be very similar to Alternative A in terms of the amount of habitat enhanced for late-successional conditions and the risks to terrestrial Van Dyke's salamanders, except for reduced effects from roads. The substantial reduction in temporary road construction, especially those in riparian reserves, would result in fewer potential negative impacts due to water quality (see Aquatic Habitat and Fisheries section) and connectivity not mitigated through stream protection measures than Alternatives A, B, or D. This would reduce potential impacts to bald eagle prey and sensitive amphibian species in their aquatic phase. The impacts of increased use of helicopter yarding would be mitigated through seasonal restrictions in areas where nests or winter roosts are found to be within the noise harassment distance for helicopters and other equipment being used. There could still be minor incidental impacts, however, to eagles flying through these areas during project implementation from the increased levels or noise disturbance outside of these seasonally restricted periods that would not be mitigated by buffering around nests or roosts. The differences in impacts from Alternative A would otherwise be small for all other sensitive species for which there is habitat present in the project area.

Alternative D

Direct, Indirect, and Cumulative Effects

The effects of this alternative would be similar to Alternative A, except for a decrease (15%) in the amount of habitat enhanced for late-successional conditions. Potential impacts to bald eagle prey and aquatic-phase sensitive amphibians due to sedimentation potential (see Aquatic Habitat and Fisheries section) would be similar to Alternatives A and B, though short term connectivity for aquatic-phase amphibians would be maintained since there would be no new

stream crossings under this alternative. The potential for incidental harassment impacts to eagles traveling to and from nests or roosts, would be similar to Alternatives A and C. As with the other alternatives, the lack of known roosts or nests within 1 mile of proposed units and mitigations for disturbance and effects to fisheries resources makes the impacts of this alternative on eagles, as well as the differences from other alternatives, negligible. The change in impacts would be small for all other sensitive species for which there is habitat present in the project area.

Common to all Action Alternatives (Alternatives A, B, C, and D)

Due to a lack of habitat, the proposed project activities would have no impact to Mazama pocket gopher or common loon under any alternative. The distance of potential nesting habitat from proposed activities and lack of peregrine falcon detections at those cliffs, seasonal timing restrictions, overall snag and large tree retention would result in no impacts to American peregrine falcons under any alternative. Under all action alternatives, timing restrictions on noise-generating activities, thinning prescriptions, and fisheries (prey) mitigations would result in only very minimal impacts to bald eagles. The proposed activity may impact individual Pacific bald eagle, Pacific fisher, Townsend's big-eared bats, 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 the population or species.

Regional Forester's Sensitive and Survey and Manage Species – Mollusks

In January 2006, the US Western District Court determined that the March 22, 2004, Record of Decision to Remove or Modify the Survey and Manage Mitigation Measure Standards and Guidelines in Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl was to be set aside, and the January 2001 Record of Decision and Standards and Guidelines for Amendments to the Survey and Manage, Protection Buffer, and other Mitigation Measure Standards and Guidelines was to be reinstated including any amendments or modifications to the 2001 Record of Decision that were in effect as of March 21, 2004. In cases where Survey and Manage species are also on the Regional Forester's sensitive species list, the more stringent survey and manage requirements apply.

On October 11, 2006, in the matter of Northwest Ecosystems Alliance, et al. v Mark E. Rey, et al. (Case No. C04-844-P), the Court approved a stipulation that exempted the need for pre-disturbance "survey and manage" surveys for thinning projects in stands younger than 80 years old. The only proposed thinning units greater than 80 years old in this project area that would potentially be subject to the survey requirement are Units 20-24 (Mount Walker units). In addition, for those units subject to survey requirements, mollusk surveys are not required for projects "which affect suitable habitat elements but are dispersed through a project area so that less than 5% of those habitat components in the project area are negatively affected" (Duncan et al. 2003; p.10). Survey and manage mollusk surveys for units 20-24 were completed in April and May 2007, to protocol standards (Duncan et al. 2003).

As noted in Table 9, a number of the survey & manage mollusks are also designated as Sensitive species, and the alternatives will be evaluated for both sensitive and survey and manage mollusks, as appropriate.

Sensitive and Survey and Manage Species that were identified as having potential habitat in the proposed project area are disclosed below, as well as in the botany section.

Table 9. Sensitive and Survey and Manage Mollusks with potential habitat in the project area.

Common Name	Species Name	Status[17]	Suitable Habitat Present in Project Area	Documented Sightings in Project Area
Puget Oregonian (snail)	*Cryptomastix devia*	Survey & Manage Category A; R6 Sensitive	Yes	No
Hoko Vertigo (snail)	*Vertigo n. sp.*	Survey & Manage Category A; R6 Sensitive	N/A[18]	No
Blue-gray Taildropper Slug	*Prophysaon coeruleum*	Survey & Manage Category A; R6 Sensitive	Yes	No
Evening Fieldslug	*Deroceras hesperium*	Survey & Manage Category B3; R6 Sensitive	Yes	No
Malone's Jumping Slug	*Hemphillia malonei*	Survey and Manage Category C; R6 Sensitive	Yes	No
Warty Jumping Slug	*Hemphillia glandulosa*	Removed from Survey & Manage list; R6 Sensitive	Yes	Yes
Burrington's Jumping Slug	*Hemphillia burringtoni*	Survey and Manage Category E; R6 Sensitive	Yes	No

Of the mollusks listed as Regional Forester's Sensitive and/or on the Survey and Manage species, a number of species were identified as having potential habitat and a known

[17] *Survey & Manage Category A – Rare. Manage all known sites. Survey prior to ground-disturbing activities.*
Survey & Manage Category B – Rare. Manage all known sites. Pre-disturbance surveys not practical.
Survey & Manage Category C – Uncommon. Predisturbance surveys practical.
Survey & Manage Category E – Rare. Manage all known sites. Status undetermined.

[18] *The Jackson project area is outside the range of the Hoko vertigo snail, according to the 2003 survey protocol*

distribution that could include the proposed project area (see Table 9). The project area is outside of the documented range of occurrence of the Hoko Vertigo snail.

The Puget Oregonian snail (*Cryptomastix devia)* is associated with hardwood shrubs and trees. It's occurrence on the Olympic National Forest is based on one shell found on the Hood Canal Ranger District. Despite extensive surveys across the Olympic National Forest, no other shells nor live animals have been discovered (J. Ziegltrum 2006, pers. comm.). 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. As stated above, since less than 5% of habitat components in the project area would be effected (due to prescriptive measures protecting hardwoods), pre-disturbance surveys were not required for this species (Duncan et al. 2003). However, surveys conducted in Units 20-24 in 2007 for the other species did include habitat elements of the Puget Oregonian snail (bigleaf maple and vine maple). This species was not detected during the surveys.

The Malone's jumping slug (*Hemphillia malonei*) occurs in moist forested habitats, generally over 50 years old with greater than 50% 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 2006, pers. comm.). 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. However, since potentially suitable habitat does occur in Units 20-24, pre-disturbance surveys were required. This species was not detected during either of the two required pre-disturbance surveys in Units 20-24 in 2007.

The evening fieldslug (*Deroceras hesperium*) is reported to be associated with wet meadows in forested habitats and moist surface vegetation within close proximity to perennial wetlands, springs, seeps, and riparian areas (Duncan et al. 2003). Habitat for this species is present and the project area is within the reported range of these species. Project activities will generally not occur in these habitats, especially with respect to units 20-24. In addition, this species has not been found on the Olympic National Forest despite extensive surveys in similar habitats (J. Ziegltrum 2006, pers. comm.), making its presence in the project area highly unlikely. Since mollusk surveys were conducted in Units 20-24 for other species, this species was surveyed. This species was not detected in either of two pre-disturbance surveys in Units 20-24 in 2007.

The blue-gray taildropper slug (*Prophysaon coeruleum*) 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 2006, pers. comm.), making its presence in the project area highly unlikely. Additionally,

prescriptive measures under all alternatives will protect the hardwood elements. However, because portions of potential habitat could be affected in Units 20-24, pre-disturbance surveys were required. This species was not detected during either of the two required pre-disturbance surveys in Units 20-24 in 2007.

The warty jumping slug (*Hemphillia glandulosa*) and the Burrington's jumping slug (*Hemphillia burringtoni*) are locally common and abundant on the Olympic National Forest (Ziegltrum 2001 and Ziegltrum 2004), and occur in moist conifer forest. The warty jumping slug was removed from the survey & manage list for the Olympic Province during the 2001 Annual Species Review, and there are no survey requirements for this species. Also, the Burrington jumping slug is designated as Category E from the survey & manage program, and there are no pre-disturbance survey requirements for Category E species. Nonetheless, the warty jumping slug was detected in Units 20-24 during the pre-disturbance surveys for the other species. Previous to these detections, there were no known sites for either of these two species in the project area, though there was a likely presence due to available habitat and documentation in nearby watersheds. It should be noted that Burrington's and warty jumping slug are no longer considered distinct species, but rather species complexes (Wilke 2004).

No Action Alternative

Direct and Indirect Effects

There would not be any direct effects to any of the mollusk species likely found in the project area under the No Action Alternative. Given that these species seem to be associated with hardwood or mixed conifer-hardwood forests, there would be no indirect negative effects from not developing late-succession habitat because these species are not dependent on this habitat type.

Cumulative Effects

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

Alternative A

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. Duncan et al. (2003) state that in cases where habitat elements being used by a particular species are being negatively affected by a project, significant 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 shrub and ground cover species diversity,

along with the aforementioned measures, 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 a previous section, there may be some short term impacts to fungi associated with thinning operations.

The project area is outside of the documented range of occurrence of the Hoko Vertigo snail. Therefore, they would not be expected to occur and there would be no impact to this species under any alternative.

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, and none were detected during surveys. Therefore, there would be negligible direct or indirect effects to Puget Oregonian snails.

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. This species' status as Survey and Manage Category B would require management of all known sites (USDA and USDI 2001). Previous surveys on the forest, and the two required surveys for Units 20-24 of this project, have not identified any sites and indicate its presence to be highly unlikely in units 20-24 or elsewhere 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.

Silvicultural prescriptions and riparian and aquatic conservations measures will minimize activities within the wet meadows, perennial wetlands, springs, seeps and riparian areas which should reduce potential impacts to the evening fieldslug. Temporary road construction will not occur in riparian areas in Units 20-24. This species' status as Survey and Manage Category A would require management of all known sites (USDA and USDI 2001). Information from previous surveys on the forest, and the two surveys in units 20-24 for this project, have not identified any sites, and indicates that its presence in the project area, and specifically in units 20-24, would be highly unlikely. Therefore, while the proposed activity may impact individual evening fieldslugs, 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. This species status as Survey and Manage Category A would require management of all known sites (USDA and USDI 2001). Information from previous surveys on the forest, and the two required surveys in Units 20-24, indicates that the presence of the blue-gray taildropper in Units 20-24, or elsewhere in the project area, would 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 would be no risk to species viability or a trend toward federal listing.

Cumulative Effects

The effects of 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 Jackson thinning units, and the associated short-term disturbance, may impact certain individuals. Given the large amount of habitat in this size and age category in the subwatersheds affected (outside the project units) and the project's short-term effects to mollusks, however, the incremental impact of this project would be minimal when taking into account available habitat, as well as other past, present and future activities in the affected watersheds.

Alternative B

Direct, Indirect, and Cumulative Effects

The effects of this alternative would be very similar to Alternative A, except for the benefits from a decrease (31% fewer) in the amount of habitat potentially altered for mollusk species, mainly the Burrington's jumping slug and the warty jumping slug.

Alternative C

Direct, Indirect, and Cumulative Effects

The effects with this alternative would be very similar to Alternative A, because of the same numbers of acres treated (2,313) and, therefore, the same amount of habitat potentially altered for mollusk species. The substantial reduction in temporary road construction, however, would offer benefits to these species by reducing the amount of ground disturbance and vehicle traffic.

Alternative D

Direct, Indirect, and Cumulative Effects

The general direct, indirect and cumulative effects with this alternative would be very similar to Alternative A. The reduction in the numbers of acres treated and therefore the reduced amount of habitat potentially altered for mollusk species would reduce potential impacts to these species when compared to Alternatives A or C.

Common to all Action Alternatives (Alternatives A, B, C, and D)

Sensitive Species Determination: Because the project area is outside of its range, the proposed activities would not impact the Hoko Vertigo snail. Because of hardwood protection guidelines 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, and the evening fieldslug, 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, but would not likely contribute to a trend towards federal listing or cause a loss of viability to the population or species.

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 following species were identified as MIS for the Olympic National Forest (USDA 1990a):

Table 10. Forest Management Indicator Species.

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*	*Strix occidentalis caurina*	Mature forest stands	Yes	Yes
Pileated Woodpecker	*Dryocopus pileatus*	Mature coniferous forest	Yes	Yes (foraging sign)
Primary Cavity Excavators	*Various*	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
Columbia Black-tailed Deer	*Odocoileus hemionus*	Balance of cover and forage habitats; amount of vehicle disturbance	Yes	Yes

**Bald eagle and northern spotted owl were discussed in previous sections and, therefore, will not be discussed below.*

Pileated woodpecker, Primary Cavity Excavators, and American Marten

The pileated woodpecker (*Dryocopus pileatus*), the largest woodpecker species in the western United States, is a denizen of mature forests, relying on dead and decaying trees for foraging and nesting. It is said to be a keystone habitat modifier due to its role in creating foraging and nesting opportunities for other species and for facilitating other processes associated with decadence (Aubry and Raley 2002a). Pileated woodpeckers on the Olympic Peninsula have been reported nesting in trees that average 40 inches in diameter (range 26-61 inches dbh) and roosting in trees that average 60 inches in diameter (range 15-122 inches dbh) (Aubry and Raley 2002b). Pileated woodpeckers will return to areas after timber harvesting (Ehrlich et al. 1988), but past management in the Pacific Northwest has led to relatively few snags and down logs, especially of large diameters, remaining in many watersheds. Previous timber harvest, as opposed to wildfire events, has had the greatest effect in the Rocky Brook and Spencer-Marple Creek portion of the project area. Conversely, two successive fires are likely responsible for the low numbers of legacy snags in the Mount Walker portion of the project area.

"Primary cavity excavators" comprise a broad group of species associated with standing dead trees or snags and down logs that excavate their own cavities. Examples include the pileated

woodpecker, hairy woodpecker (*Picoides villosus*), downy woodpecker (*Picoides pubescens*), and the red-breasted nuthatch (*Sitta canadensis*). A variety of secondary cavity users such as the northern spotted owl, American marten (*Martes Americana),* northern flying squirrel, various chickadee species and others use the dead or hollow portions of live trees that are created by the primary cavity excavators. This makes the role of the primary cavity excavator particularly important.

The American marten, also known as the pine marten, is most closely associated with heavily forested east and north-facing slopes that contain numerous windfallen trees (Maser 1998). They tend to avoid areas that lack overhead protection, and the young are born in nests within hollow trees, stumps, or logs. According to a Washington Department of Fish & Wildlife study (Sheets 1993), which combined trapper interviews with remote camera surveys in various locations on the Peninsula, it was concluded that marten may only be found within the Olympic National Park, surrounding wilderness areas, and unfragmented mature timber adjacent to the park. National Forest land, in general, may be too fragmented to support a population.

It is possible that marten exist within the project area. If so, it would be more likely that they would occur in remnant old-growth or mature stands that would not be treated rather than the much younger and more simplified stands proposed for thinning.

There have not been formal surveys for any of these species. The habitat components these species require would likely be found in remnant forests in the project area or in the scattered legacy snags and down logs that are found in low numbers, if at all, in the proposed units. Therefore, the majority of these species are believed to be present in the project area. Foraging excavations of pileated woodpecker and other woodpeckers have been noted in the project area and on legacy snags in several units. A pileated wood pecker was also observed flying from Unit 1 into the adjacent portion of Unit 6. There have been no documented sightings of marten within the project area. However, the Washington Department of Fish and Wildlife database has record of a live marten observation near Highway 101 toward the mouth of Marple Creek in 1987. Therefore, it is probable that individuals are using the project area for foraging, and likely nesting or denning in remnant old-growth as well.

As previously mentioned, local information combined with the DecAID analysis found low levels of larger diameter snags and a low percentage cover of down wood across all three subwatershed to some extent, including units on Mt. Walker. The low levels of larger snags and larger coarse woody debris and greater abundance of small diameter snags across these subwatersheds are likely the result of intensive management and fire history.

The 30% tolerance levels for snag size are likely being met under current conditions, although marginally so for species such as northern flying squirrel, brown creeper, and red-breasted nuthatch when considering that the estimated levels in the managed stands are likely much lower than remnant, unharvested stands. The 30% tolerance level, and perhaps even the 50% level across certain areas are likely being met for snags used for foraging by pileated woodpecker and hairy woodpecker, while not necessarily meeting that minimum tolerance for nesting, resting or roosting uses. The 30% tolerance level for snag density in the smallest size

class is likely being met, at across the relevant subwatersheds as a whole, for species such as northern flying squirrels. Tolerance levels for densities of snags greater than 20" dbh may be met for various bat species at the 30% and even 50% levels across a larger proportion of the 3 subwatersheds because these species require a relatively low number of these larger snags per acre. But, tolerance levels for the density of larger snags is probably not being met for other species, except perhaps at the 30% tolerance level, when looking at all three subwatersheds as a whole.

Roosevelt Elk (Cervus Canadensis roosevelti) and Columbia Black-tailed Deer (Odocoileus hemionus)

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 2004). Deer occur throughout the watersheds associate with the project area. Both species use a combination of habitats comprised of cover, forage, water, and space and are susceptible to disturbance or direct mortality associated with vehicle access.

The Olympic National Forest LRMP requires that 20% of the area necessary for winter survival be managed as optimal cover (USDA 1990a). Only a portion of the Jackson project area is considered potential elk and deer winter range. Winter range for deer and elk on the east 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, Taber and Raedeke 1980b). Eight of the proposed units are at least partially below 1,500 feet elevation and have southerly aspects more favorable for winter use. Optimal cover has understory and overstory components which provide forage as well as snow-intercepting canopy to allow more forage to be available. These criteria are generally achieved when dominant trees average 21 inches in diameter or greater, there is 70% or greater canopy closure, and the stand is predominantly in the large sawtimber condition (USDA 1990a). Remnant forest being maintained for suitable NSO and MAMU habitat may also function as optimal cover. Likewise, activities intended to develop late-successional conditions should also help to develop optimal cover for deer and elk. In the short term, thinned areas, especially the more open "gaps," would likely develop more understory that could be available as forage. Currently those stands probably function primarily as hiding cover, or potentially as thermal cover. Preferred forage areas are in natural openings or managed stands less than 30 years old. Aside from private lands adjacent and near the project area, there are few areas within the project vicinity that were harvested this recently. 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. Elk reproductive rates and survival are also influenced by home range quality and nutrition (Cook et al. 2004, Hutchins 2006).

Winter mortality, legal harvest, and poaching were reported as primary causes of elk and deer mortality in Washington (Taber and Raedeke 1980a, 1980b, Bender et al. 2004). Poaching of elk is believed to be prevalent on the Olympic Peninsula (WDFW 2004). A high density of roads, such as those common throughout much of the Peninsula, can have a negative impact on elk with increased disturbance from legal hunting and poaching (CEMG 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. The Washington Department of Fish and Wildlife (1996) recommends that road densities be kept below 1.5 mi/mi^2 mile in elk summer/fall range and below 1.0 mi/mi^2 mile in winter/spring range. Neither the Rocky Brook, Jackson Marple or Turner creek areas that are included in the Jackson project area meet these recommendations.

The group of elk using the Jackson project area is a relatively small and isolated group associated with the Dosewallips watershed (WDFW 2004). This group of elk remained at low levels in the early through mid 1990s, but hunting closures and the relocation of 17 elk from another herd have helped to increase the herd. A group of forty or more elk have been observed in the lower Dosewallips valley in recent years (Ament 2006, personal communications) with more animals suspected in the drainage, and limited hunting has resumed. Since the relocation, a number of the elk have remained in the lower watershed most of the year while the remainder of the group has continued to migrate into Olympic National Park in the summer months.

Because of low elk numbers in this general area, both watershed analyses stopped short of recommending habitat enhancement efforts directed solely at elk habitat enhancement (USDA and WDNR 1994, USDA 1999). However, both documents did offer opportunities that could be taken to enhance elk habitat in concert with other habitat improvement-related projects.

No Action Alternative

Direct and Indirect Effects

There would not be any 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 units would also be foregone.

Cumulative Effects

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

Alternative A

Direct and Indirect Effects

Thinning the proposed stands may have short term negative impacts from disturbance on foraging pileated woodpeckers and other primary cavity excavators due to short term losses of smaller snags that would otherwise have been created through self-thinning mortality in overly dense stands. However, the long-term, more indirect, beneficial impacts would be improved habitat, especially with regards to the size of future snags from increased tree growth and snag and down wood habitat that can be enhanced through additional funding from sources such as timber sale receipts (e.g., snag creation, coarse woody debris placement). Snags and down wood would not be removed in the thinning prescriptions except for safety reasons. Skip areas would also provide a means to buffer existing snags and allow for some natural morality to occur as well.

Benefits to deer and elk would include about 2,313 acres of enhanced habitat that would likely provide more understory forage in the short term than it presently does, and also develop more rapidly to a condition of optimal cover. This alternative would involve the treatment and expected enhancement of approximately 521 acres below 1,500 feet elevation, of which approximately 309 acres would be in the Rocky Brook area, closest to the area the elk are currently using. This could be a positive impact for Dosewallips elk and deer using the project area. The acres treated below 1,500 feet in the Rocky Brook area would be most relevant to the elk herd wintering in the lower Dosewallips watershed.

The inclusion of Unit 21 under this alternative offers forage benefits by creating forage under cover adjacent to an area of newly harvested forest on adjacent private land that could complement the thinned stands with added forage. However, the proximity to Highway 101, and related disturbance effects, could reduce the potential benefits of increased forage. There is also the potential for invasive weed encroachment in this area, but mitigation measures and potential, additionally funded opportunities would reduce this concern (see Botanical Resources section).

Temporary road construction would add to road densities in the short term, with proportionately greater impacts expected from road construction or reconstruction in potential riparian corridors. In the long term, decommissioning new temporary and unclassified, abandoned roads along with the potential decommissioning of additional forest system road would also benefit deer and elk by reducing disturbance from vehicle and human access. This would be especially important given that road densities in the Rocky Brook, Jackson-Marple, and Spencer Creek areas are currently above levels recommended for deer and elk. In the short term, seeding with road beds palatable forage species for erosion control following the decommissioning efforts could also provide additional forage.

Cumulative Effects

Historic timber harvest and road building have had the greatest impact on management indicator species. Aerial fertilization, commercial thinning, and pre-commercial thinning in the

project area in the past likely benefited elk and deer. Increasing the complexity of the Jackson proposed stands would be of benefit to all MIS species in terms of accelerating late-successional habitats. Benefits to deer and elk would also include forage enhancement and decreased road density.

Alternative B

Direct, Indirect, and Cumulative Effects

For the pileated woodpecker, primary cavity excavators, and the American marten, the general effects associated of this alternative would be similar to Alternative A other than a decrease (31%) in the amount of habitat enhanced.

For elk and deer, the general direct, indirect, and cumulative effects of this alternative would be similar to Alternative A other than a decrease (31%) in the amount of habitat enhanced for short term forage and optimal cover in the long term. Under this alternative, there would be markedly fewer acres treated below 1,500 feet elevation. The more functionally important acres below 1,500 feet elevation are located in the Rocky Brook Creek area, and the majority would remain as part of this alternative. The miles of temporary road construction would decrease only slightly under this alternative, meaning similar potential impacts to travel and potential for disturbance, especially given the currently elevated road densities in the project area. Although this alternative treats fewer acres, the acres dropped include areas in the lower part of Mt. Walker that would likely provide limited forage benefits to elk and deer because of its proximity to Highway 101.

Alternative C

Direct, Indirect, and Cumulative Effects

For the pileated woodpecker, primary cavity excavators, and the American marten, the general effects with this alternative would be similar to Alternative A. The amount of habitat enhanced would be the same.

For deer and elk the benefits of thinning would be the same as Alternative A, with the added benefit of markedly less temporary road construction. The number of acres below 1,500 feet that would be thinned would be the same as Alternative A. The concerns regarding the potential response of understory or invasive species would be the same as given under Alternative A.

Alternative D

Direct, Indirect, and Cumulative Effects

For the pileated woodpecker, primary cavity excavators, and the American marten, the general effects of this alternative would be similar to the other alternatives, with a mid-range of acres treated. Effects from temporary road construction would be similar to Alternative B.

Benefits to elk and deer would be a mid-range value of acres of enhanced forage and developed optimal cover. The acres treated in Rocky Brook would be the same as Alternative B. This alternative would treat more total acres below 1,500 feet than Alternative B, though less than Alternative A or C. Although this alternative treats fewer acres, a portion of the acres dropped included those that could provide limited benefits to elk. Effects to deer and elk from temporary road construction would be similar to Alternative B under this alternative.

Common to all Action Alternatives (Alternatives A, B, C, and D)

Direct, Indirect, and Cumulative Effects

As mentioned previously, although snags of all sizes can be found throughout the project area, in general, the numbers of larger-sized snags and down logs are low. However, project activities would likely serve to protect and enhance rather than degrade existing snag and down wood conditions. Road densities are currently above recommended levels in all three subwatersheds, and though they would increase temporarily with temporary road construction, those roads would be removed after project activities are completed.

Forest Landbirds

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 (USFWS). Pursuant to EO 13186 the Forest Service entered into a Memorandum of Understanding with the USFWS 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 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 (*Accipter gentilis*), chestnut-backed chickadee (*Poecile rufescens*), red-breasted sapsucker (*Sphyrapicus ruber*), and hermit warbler (*Dendroica occidentalis*). The project area provides habitat to the species mentioned above. 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 significant recent declines (1980-1996) or long-term (1966-1996) declining trends based on breeding bird surveys, while 12 species have seen significantly 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 are of particular importance as a key habitat for some breeding neotropical and winter resident songbirds, can be an important predictor of bird species richness (Hagar et al. 1996), and were identified as being limited in both watershed analyses pertaining to this project area. Though not particularly common in the project area, there are small pockets of hardwood stands and mixed hardwood/conifer stands scattered primarily throughout the Rocky Brook portion of the Jackson project area, some of which fall within proposed units. Although there have been no surveys conducted specifically for forest landbirds in Jackson, a variety of species are likely to occupy the project area.

For species such as chickadees that rely on snags for nesting, this resource is somewhat limited in the proposed units and across the three subwatershed as a whole, as described in the DecAID analysis. Especially limited are the larger size classes. A variety of studies given in DecAID found chestnut-backed chickadee nests in snags averaging 30 inches in diameter or more. Based on information gathered during this analysis, few of the proposed units meet this description. However, the 30% tolerance levels for snag size are likely being met under current conditions, though marginally so, for species such as the brown creeper, when considering that the levels in the managed stands that were estimated are likely much lower than remnant, unharvested stands.

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. Similar to the mollusks, many forest birds are, particularly during the breeding periods, 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. Habitat adjacent to abrupt edges in units bounded by non-Forest Service lands would not be thinned.

Cumulative Effects

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

Alternative A

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 have been found 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. All such changes would all be indirect effects from the habitat manipulation. There may be some direct effects in terms of mortality of nests or chicks from harvest operations and possibly adults. It is likely this mortality would be minimal, except perhaps around temporary road construction due to the impacts to ground nesters such as the dark-eyed junco. Indirect effects of road construction in riparian reserves would likely have greater negative effects on neotropical birds from habitat impacts due to the overall importance of riparian habitats on migratory birds. Additionally, as mentioned in an earlier section, increases in predator numbers or hunting efficiency can potentially offset positive impacts of thinning.

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 all action alternatives. It should be noted, though, that Hagar et al. (1996) found no significant differences in winter bird densities between thinned and unthinned stands and only marginally greater species richness in thinned stands.

Hardwood clumps and individual trees would be protected under all alternatives, 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 in treated root-rot gaps would also be beneficial to these species (under all action alternatives). 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. This is consistent with the proposal to leave unthinned “skip” areas in units under all action alternatives.

Concerns regarding potential edge effects (nest predation) in units bounded by non-National Forest lands, however, would be similar to those described for marbled murrelets.

Cumulative Effects

In other ownerships around the project boundary, it is likely that conifer and hardwood habitat will be harvested, depending on market conditions, limiting the potential of these 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.

Alternative B

Direct, Indirect, and Cumulative Effects

The effects of this alternative would be very similar to Alternative B, with a decrease (31%) in the amount of habitat potentially altered for forest landbird species. The habitat effects associated with road construction would be only slightly less than Alternative A. Dropping units with abrupt habitat edges could reduce the attractiveness of habitat where higher rates of nest predation may be incurred and would reduce potential impacts to neotropical migrants and other landbirds under this alternative.

Alternative C

Direct, Indirect, and Cumulative Effects

The general effects of thinning on migratory birds would be similar to Alternative A, given that the same number of acres would be treated. However, effects related to road construction would be markedly less than Alternatives A, B and D under this alternative. This would reduce potential impacts to species susceptible to habitat removal in riparian areas.

Alternative D

Direct, Indirect, and Cumulative Effects

As with other species, this alternative is likely to result in beneficial and negative effects that are intermediate between Alternatives A, B, and C in terms of acres thinned. Effects from road construction would be most similar to Alternative B. Dropping Units 6 and 21 would mean not accelerating the structural development of habitat and attracting birds to those areas where abrupt edges are likely to occur, thereby potentially reducing future potential for nest predation. As with Alternative B, this would reduce potential impacts to neotropical migrants.

Soils

The Olympic National Forest Ecological Unit Inventory, or EUI (USDA 2000b) was used to determine effects on the soil and water resources and evaluate the capabilities of soil for various uses. Field reconnaissance and surveys were completed to verify conditions such as existing soil disturbance, observations and surveys of historic management effects to the soil, effective ground cover (by field survey), and soil erosion potential.

The definitions and categories for detrimental soil impacts were based on Forest Service regional guidelines in Forest Service Manual 2500, Region 6 Supplement 98-1 (1998).

Slope Stability

The term stability generally applies to geologic or bedrock stability. In this case it applies to surface or soil movement. The harvest units in the Jackson Project Area are located primarily on moderately steep (35 to 60%) to steep (60 to 80%) slopes. The Dosewallips (USDA, 1999), Big Quilcene (USDA, 1994), and Hamma Hamma/Hood Canal Tributary (USDA, 1997) watershed analyses identifies and describes areas of slope instability within the planning area. These analyses and field investigations have determined little recent evidence of slope instability within the general project planning area. Within the planning area, unstable terrains are primarily concentrated on steep “inner gorges,” convergent headwalls, bedrock hollows and steep 1st order channels. Historic slope failures (debris slides, debris flows, torrents) within the planning area were either the result of natural slope instability, with some failures the result of clearcut logging and road-related activities. Mapped historic failures were primarily shallow rapid landsliding that were associated with both natural and management-related sources. Triggers of these landslides generally are slopes greater than 70%, concave slope shape, inner gorge and headwall areas with seeps and springs. Loss of root strength due to extensive timber stand removal and “stacked” roads and stream intersections are historically where management-related landsliding has occurred. Based on the landslide inventory conducted for the watershed analyses, historic landsliding occurred in only a few geomorphic landform types that are found in the planning area. These are GMU 77 (converging headwater drainage areas), 78 (debris tracks), and escarpments (60 - Fluvial Depositional). The most active of these landforms in the Jackson Project Area in the last one hundred years are GMU 77 and 78. Recent intense rainstorms over the last 10 years, however, have not produced additional slope failures within any of the proposed units on these or other landforms.

Suitability

All of the proposed harvest units in the Jackson project area are considered suitable for timber management as defined by the Olympic Forest Plan. Areas unsuitable for timber management would include areas with high slope instability, wet areas, and soils that are excessively shallow and rocky. All identified areas with these unsuitable soils of significant acreage were not considered for thinning. There are some small seeps, wet areas and rock outcrops that are too small to delineate. These areas would be excluded from thinning in the project design criteria.

Soil Productivity

Impacts to soil productivity may be measured by the percent detrimental soil condition for each activity area. Forest Plan Standards and Guidelines stipulate that detrimental soil conditions should not exceed 20% of the total acreage within the timber sale activity area, including landings and system roads (USDA 1990b). If detrimental conditions are 20% or more of the activity area, restoration treatments should be implemented. Detrimental soil conditions include, but are not limited to compaction, puddling, displacement, and severely burned soil.

Generally, soils in the planning area are shallow to moderately deep, weakly structured, well drained, gravelly, medium-textured, that are derived from basalt, or overlain by glacial till deposits. The majority of soils that are found within the proposed harvest units have moderate to moderately low productivity. Historic wildfires has affected these forest soils, reducing organic matter content, increasing surface erosion, and caused a slight reduction in potential soil fertility.

Management activities associated with the proposed action have the potential to result in direct and indirect effects upon the soil resource. Direct and indirect effects may include alterations to physical, chemical, and biological properties of soil. Physical properties of concern include structure, density, porosity, infiltration, permeability, water holding capacity, and depth to water table, surface horizon thickness, and organic matter size, quantity, and distribution. Chemical properties include changes in nutrient cycling and availability. Biological concerns commonly include the abundance, distribution, and productivity of the many plants and animals that live in and on the soil and in the organic detritus on the soil surface.

Processes known to cause the greatest adverse effects on soil physical, chemical and biological properties include soil compaction, displacement, puddling, burning, erosion, and mass wasting. Direct effects of management activities commonly include compaction, displacement, puddling, and burning. Definitions of the detrimental soil conditions can be found in the Forest–wide Standards and Guidelines (USDA 1990a) and the Forest Service Manual, R-6 Supplement No. 2500.98-1 (USDA 1998). Erosion, mass wasting, and changes in water table, organic detritus recruitment, fertility and soil biology usually occur as indirect effects. Microbial populations and nitrogen fixation by free-living organisms (mycorrhizal fungi) are decreased in compacted soils, resulting in decreases in nutrient cycling. Compacted areas also restrict root growth, resulting in an overall loss of vigor and increased susceptibility to wind-throw. Roads and historic log landings and rock source areas are considered a part of the activity area when they are adjacent to the management unit. The detrimental soil conditions for skyline and helicopter harvest systems are discussed in the literature, such as Klock (1975), Aulerich et al. (1974) and Power (1974). These studies have shown that skyline-yarding systems cause little impact to soil. Additionally, skyline-yarding systems substantially reduce the need for new roads in units. Helicopter yarding lifts the logs vertically from the unit, thereby minimizing soil disturbance. Based on past observations, helicopter-yarding effects on soil productivity are expected to be less than skyline yarding. Impacts from ground based yarding and landings are both an estimate based on a

preliminary logging plan and professional judgment of a logging system specialist, timber sale officer, and soil scientists.

The percentage of each unit in a detrimental soil condition was determined through aerial photo interpretation and field reconnaissance. Detrimental condition varies from stand to stand due to the occurrence, manner, and extent of past timber harvest, road construction and fuel treatment activities and the sensitivity of soils. The majority of the Jackson units proposed for thinning are plantations that were previously harvested 40 to 70 years ago. Units 20, 21, 22, 23, 24 and portions of Unit 6 are stands that developed from past fires, rather than previous clearcutting and replanting. Calculated acres of detrimental soil conditions are shown under each alternative.

Approximately 4.5% of the acreage proposed for thinning in the Jackson planning area is in a detrimental soil condition. Roads in planning area are the primary detrimental soil condition that has occurred from past management activities.

No Action Alternative

This alternative would not commercially thin any forest stands or have any road development, reconstruction or decommissioning and closure work associated with the project.

DIRECT AND INDIRECT EFFECTS

Slope Stability

The No Action Alternative would not change existing slope stability in stands proposed for commercial thinning since no thinning or road development activities would occur. As described in the Affected Environment Section, the Jackson Planning Area overall is comprised of stable landforms, and no recent (<10 years) landslide features has been observed through aerial photo interpretation and field reconnaissance.

Soil Productivity

This alternative creates no new adverse effects on soil resources in the planning area. Some opportunities to address existing compaction from past harvest operations may be foregone under this alternative.

Detrimental soil conditions would remain unchanged, at 4.5% for the project area. Soil impacts from past activities would continue to slowly decline as soils continue to develop and recover through natural physical and biological processes. Compaction and displacement would be ameliorated through root mass expansion, ground cover, organic matter, and litter layer development. Soil fauna and microbe activity would also gradually recover. Coarse woody debris numbers are not expected to increase over natural levels. As un-thinned stands age, trees would eventually fall over in a natural thinning process. Understory trees would develop slowly and only where mortality of the overstory creates growing space. In the absence of natural large scale disturbances, these stands would eventually produce large trees

and large down logs. The time period for this to occur would be much longer than under the action alternatives.

CUMULATIVE EFFECTS

The cumulative watershed effects in the planning area include the Dosewallips River, Upper West Hood Canal Frontal, and Big Quilcene River watersheds. The positive and negative effects include a combination of the management actions that occur on private, State, and National Forest lands, along with natural occurrences. The trend for management actions on National Forest land is to improve the aquatic conditions.

The Big Quilcene, Dosewallips, and Hamma Hamma/Hood Canal Tributaries watershed analyses identified and described the negative effects of erosion, sedimentation, loss of soil productivity and impacts to aquatic habitat conditions from past timber harvest practices and roads. The subwatersheds within the planning area are currently recovering from these past effects. Road restoration activities, however, have also occurred on National Forest lands within the Big Quilcene and Dosewallips watersheds over the last 10 years. About 15.0 miles of road decommissioning has been completed, and about 10 miles of drainage and stabilization work has been done.

Foreseeable activities on National Forest System lands within the watersheds include two miles and three miles of existing roads that are planned to be decommissioned in the Dosewallips and Big Quilcene, respectively, on National Forest lands within the next several years. Also within these two watersheds, rehabilitation of riparian dispersed campsites is planned. Other foreseeable activities on National Forest lands across all watersheds include dispersed recreation and repair and maintenance of the road network.

Ongoing activities on state and private lands include, but are not limited to the following: planned timber harvesting and road construction; large woody debris removal; and the conversion of floodplain to pasture lands and residential development. Regeneration harvest, road construction, and log hauling is occurring and also planned on State and private lands within all subwatersheds. Regeneration and seed-tree harvesting is the more common harvest method on these lands. The extent of acreage treated, and miles of road constructed and reconstructed on state and private lands is difficult to estimate, but it is assumed that these land managers will continue with an even-flow harvest strategy. These landowners, however, routinely close (berms or gates) short local spurs when they are not needed for harvest activities, preventing unauthorized motorized vehicle access.

Given there would be no change from the existing condition, there would be no cumulative effects from this alternative.

Alternative A

Alternative A proposes the greatest amount of activity, and as a result, has the greatest potential of any Action Alternative to affect soil productivity and slope instability.

DIRECT AND INDIRECT EFFECTS

Slope Stability

Based on observations of past commercial thinning tree removal and other logging practices, the environmental consequences of typical thinning operations, and local data collected on similar soils and landforms, there is no evidence to indicate that commercial thinning (30% to 50% tree removal) of second growth stands increases failure risk of instability. Several small (less than 0.1 acre), shallow rapid landslides were observed during the field reconnaissance. Located within Unit 11 and 18, these failures occurred in the early-1990s and are associated primarily with road construction and maintenance activities on FS 2620-030 road. These and other observed slope failures identified through aerial photographs have since stabilized.

Harvest units that have been determined to pose slope instability concerns based on GMUs are 1, 2, 7, 8, 11, 16, and 18. Stability concerns with potential tree harvesting and road construction within the planning area, however, are addressed primarily through unit design, and Riparian Reserve no-cut buffer prescriptions (see Project Design Criteria). Application of these project design features address the concerns of potential slope instability within units associated with proposed treatments.

The risk of increasing slope instability for Alternative A associated with thinning would be low. This is due to thinning occurring mostly on stable landforms, the nature of the thinning prescription, the delineation of the unit boundaries, and the riparian no-cut buffers, as described in Chapter 2. Thinning of the proposed Jackson timber stands promotes tree growth of the residual trees. Crowns increase in size and root systems expand. These factors all promote greater slope stability. Thinning within and through riparian reserves outside of no-cut buffers improves long-term slope stability as stand conditions change with release and increased tree growth. Thinning would emphasize the retention of a well-distributed stand of larger trees, both conifer and hardwood. These larger trees also provide the stream the opportunity to better withstand the assaults of windstorms and floods over time, and contribute to future large organic debris, that is deficient in most stream channels in the Jackson project area.

Road development on or downslope of potentially unstable GMU landforms, especially GMU's 77 and 78 would pose the greatest concern for slope instability. GMU 36 (Glaciated Mountain Slopes) also poses instability and road drainage concerns where roads are located near stream channels (USDA and WDNR 1994). No road development, however, is planned within these potentially unstable GMU's, and the remaining road development proposed in Alternative A would not pose a slope stability concern.

Soil Productivity

Ground-based yarding and road construction/reconstruction would displace the organic and surface soil layers, increasing the potential for overland flow and erosion. Although all new roads would be treated as temporary roads and rehabilitated after the proposed timber sale, compaction of subgrades and addition of surfacing materials create an inhospitable seedbed with low water holding capacity, and would lengthen the period of revegetation and hydrologic recovery for the road prism. Soils that are compacted take time to recover; tree roots and burrowing animals eventually penetrate these hardened soils. Miller et. al. (1996), found that after 7-8 years after harvest, however, tree height and volume did not differ significantly between conifers planted in skid trails and those outside of compacted areas. The recovery process may also be accelerated by using machines such as subsoilers, cats, excavators or other machinery that would scarify deeply into compacted soils. While landings, skid trails and temporary roads are good candidates for such mechanical treatment, skid trails in plantations pose a dilemma for mechanical treatment because lateral tree roots have penetrated the skid trails. Mechanical treatment in these cases may cause excessive root damage that would lead to reduced growth, and increased root disease and mortality. Monitoring conducted on numerous timber sales on the Olympic National Forest, however, have shown that decompaction treatments on skid trails and temporary roads have been successful in improving soil productivity of these impacted sites, and that damage to lateral tree roots within these corridors does not appear to kill the trees in the residual stands. Project design criteria for this project (see Chapter 2) have been developed to minimize the extent of area in a detrimental soil condition, including the following: restricted ground-based logging with designated skid roads; tractor operations are generally restricted to areas with side slopes less than 30%. Compaction of skid trails and temporary roads would be mitigated by decompaction methods. Long term compaction and mitigating subsoiling would affect few acres in the planning area.

Soil impacts under this Alternative would not exceed Forest Plan standards and guidelines of not exceeding 20% of the planning area in a detrimental soil condition, including existing roads and skid trails. Locally concentrated losses in soil productivity would occur due to additional compaction and displacement. The extent of soil disturbance is expected to be less than 8.7% in any activity area with the prescribed logging system design, an increase of up to 4.2% over existing conditions. Treatments that were considered for basing detrimental soil conditions in the activity area include timber harvest, landings, new temporary road construction, reconstruction of unclassified roads, and existing system roads. Ground-based equipment such as tractors and harvesters may be used for yarding logs if they operate from skid roads, on ground less than 30%, and are limited to the dry season (June through October).

Implementation of Alternative A would result in the highest number of overall acres and the highest percentage of area in a detrimental soil condition of all Action Alternatives. The primary sources for detrimental soil conditions are compaction from roads, followed by helicopter landings and ground based skidding equipment. The degree or intensity of soil productivity losses would be variable depending on the nature of the impacting mechanism. Soil compaction resulting from temporary roads, landings and skid trails associated with Alternative A would result in the short term loss of porosity, water infiltration rate and

saturated hydraulic conductivity. These compacted areas would also restrict root growth resulting in an overall reduction in growth of affected trees and make them more susceptible to windthrow. These losses, in turn, decrease microbial populations and nitrogen fixation by free living organisms resulting in decreases in nutrient cycling. However, these losses are short term. As stated previously, all temporary roads, reconstructed abandoned roads and landings would be decommissioned as part of the timber sale.

Restoration through decompaction treatments to the temporary roads, skid trails and landings would initiate recovery of productivity and revegetation, but soil productivity would be lost or reduced to some degree on temporary roads and landings due to soil displacement, as represented by the increased area in detrimental soil condition. Potential effects of the proposed activities on soil productivity would be due to compaction, puddling, displacement, erosion, severe burning and loss of soil organic matter. Soil losses due to extensive erosion and mass failures resulting from timber harvest and road building activities are not expected to occur considering the project design features included for all action alternatives, principally, by not locating units or roads in unstable or potentially unstable areas.

Units 2, 3, 5 and 6 are proposed for ground-based logging in this alternative, and would have a higher potential for compaction than other units using cable and helicopter systems. Ground-based logging has the highest potential to disturb soils of the different logging systems. Approximately 18 acres within the Riparian Reserve would be ground-based logged under this alternative, which would displace the organic and surface soil layers, increasing the potential for overland flow and erosion. However, project design criteria (see Chapter 2) would reduce the potential for sedimentation associated with ground-based logging.

Thinning and yarding activities have the potential to increase erosion, and to a lesser extent sediment delivery to streamcourses, particularly in the short-term (first few years after treatment). However, monitoring of several thinning operations on the Olympic National Forest have found that very little sediment is eroded downstream when project mitigations are followed. Unit layouts that are set back from streamcourses and steep slopes, riparian buffer prescriptions and limiting ground based equipment near streams all help to prevent sediment from reaching streamcourses. No-cut buffers on all streams in the sale area would provide a sufficient distance from water sources to protect them from yarding-related sediment entering streams.

Fuel reduction practices and total acres of slash treatment during and post- harvest would be minimal for Alternative A. The project design criteria described in Chapter 2 should minimize disturbance and maintain duff and woody debris in most of the units. This would aid in maintaining duff and woody debris on-site. Some hand piling and landing piles would be needed, but extent of soil disturbance would be small.

CUMULATIVE EFFECTS

Past, present, and foreseeable future management activities mentioned under the cumulative effects analysis for the No Action Alternative also apply to Alternatives A through D. The positive and negative effects considered for cumulative effects to the watersheds in the

planning area include a combination of the management actions that occur on private, State, and National Forest lands, along with natural occurrences. The Big Quilcene, Dosewallips, and Hood Canal Tributaries Watershed Analyses identified and described the negative effects of erosion, sedimentation, loss of soil productivity and impacts to aquatic habitat conditions from past timber harvesting and roads. The subwatersheds within the planning area are currently recovering from these past effects, and the current trend for management actions on National Forest land is to improve the aquatic conditions.

As stated previously, road restoration activities have also occurred on National Forest lands within the Big Quilcene and Dosewallips watersheds over the last 10 years. About 15.0 miles of road decommissioning has been completed, and about 10 miles of drainage and stabilization work has been done.

This alternative would not result in any unacceptable cumulative effects with respect to either slope stability or soil productivity. As stated above, past slope failures in the project area have since stabilized, and the risk of increasing slope instability from either the thinning or road construction/reconstruction activities associated with this alternative would be low. While the implementation of Alternative A would result in approximately 8.7% of the proposed thinning units to be considered as having detrimental soil conditions, none of the proposed thinning units would exceed the 20% standard for detrimental soil conditions in both the short and long term. There are no other activities in the foreseeable future that are expected to substantially increase the detrimental soil condition in the planning area. Additional road decommissioning and stabilization work potentially made possible through additional funding, such as from timber sale receipts, would result in slightly increased benefits to soil condition and slope stability that would further add to the restorative effects of the projects undertaken to date.

Alternative B

This alternative aims to further address the significant issues of thinning in older, fire-regenerated stands and impacts to recreation by dropping proposed units on Mt. Walker (Units 20-24) and Unit 6.

Alternative B has the second greatest potential to negatively affect soil productivity and risk to slope stability. Alternative B has the second highest overall acreage of units treated (1,606). Approximately 303 acres would be harvested by helicopter, 1,253 acres cable-logged, and 50 acres ground-based logged. This alternative has the second highest amount of road development (5.5 mi), of which 1.7 miles are within Riparian Reserves. In addition, there are 3 new stream crossings planned under Alternative B.

Outside the changes noted above, the proposed thinning treatment for stands included in this alternative would follow the same prescription as detailed in Alternative A.

DIRECT AND INDIRECT EFFECTS

Slope Stability

Because the risk of increasing slope stability from the commercial thinning activity is low, and the roads proposed for use are the same as Alternative A except for the deletion of one new temporary road 0.8 mile in length that does not pose slope stability concerns, the effects of Alternative B would be similar to Alternative A.

Soil Productivity

Soil impacts would not exceed Forest Plan standards and guidelines of no more than 20% of the project units in detrimental soil condition, including existing skid trails. Locally concentrated losses in soil productivity would occur due to additional compaction and displacement. With the prescribed logging system design, the extent of total soil disturbance is expected to be less than 7.2%, which is an increase of up to 2.7% over existing conditions.

Implementation of Alternative B would result in the second highest overall acreage and the second highest percentage of area in a detrimental soil condition of the four action alternatives. Except for the difference in amount of soil disturbance and amount of proposed ground-based logging in Riparian Reserve (7 acres instead of 18 acres), the effects for Alternative B would be similar to Alternative A.

CUMULATIVE EFFECTS

The cumulative effects would be similar to Alternative A. Taking into account existing conditions, the total detrimental soil conditions under this alternative would be less than 7.2%, far below the Forest Plan standard of 20%. There are no other activities in the foreseeable future that are expected to substantially increase the detrimental soil condition or risk to slope stability in the planning area.

Alternative C

The focus of this alternative is to address the issues of road-related sedimentation impacts by increasing the use of helicopter logging and reducing the amount of proposed road development. The portions of Unit 20 and 23 on Mt. Walker proposed for cable-yarding in Alternative A are also proposed for helicopter logging in this alternative.

In comparison to the other Action Alternatives, Alternative C has the least amount of potential ground disturbance from thinning activities and road construction and reconstruction, and therefore, a correspondingly potential to affect soil productivity and risk to slope stability. There would only be approximately 0.4 miles of temporary roads constructed, of which none would be in Riparian Reserve or on potentially unstable landforms. Also no new stream crossings would be constructed under this alternative.

Outside the changes noted above, the proposed thinning treatment for stands included in this alternative would follow the same prescription as detailed in Alternative A.

DIRECT AND INDIRECT EFFECTS

Slope Stability

Similar to Alternatives A and B, the risk of increasing slope instability under Alternative C associated with thinning would be low. The approximately 0.7 miles of road development is on stable terrain.

Soil Productivity

Soil impacts would not exceed Forest Plan standards and guidelines of no more than 20% of the project units in detrimental soil condition, including existing skid trails. Locally concentrated losses in soil productivity would occur due to additional compaction and displacement. The extent of total soil disturbance to areas that would be impacted under this alternative is expected to be less than 6.4% of any activity area with the prescribed logging system design, which is an additional 1.9% over existing conditions.

Implementation of Alternative C would result in the second lowest percentage of area in a detrimental soil condition of all action alternatives. Except for the difference in amount of soil disturbance and amount of proposed ground-based logging in Riparian Reserve (7 acres instead of 18 acres), the effects for Alternative C would be similar to Alternative A.

CUMULATIVE EFFECTS

The cumulative effects would be similar to Alternative A. Taking into account existing conditions, the total detrimental soil conditions under this alternative would be less than 6.4%, far below the Forest Plan standard of 20%. There are no other activities in the foreseeable future that are expected to substantially increase the detrimental soil condition in the planning area.

Alternative D

Alternative D has the second least potential to impact soil productivity and risk to slope stability of the action alternatives, based on this alternative having the second least amount of road construction and reconstruction (1.5 miles) in Riparian Reserve, and no new constructed stream crossings. No temporary roads would be built in potentially unstable landforms.

Outside the changes noted above, the proposed thinning treatment for stands included in this alternative would follow the same prescription as detailed in Alternative A.

DIRECT AND INDIRECT EFFECTS

Slope Stability

Similar to Alternatives A through C, the risk of increasing slope instability under Alternative D associated with thinning would be low. The approximately 5.2 miles of new and unclassified roads proposed for use are on stable terrain.

Soil Productivity

Soil impacts would not exceed Forest Plan standards and guidelines of no more than 20% of the project units in detrimental soil condition, including existing skid trails. Locally concentrated losses in soil productivity would occur due to additional compaction and displacement. The extent of total detrimental soil condition in the area is expected to be less than 5.7% of any activity area with the prescribed logging system design, which is an increase of 1.2% from existing conditions.

Implementation of Alternative D would result in the lowest percentage of area in a detrimental soil condition of all action alternatives. Except for the difference in amount of soil disturbance and amount of proposed ground-based logging in Riparian Reserve (7 acres instead of 18 acres), the effects for Alternative D would be similar to Alternative A.

CUMULATIVE EFFECTS

The cumulative effects would be similar to Alternative A. Taking into account existing conditions, the total detrimental soil conditions under this alternative would be less than 5.7%, far below the Forest Plan standard of 20%. There are no other activities in the foreseeable future that are expected to substantially increase the detrimental soil condition or risk to slope stability in the planning area.

Aquatic Habitat and Fisheries

Impacts of this project on aquatic habitat from sediment related impacts were identified as a significant issue.

The Jackson planning area falls within three sixth field subwatersheds (6HUC): the Lower Dosewallips River (Units 1, 2, 3, 4, 5, 6, 7, and 16), Spencer Creek/Marple Creek (Units 8, 9, 10, 11, 17, 20, 21, 22, 23, and 24), and a small proportion of the proposed sale area is in the Lower Big Quilcene River (Unit 20, and 22) subwatershed. Primary streams (which include the tributaries that flow into them) that have the potential to be affected are Rocky Brook, Jackson Creek, Marple Creek and Spencer Creek.

Lower Dosewallips River

Rocky Brook is the main stream within this subwatershed that has the potential to be affected by the proposed project. Rocky Brook enters the mainstem of the Dosewallips at

approximately river mile (RM) 3.3. The only fish bearing streams that contain resident rainbow trout (*Oncorhynchus mykiss*) and sculpin (*Cottus* spp.) within the sale area are Rocky Brook and its tributaries, which are adjacent to Units 1, 2, and 3. Anadromous fish species found in the lower reaches of Rocky Brook and in the Dosewallips mainstem, outside the immediate project area are Chinook salmon (*O. tshawytscha*), coho salmon (*O. kisutch*), summer and late fall chum salmon (*O. keta*), pink salmon (*O. gorbuscha*), winter and summer steelhead trout (*O. mykiss*), and sea-run cutthroat trout (*O. clarkii*). Rocky Brook Falls, the anadromous barrier on Rocky Brook, is at approximately RM 0.3. Bull trout (*Salvelinus confluentus*) have been historically documented in the lower river and estuary, but recently have not been observed in the Dosewallips mainstem. Fish present in the Lower Dosewallips River, their stock status, and their potential presence within the project area are listed in Table 11. The majority of streams within the planning area and within this subwatershed are classified as transport (stream gradients 3-20%) and source (stream gradients greater than 20%) channel types.

Spencer Creek/Marple Creek

Streams within this 6 HUC that have the potential to be affected by the timber sale are Marple Creek, Jackson Creek (which is a tributary of Marple Creek), and Spencer Creek. All proposed sale area units within this subwatershed are adjacent to non-fish bearing streams and are primarily transport and source type channels. Resident fish found downstream of sale area units within the subwatershed are cutthroat trout (*O. clarkii*) and sculpin (*Cottus* spp.). Anadromous habitat extends approximately up to RM 0.7 on Marple Creek, RM 0.2 on Jackson Creek, and RM 1.4 on Spencer Creek. The following anadromous fish are present in Spencer/Marple Creeks: coho salmon (*O. kisutch*), fall chum salmon (*O. keta*), winter steelhead trout (*O. mykiss*), and sea-run cutthroat trout (*O. clarkii*) (see Table 11).

Lower Big Quilcene River

There are only two unnamed tributaries to the Big Quilcene River that have the potential to be affected by portions of two proposed units. These non-fish bearing tributaries are primarily source type channels. Anadromous fish present further downstream in the Lower Big Quilcene River are coho salmon (*O. kisutch*), summer and late fall chum salmon (*O. keta*), pink salmon (*O. gorbuscha*), winter steelhead trout (*O. mykiss*), and sea-run cutthroat trout (*O. clarkii*) (see Table 11).

Table 11. Fish species found within Lower Dosewallips, Spencer/Marple, and Lower Big Quilcene 6HUCs.

					Present in 6HUC - subwatershed		
Fish Species	**ESU**	**Status**	**Sensitive Species**	**Within Project Area**	**Lower Dosewallips River**	**Spencer Creek/Marple Creek**	**Lower Big Quilcene River**
Chinook summer/fall	Puget Sound	Threatened[19]	No	No	X		
Chum summer	Hood Canal summer-run	Threatened[19]	No	No	X		X
Chum late fall	Puget Sound/Strait of Georgia	Healthy[20]	Yes	No	X	X	
Coho	Puget Sound/Strait of Georgia	Unknown[20]	Yes	No	X	X	X
Pink	Odd Year	Depressed[20]	No	No	X		X
Steelhead winter	Puget Sound	Threatened [21]	No	No	X	X	X
Steelhead summer	Puget Sound	Threatened[21]	No	No	X		
Coastal Cutthroat	Puget Sound	Unknown[22]	Yes	Yes	X	X	X
Bull trout	Coastal Puget Sound	Threatened [23]	No	No	X		
Sculpin	Not Applicable	Unknown	No	No	X	X	X

Federally Listed & Proposed Threatened Fish

Lower Dosewallips River

Puget Sound Chinook, Puget Sound steelhead, and Hood Canal summer chum have been listed as Threatened by the National Marine Fisheries Service, are present in the Dosewallips River. Critical Habitat for Puget Sound Chinook and Hood Canal summer chum has been designated by the National Marine Fisheries Service. Critical Habitat for Puget Sound steelhead has yet to be designated; however steelhead and Chinook share similar distribution within the subwatershed. Bull trout have been listed as Threatened by the U.S Fish & Wildlife (USFWS). There is not a self sustaining population of bull trout in the Dosewallips River. The

[19] *National Marine Fisheries Service (NMFS), 1999*

[20] *Washington Department of Fish and Wildlife's Salmonid Stock Inventory (SaSI), 2002*

[21] *NMFS, 2007*

[22] *SaSI, 2000*

[23] *US Fish and Wildlife Service, 1999*

estuary and anadromous zone of the river, however, are classified as potential Forage, Migration, and Overwintering habitat. Critical habitat for bull trout has been designated by the USFWS on the lower Dosewallips River and occurs along portions of private and state lands, but does not include Olympic National Forest lands.

Spencer/Marple Creek

Puget Sound steelhead are found in Spencer Creek. There are no other listed fish species in this creek.

Lower Big Quilcene River

Hood Canal summer chum and Puget Sound steelhead are present in the Lower Big Quilcene River. Critical Habitat for Hood Canal summer chum has also been designated in the Big Quilcene River.

Endangered Species Act (ESA) Effects Determination: The effects determination for all action alternatives for Puget Sound Chinook, Hood Canal summer chum, and Puget Sound steelhead is "May Affect, Not Likely to Adversely Affect". Additionally, associated Critical Habitat for Chinook and summer chum would also be "May Affect, Not Likely to Adversely Affect" for all action alternatives. The effects determination for all action alternatives for bull trout is "No Effect."

Essential Fish Habitat

Essential Fish Habitat has been designated by the National Marine Fisheries Service (NMFS) within the Dosewallips watershed under the Magnuson-Stevens Fishery Conservation and Management Act (NMFS 2002). EFH includes all Chinook, coho, and pink salmon habitat. The anadromous reaches of the Dosewallips, Rocky Brook, Jackson, Marple, Spencer, and Big Quilcene (upper extent of coho RM 4.9) are all considered Essential Fish Habitat. All of these areas are located outside of and downstream from the project area. Table 12 provides the distance of known fish locations to the closest proposed project unit.

For all action alternatives road construction, road reconstruction, and log haul would deliver fine and coarse sediment to streams within the proposed project area. Effects would be small, short-term, and localized. Sediment inputs to streams from culvert work are likely to create turbidity pulses that last for only a few hours, at most, before water clarity returns to background levels. Construction sites may continue to produce small amounts of sediment throughout the first winter until the sites are fully revegetated and stable. Log hauling on gravel forest roads would increase the delivery of sediment to stream channels, but impacts would be limited by the low number of truck trips per day and standard BMPs that would be implemented to control erosion and sediment delivery to stream channels. 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 water quality, turbidity or sediment production would not be detectable. Measurable impacts to Chinook, coho, and pink habitat are not expected to occur in

any of the watersheds in the planning area; adverse affects to Essential Fish Habitat are not anticipated.

Table 12. Distance of known fish locations to closest project unit.

	Distance to closest Unit (mi)				
Fish Species	**Rocky Brook**	**Jackson Creek**	**Marple Creek**	**Spencer Creek**	**Big Quilcene**
Chinook salmon	0.2	Not Present	Not Present	Not Present	Not Present
Summer chum salmon	0.5	Not Present	Not Present	Not Present	1.7
Coho salmon	0.2	1.0	1.1	1.6	0.7
Steelhead trout	0.2	Not Present	Not Present	0.7	0.7
Rainbow trout	Adjacent	Not Present	Not Present	Not Present	0.7
Cutthroat trout	0.2	0.7	0.8	0.1	0.6

Effects to Habitat Indicators

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 different alternatives. Indicators selected from the matrix are representative of habitat features that can be affected by commercial thinning timber harvest, road construction, and road use. Indicators selected from the matrix are: temperature, sediment, substrate embeddedness, pool quality, streambank condition, drainage network increase, road density and location, and function of riparian reserve (Table 13). The proposed alternatives were analyzed for these selected indicators to assess potential environmental effects based on existing conditions at the project and watershed levels. The ratings of these indicators show relative changes from the current condition, and display if the action would have a beneficial, neutral or negative impact on the habitat indicator. Within this analysis, short term effects are considered impacts related to the construction phase and within 1 year after construction is complete. Impacts that would last for more than one year after construction or that would continue for more than one year during project implementation were considered long term effects.

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 the selected alternative prior to the Decision Notice for this project. This BA will include the entire list of indicators and accompanying narratives with suggested thresholds.

Table 13. Effects on selected indicators taken from the Matrix of Pathway and Indicators (NMFS).

	Baseline (Watershed Scale - 5HUC)			Effects of Proposed Alternatives (Project Scale)					Effects of Proposed Alternatives (Watershed Scale)				
Indicator	**Properly Functioning**	**At Risk**	**Not Properly Functioning**	**No Action**	**Alt. A**	**Alt. B**	**Alt. C**	**Alt. D**	**No Action**	**Alt. A**	**Alt. B**	**Alt. C**	**Alt. D**
Temperature	DO, BQ	UW		M	M	M	M	M	M	M	M	M	M
Sediment		DO, BQ, UW		M	D	D	D	D	M	M	M	M	M
Substrate Embeddedness		DO,BQ, UW		M	D	D	D	D	M	M	M	M	M
Pool Quality		DO, BQ	UW	M	M	M	M	M	M	M	M	M	M
Streambank Condition		DO, UW	BQ	M	D	D	M	M	M	M	M	M	M
Drainage Network Increase		DO, BQ, UW		M	M	M	M	M	M	M	M	M	M
Road Density & Location		DO	UW, BQ	M	M	M	M	M	M	M	M	M	M
Riparian Reserve		DO	UW, BQ	M	R	R	R	R	M	M	M	M	M

(R)estore = project is likely to have a beneficial impact on habitat indicator
(M)aintain = project may affect indicator, but impact in neutral
(D)egrade = project is likely to have a negative impact on the habitat indicator.
DO = Dosewallips
UW = Upper West Hood Canal Frontal
BQ = Big Quilcene

Table 14. Comparison of Temporary Road Construction/Reconstruction by Alternatives (miles).[24]

	No Action	Alt. A	Alt. B	Alt. C	Alt. D
New temporary roads in RR	0	0.7	0.5	0.0	0.5
Total new temporary roads	**0**	**3.8**	**3.1**	**0.4**	**3.2**
Unclassified roads in RR	0	0.4	0.4	0.1	0.2
Total unclassified roads	**0**	**2.4**	**2.4**	**0.4**	**2.0**
Total new and unclassified temporary roads in RR	0	1.1	0.9	0.1	0.7
Total new and unclassified temporary roads	**0**	**6.2**	**5.5**	**0.7**	**5.2**
Total new stream crossings	0	5	3	0	0

Table 15. Comparison of Logging Systems proposed in Riparian Reserve by Alternative (acres).

Logging System	No Action	Alt. A	Alt. B	Alt. C	Alt. D
Ground-based	0	18	7	7	7
Cable	0	581	551	464	553
Helicopter	0	285	196	413	237
Total	**0**	**884**	**754**	**884**	**797**

[24] *Temporary roads would exist only during project implementation. All unclassified, abandoned and new temporary roads would be decommissioned after log haul is completed.*

Table 16. Comparison of Road Densities By Alternative.[25]

6HUC	Current Road Density (mi/mi^2)	No Action	Alt A (mi/mi^2)	Alt B (mi/mi^2)	Alt C (mi/mi^2)	Alt. D (mi/mi^2)
Lower Dosewallips	1.3	1.3	1.4	1.4	1.3	1.4
Spencer/Marple	3.4	3.4	3.5	3.5	3.4	3.5
Lower Big Quilcene	3.2	3.2	3.2	3.2	3.2	3.2

No Action Alternative

Direct and Indirect Effects

This alternative would have no effect on instream or wetland aquatic habitat, or water quality within the Lower Dosewallips River, Spencer/Marple Creeks, Lower Big Quilcene River subwatersheds (6HUC). All indicators: temperature, sediment, substrate embeddedness, pool quality, streambank condition, drainage network increase, road density and location, and function of riparian reserve would be maintained. 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. Instream aquatic habitat would continue to be similar to current conditions barring any large flood events; the possible impacts of such events are variable and are dependent on reach specific channel conditions.

Temperature: No effect to this indicator. All three watersheds have 303d listed waterbodies that have exceeded Washington State water quality temperature standards of 16^oC. All of these listed stream segments are off National Forest, in the lower reaches of the Dosewallips River, Marple Creek, and Big Quilcene River (WA DOE 303d list 2004).

Sediment: No effect to this indicator. Under the No Action Alternative, there would be no erosion and sedimentation above existing conditions, since no roads would be used or logging activities occurring in proposed stands.

[25] *Current road densities do not include existing unclassified roads. Increases in road densities as a result of this project would only last during timber sales activities. All new temporary roads and all unclassified roads utilized for timber harvest would be decommissioned after log haul is completed. Road densities would then return to pre-harvest conditions. Additional road decommissioning using funds generated from the project may reduce road densities further.*

The current road system in the planning area is generally stable with functioning major drainage structures. However, many culverts are undersized, deteriorating, and are spaced too far apart for adequate drainage. These and other deteriorating road conditions are likely to continue. Road maintenance and repair work would still occur to the extent necessary to protect public safety and to prevent ongoing resource damage within existing budgets. Road maintenance and repair work would still occur to the extent necessary to protect public safety and to prevent ongoing resource damage within existing budgets. Road-related sediment above natural levels, would continue to be generated from poorly maintained open system and unclassified, abandoned roads.

Under the No Action Alternative, there would be no opportunity to utilize potential KV funding from timber sale activities to reduce sediment inputs by decommissioning or stabilizing roads or improving road drainage structures.

Substrate Embeddedness:[26] No effect to this indicator.

Pool Quality: No effect to this indicator.

Streambank Condition: No effect to this indicator.

Drainage Network Increase: No effect to this indicator.

Road Density and Location: No effect to this indicator. Under the No Action Alternative, there would be no opportunity to utilize potential KV funding from timber sale activities to reduce road density by decommissioning roads.

Riparian Reserve: No effect to this indicator.

Cumulative Effects

Given that there would be no changes to the current condition under the No Action Alternative, no cumulative effects would occur within the Dosewallips River, Upper West Hood Canal Frontal, or Big Quilcene River.

Alternative A

Alternatives A, B, and D would have similar levels of effects to aquatic habitat from sediment delivery to streams primarily from road construction and reconstruction and log haul. Adverse effects would be relatively minor, due to the limited amount of road construction in Riparian Reserves and the low magnitude and frequency of log haul. However, Alternative A would have the highest potential to deliver sediment to streams, because it has the highest amount of road construction and reconstruction in Riparian Reserve (1.1 miles), and the largest number

[26] *Substrate embeddedness is the degree to which larger particles (e.g., boulders or gravel) are surrounded or covered by sediment. This is usually measured in classes according to % coverage.*

of new constructed stream crossing (5) of all the action alternatives. No temporary roads would be built on landforms that are unstable and sensitive to erosion.

Direct and Indirect Effects

Temperature: 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. No-cut buffers would be a minimum of 100 feet wide on fish-bearing streams and a minimum of 66 feet wide on non-fish bearing streams. The width of the no-cut buffers would expand on steep slopes. The thinning would be removing the less dominant and co-dominant trees within the stand, the dominant shade-producing trees would remain.

No change in stream shade is anticipated from the proposed timber sale activies. No increase in water temperature would be anticipated as a result of any activities under this alternative. Stream temperatures would remain rated as "Properly Functioning" for the Dosewallips and Big Quilcene, and "At Risk" for the Upper West Hood Canal Frontal. No change in stream shade is anticipated from the proposed timber sale.

Sediment: Of all the indicators sediment delivery to streams from forest roads would have the greatest potential effect on fish and fish habitat. The primary process by which roads contribute sediments to streams systems is by the surface erosion of the road prism and transport of this material to the stream (Wald 1975).

After entry into a stream system, sediment is either deposited and stored on the streambed for a period of time or is transported immediately downstream. The impacts of this material on stream biota are different depending upon its fate in the stream system. High levels of deposited sediment can increase mortality of salmonids eggs and alevins[27] by reducing waterflow through spawning gravels, thus suffocating the eggs, and by preventing the fry from emerging from gravel (Meehan and Swanston 1977). While increased levels of suspended sediment may cause decrease feeding (Noggle 1978) and cause displacement or avoidance of turbid waters (Bisson and Bilby 1982), effects of suspended sediment on stream biota, in general, tend to be more subtle than those observed for deposited sediment.

Increases in turbidity (fine particulate suspended matter) appear to have little effect on large juvenile and adult salmonids (Bjornn and Reiser 1991), but newly emerged juveniles are more susceptible and are affected at much lower turbidities. Increases in turbidity may also smother redds of salmon, preventing development of fry.

Even though effects on young juveniles are expected to be minimal because of project design criteria, higher turbidity levels during summer or fall storms could disrupt feeding of resident trout within the project area. Turbidity has the potential to travel miles downstream

[27] *larval salmonid that have hatched, but has not fully absorbed its yolk sac and generally has not yet emerged from the spawning gravel.*

and occur during instream construction or log haul. Effects to anadromous fish are anticipated to be less due to the increased distance between potential turbidity causing activities in the project area and anadromous fish habitat.

Activities associated with timber harvest that have the potential to generate sediment are yarding, road construction and reconstruction, and log haul. The potential effects of these activities are analyzed in more detail below.

Yarding:

Table 17 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. Under this alternative, approximately 18 acres within the Riparian Reserve would be ground-based logged. Project design criteria (see Chapter 2) would all but eliminate the potential for sedimentation associated with ground-based logging. Buffers on all streams in the sale area would provide a sufficient distance from water sources to protect them from yarding-related sediment from entering streams. Rashin et al. (2006) reported that a 10 meter buffer along streams channels where ground disturbance is restricted prevented sediment delivery to streams from about 95 percent of harvest-related erosion features.

Table 17. Alternative A approximate acres in Riparian Reserve by logging system.

Logging System	Acres
Ground-based	18
Cable	581
Helicopter	285
Total	884

Temporary road construction and reconstruction:

Alternative A would construct or reconstruct and then decommission a total of approximately 6.2 miles of temporary roads. See Table 18 for the breakdown of new construction, reconstruction, and roads in Riparian Reserve (RR).

Table 18. Temporary Road Miles in Alternative A.

New temporary roads in RR	0.7
Total new temporary roads	**3.8**
Unclassified roads in RR	0.4
Total unclassified roads	**2.4**
Total new and unclassified temporary roads in RR	1.1
Total new and unclassified temporary roads	**6.2**
Estimated total new stream crossings	5

Culvert installations and removals at stream crossings have the potential for generating sediment and turbidity that could impact aquatic habitat. Under Alterative A, approximately 5 new culverts would be installed in conjunction with the temporary road construction and reconstruction of unclassified roads. All newly installed culverts would be sized to accommodate 100-year flow events, and all new culvert installations would be on non-fish-bearing streams above resident fish habitat. The closest new stream crossings to fish habitat would be on temporary road 2620106, which is in Unit 6, and flows into Rocky Brook. The distances from new stream crossings to resident fish habitat (rainbow, cutthroat, and sculpin) ranges from approximately 0.2 to 1.9 miles; and distance to anadromous habitat (Chinook, coho, chum, pink, and steelhead) rangers from approximately 0.5 to 2.0 miles.

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 settle out rapidly and was stored in small mountain stream channels. Less than 50% of sediments traveled further than approximately 310 - 410 ft. The closest new culvert installation to resident rainbow trout habitat is along temporary road 2620106 and is approximately 1050 feet from a tributary to Rocky Brook in Unit 6.

Impacts to fish and fish habitat from temporary road construction, reconstruction, and decommissioning would be minimal given the relatively small amount of roads, the low number of new culvert crossings that would be constructed, the limited sediment and turbidity that would be generated by construction activities during the summer low-flow season, the limited transport of any introduced sediment in small tributary channels during summer low flows, and the distance to downstream fish habitat.

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 Jackson Creek, Rocky Brook, and the Dosewallips River during high flows. Given that erosion control measures would be implemented at the stream crossings sites, however, sediment from long-term erosion is expected to be minimal.

Log Haul:

Log hauling on gravel forest roads would increase fine sediment delivery to streams and have the potential to degrade aquatic habitat conditions. Approximately 40.7 miles of temporary and system roads would be used for haul in Alternative A. Almost all of the roads that would be used have gravel surfacing, and most of the haul would occur during the late fall and winter periods. 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 (Reid 1981). Sediment delivery to streams can increase 7.5 times baseline conditions from more than four loaded trucks per day (Reid and Dunne 1984). On average approximately four loaded trucks per day is anticipated to be the traffic volume generated for any given timber sale within the planning area.

Alternatives A and C have the most timber volumes projected to be generated at approximately 32.4 MMBF. Given that more volume would equate to more log haul, the potential sediment generated from log haul would be highest for Alternatives A and C. The amount of fine sediment entering stream channels as a result of haul would be minimized by use of standard Best Management Practices to control erosion and sediment delivery to streams. These measures include spot rocking at stream crossings and the suspension or reduction of haul if erosion control measures are inadequate to prevent sediment delivery to streams (see Project Design Criteria).

For units within the Jackson Creek, Marple Creek, and Rocky Brook catchments (Units 1-11 and 16-18) the anticipated haul route uses FSR 2620 (only the Rocky Brook side), 2620030, and 2630. Log haul associated with Units 20, 22, 23, on National Forest lands would occur primarily off FSR 2730 and 2730011. There are three potential helicopter landings off Forest associated with harvest of Units 20, 21, 23, and 24 where log haul would be primarily on DNR roads and Highway 101.

Under Alternative A, timber haul would primarily occur along FSR 2620 and 2630, which parallels Rocky Brook. Stream crossings are the primary areas of concern for timber haul because they are the predominant entry points for road sediment into stream channels. There are approximately 81 stream crossings on the anticipated haul routes on National Forest lands. Four culverts along the haul route cross streams with resident rainbow trout which are along FSR 2630 that cross Rocky Brook and its tributaries. The closest culvert that lies within the haul route along the 2620 to anadromous habitat is approximately 0.4 miles.

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, the small number of fish stream crossings, and the Best Management Practicies that would be implemented to control erosion and sediment delivery to stream channels would all minimize potential effects. No adverse impacts to resident or anadromous fish populations would be anticipated.

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. They, however, would extend for several years as various sales were prepared and logged.

Conclusion:

This planning area would likely be broken into at least two if not more 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. Effects of sediment from road construction would primarily occur the year the road is built and then when it is decommissioned. Timber sales would likely be sold one to two years apart. Thus, effects across the planning area could be dispersed across 5-10 years. Relatively low levels of sediment would be delivered to streams over a number of years. Because sediment impacts could extend for more than one year, this indicator was rated as a "long-term degrade."

Within the Big Quilcene 5HUC sediment effects to aquatic resources is anticipated to be minimal. Sediment effects would primarily be apparent within the Dosewallips and Upper West Hood Canal Frontal 5HUCs.

Actual adverse impacts to the aquatic system from increased sediment delivery or turbidity would be small, localized, intermittent, and temporary. Indirect effects are likely to occur lower down in the watersheds within response reaches (stream gradient less than 3%) where any sediment would deposit, but effects are anticipated to be minimal. There would be little effect to fish or fish habitat, and no adverse impacts would be discernable at the watershed scale.

There is the potential of funding road decommissioning projects from funds generated from the sale. Road decommissioning would reduce road related sediment delivery to streams and have a long-term beneficial effect on this indicator, and thus benefiting aquatic resources. However to what extent is unknown due to the fluctuation of the timber market and availability of funds, but would be relative to revenue generated by the alternative (see Economic Viability section).

Substrate Embeddedness: Minor amounts of fine sediment may cause some short-term embeddedness immediately downstream of culverts connected to log haul and during the low flow period immediately after stream crossing construction. Observable effects would be limited to within several hundred feet or less of the crossings. Deposited sediments would be

remobilized by high flows in the fall and winter and effects would become immeasurable as the small amounts of introduced sediment are overwhelmed by natural sediment transport during high winter flows. Introduced sediment would eventually be routed to response reaches (1-3% gradient) further downstream within the mainstems of the Dosewallips River and Marple Creek before settling out. Sediment inputs would occur during temporary road construction and reconstruction activities, during periods of log haul, and again during decommissioning of temporary roads. Because sediment impacts could extend for more than one year, this indicator was rated as a "long-term degrade."

As described in detail under the Sediment section above, actual adverse impacts to the aquatic system from increased fine sediment and substrate embeddedness would be small, localized, intermittent, and temporary. There would be little effect to fish or fish habitat at the project scale. No adverse impacts would be discernable at the watershed scale.

Pool Quality: There would be an increase of sediment delivery to streams from timber sale activities, primarily from log haul, but the amount of fine sediment is not anticipated to result in measurable deposition in pools. Current conditions would be maintained across the planning area. There would be no effects to fish or fish habitat at the project scale. No adverse impacts would be discernable at the watershed scale.

Streambank Condition: Streambank condition would not change within the Big Quilcene River Watershed since there would be no new stream crossing connected with the road construction and reconstruction in this watershed. Some disturbance would occur on streambanks at the five new stream crossings that would be part of new temporary road construction in the Rocky Brook and Jackson/Marple creeks drainages. Short term disturbance would occur when the culverts are installed and then again when the culverts are pulled as the temporary roads are decommissioned. In the long term, streambanks condition at the five new crossing sites would recover as re-vegetation takes place. Because road construction and decommissioning would likely extend over more than one year at a given site, this indicator was rated as a "long-term degrade."

Actual adverse impacts to the aquatic system from decreased streambank condition at the five new culvert sites would be minimal. All of the new culvert sites are on temporary roads that would be decommissioned after the timber sale. None of the five new crossings present any unusual long-term slope stability or erosion concerns. All of the new crossings are above the upper limit of resident fish habitat. There would be minor effects to fish or fish habitat at the project scale, and no adverse impacts to streambank condition would be discernable at the watershed scale.

Drainage Network Increase: Roads can increase the volume of water available for rapid transport to streams channels in two ways. Roads intercept precipitation, which results in overland flow over compacted surfaces – reducing infiltration rates. Secondly, shallow subsurface flow may be intercepted at road cutbanks and converted to rapid surface runoff and routed to the stream network. This process effectively increases drainage density in a watershed, which would create new stream channels that could route sediment to streams and affect base and peak flows (Wemple et al 1996). Existing unclassified roads within the

planning area generally have a road prism which already intercepts subsurface water flow so reconstructing these roads would not increase the stream channel network.

With only 0.1 miles of new temporary road construction proposed within the Big Quilcene watershed, the drainage network in the Big Quilcene watershed would remain unchanged.

Increase in the drainage network would mainly be seen in new road construction, especially within Riparian Reserves within the Dosewallips and Upper West Hood Canal Frontal watersheds. Under Alternative A, a total of 3.7 miles of new temporary road would be constructed within the Dosewallips and Upper West Hood Canal Frontal watersheds. Approximately 0.7 miles of new temporary road would be constructed within the Riparian Reserve. In the Rocky Brook and Jackson/Marple subwatersheds, there may be a slight increase in the drainage network associated with new temporary road construction. The exact extent that the new temporary roads would actually result in interception of subsurface flow and increase the stream channel network is unknown. Changes, however, would be minimized by installing frequent ditch relief pipes to divert ditch flow back onto the forest floor before it reaches a stream channel. Actual changes in streamflow patterns, if any, from the construction of temporary roads under Alternative A are anticipated to be small and limited to the immediate project area. New road construction within riparian areas have the most potential in affecting the drainage network, and this alternative has a relatively small amount of roads within the Riparian Reserve less than a mile. A total of 0.7 miles of new temporary road construction in Riparian Reserves across two subwatersheds approximately 10,500 acres in size is likely to have an immeasurable effect on this indicator.

There is the potential of funding additional road decommissioning from additional funds generated from the sale. This would have a long-term beneficial effect on this indicator, and thus benefiting aquatic resources. However to what extent is unknown, due to the fluctuation of the timber market and availability of funds. How much road decommissioning would actually occur with the additional funding is unknown.

Road Density and Location: Roads can act to impede surface water infiltration, intercept subsurface flows, and provide a direct surface linkage for delivering water to stream channels. The road network can substantially increase the natural drainage density of a watershed. By changing hydrologic flow paths, roads can contribute to changes in the hydrologic performance of the watershed, and can be substantial sources of fine sediment in streams draining heavily roaded watersheds. Current road densities and the temporary increases for this alternative by sixth-field watershed within the planning area are displayed in Table 19. These values do not include existing unclassified roads.

A total of 6.2 miles of new temporary and unclassified roads would be constructed and reconstructed. Approximately 3.8 miles of new temporary roads would be constructed, and 2.4 miles of existing unclassified road would be reopened under this alternative. 0.7 miles of new temp road would be constructed in Riparian Reserve. 0.4 miles of existing unclassified road within Riparian Reserve would be reopened. All new temporary roads and all reopened unclassified roads would be decommissioned after timber harvest. With only 0.1 miles of

new temporary road construction proposed within the Lower Big Quilcene watershed, the road density in the Lower Big Quilcene watershed would remain unchanged.

There would be small and temporary increases in road densities in the Lower Dosewallips and Spencer/Marple watersheds. Road densities would increase temporarily by 0.1 mi/mi2 within these watersheds. Decommissioning of temporary roads at the completion of the timber sale (which may last up to 5-10 years) would return road densities to pre-harvest conditions. Because of the temporary and relative minor increases to road densities, this indicator is rated as a "maintain."

Table 19. Road densities by 6HUC subwatershed for current condition and during implementation of Alternative A.

6th Field Watershed	Current Road Density (mi/mi^2)	Alternative A Road Density (mi/mi^2)[28]
Lower Dosewallips	1.3	1.4
Spencer/Marple	3.4	3.5
Lower Big Quilcene	3.2	3.2

There is the potential of funding road decommissioning from funds generated from the sale. This would reduce road densities and have a long-term beneficial effect on this indicator, and thus benefiting aquatic resources. However to what extent is unknown, due to the fluctuation of the timber market and availability of funds. How much road decommissioning would actually occur is unknown.

Riparian Reserve:

LWD Recruitment:

One of the key objectives of Riparian Reserves is to protect and provide for long term supply of large woody debris (LWD) to streams and aquatic environments. Table 20 shows LWD recruitment potential (USDA and WDNR 1994, and USDA 1999).

Table 20. Large woody debris recruitment.

	Good %	Fair %	Poor %
Rocky Brook*	5	0	95
Spencer Creek**	17	33	50
Jackson Creek**	30	28	42

**=Includes all streams in 7HUC, on National Forest*
***=Includes only Type 1-3 streams, off National Forest*

[28] *Increases in road densities as a result of this project would only last during timber sales activities. Temporary roads would be decommissioned after log haul is completed. Road densities would then return to pre-harvest conditions. Additional road decommissioning using funds generated from the project may reduce road densities further.*

Approximately 884 acres of Riparian Reserve would be thinned. In general, 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 (see Project Design Criteria). No-cut buffer sizes would vary depending on slope break, a minimum of 100 feet would be designated for fish bearing streams, and 66 feet for non-fish bearing streams. 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. 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.

Treated portions of the Riparian Reserve outside the no-cut buffers would be thinned to a 60% to 90% 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 minimum 100 and 66 foot 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 (leaving dominant and co-dominant trees within the stand), most of the trees that would be cut in the Riparian Reserve outside the no-cut buffers are generally be too small to reach the stream channel and contribute to instream large wood. The remaining trees within the Riparian Reserve would respond to the thinning by increased growth rate, both in height and diameter. Increase in stand complexity within the treated Riparian Reserve is also anticipated. The inner no-cut buffer of the Riparian Reserve would be maintained, while the outer thinned portioned of the Riparian Reserve would improve from increased growth rates and increased stand complexity.

Aquatic Habitat Fragmentation:

Another objective of Riparian Reserves is to protect and provide connectivity of instream and riparian habitats. Roads and culverts under this alternative have the potential to alter the flow pattern of large wood, organic material and gravels through the stream network. Additionally, roads and culverts also have the potential to fragment aquatic habitat for organisms other than fish, including amphibians and invertebrates during project implementation. All culverts along temporary roads would be removed as part of the decommissioning of all temporary roads following project implementation. All new temporary road construction and associated culverts are above fish habitat.

There is a possibility of reconnecting resident fish habitat by replacing fish barrier culverts on tributaries to Rocky Brook, off of Forest Service Road 2630, with the use of additional funds generated by the timber sale. Costs to replace fish barrier culverts are typically high, however, and the amount of money available to fund the project is uncertain. Alternative A would offer the greatest potential opportunity to fund fish barrier culvert correction projects from funds generated from the timber sale. How much funding might be available under this alternative and which projects might be selected is unknown at this time.

Cumulative Effects

The major impacts to aquatic resources across all three watersheds from past actions have come from fire, timber harvest, roads, and residential development. The planning area has had approximately five large fires since 1860 of 1,000 acres or larger, usually resulting in stand replacement. All three subwatersheds have had extensive timber harvest starting from the early 1900s. Additionally, logging roads have caused numerous landslides. Residential development associated with the towns of Brinnon and Quilcene, and the development along the Hood Canal has negatively affected stream channel function and habitat conditions.

In the past few years there have also been several positive efforts made to improve salmonid habitat within all subwatersheds by local environmental groups, tribal, federal, state and county governments. Projects such as road decommissioning, levee removal, instream placement of LWD, land acquisition and conservation easements to protect high value floodplain and riparian areas have been accomplished and are underway primarily within the Dosewallips and Big Quilcene Rivers. On National Forest lands, over the past 10 years, several miles of road have been decommissioned within both the Dosewallips and Big Quilcene watersheds.

Existing and foreseeable non-Federal activities across all the watersheds include timber sales, road construction, bank hardening, dike construction, LWD removal, and the conversion of floodplain to pasture lands and residential development. Assuming population increases in the lower watershed and population densities rise, these future private and state actions would persist and would likely increase, thus, exacerbating the adverse effects on salmonid habitat within the lower subwatersheds.

Two miles and three miles of existing roads are planned to be decommissioned in the Dosewallips and Big Quilcene, respectively, on National Forest lands within the next several years. Also within these two watersheds rehabilitation of riparian dispersed campsites are planned. Other foreseeable activities on National Forest lands across all watersheds include repair and maintenance of the road network.

In the planning area there are relatively low levels of timber activity proposed within the Big Quilcene, and effects from sediment and road construction and reconstruction would be minimal. Because of these minor impacts and the discountable effects of overlap of past, present and future actions within the watershed no cumulative impacts are anticipated in the Big Quilcene watershed.

Within the Dosewallips River and Upper West Hood Canal Frontal, Alternative A would contribute most towards cumulative effects relative to the other action alternatives from the proportional incremental increase of sediment to stream channels from log haul and road construction and reconstruction. Sediment effects would last only during implementation of timber sales activities, which could potentially last 5 to 10 years, assuming 2 or 3 timber sales would occur over the planning area. Cumulative effects, however, would not likely be apparent in stream channels within the planning area due to steeper stream gradients, and the ability of the streams to transport sediment. Sediment generated from any past, present, or foreseeable future activity in the planning area watersheds are likely to deposit lower down in the watersheds within response reaches (stream gradient less than 3%), but the added effects from this alternative are anticipated to be minimal and, even when taking other activities into account, would not change the baseline watershed indicator rating for sediment. The following indicators would be degraded to any extent at the project level: sediment, substrate embeddedness, and streambank condition. But because overall magnitude of effects are anticipated to be small, short-term, intermittent, and not rise to the level of affecting resident and anadromous fish populations across the planning area, cumulative effects would remain at acceptable levels, and the Aquatic Conservation Strategy objectives would still be maintained.

Alternative B

Alternative B has the second greatest potential to negatively affect aquatic habitat by sediment delivery to streams primarily from road construction and reconstruction and log haul. Adverse effects would be relatively minor, due to the limited amount of road construction in Riparian Reserves and the low magnitude and frequency of log haul. Alternative B has the second highest amount of road construction and reconstruction in Riparian Reserve (0.9 miles), and the second largest number of new constructed stream crossing (3) of all the action alternatives. No temporary roads would be built on landforms that are unstable and sensitive to erosion.

Direct and Indirect Effects

Temperature: Effects would be the same as Alternative A. Stream temperatures are not anticipated to be affected and would be maintained within all watersheds.

Sediment: Mechanisms of sediment delivery to streams and effects to fish are similar to what is described under Alternative A.

Yarding:

Effects of sediment from yarding are similar to Alternative A. Buffers on all streams are expected to prevent yarding-related sediment from entering stream channels. Rashin et al. (2006) reported that a 10 meter buffer along streams channels where ground disturbance is restricted prevented sediment delivery to streams from about 95 percent of harvest-related erosion features.

Temporary road construction and reconstruction:

Alternative B has similar amounts of total road construction and reconstruction and total construction and reconstruction in Riparian Reserve (RR) as Alternative A (see Table 21). Alternative B would include a little less road construction and reconstruction in this alternative than in Alternative A, but would still include the second highest amount among all of the action alternatives.

Table 21. Temporary Road Miles in Alternative B.

New temporary roads in RR	0.5
Total new temporary roads	**3.1**
Unclassified roads in RR	0.4
Total unclassified roads	**2.4**
Total new and unclassified temporary roads in RR	0.9
Total new and unclassified temporary roads	**5.5**
Total new stream crossings	3

All new culvert installations would be in non-fish-bearing streams above the upper limits of fish habitat. The closest new stream crossing to fish habitat would be on temporary road 2620109, which is in Unit 7 and 16, and flows into Rocky Brook. The distance to resident fish habitat is approximately 1 mile and 1.7 miles to anadromous fish habitat. Effects of new culvert installations would be similar to Alternative A.

Log Haul:

While overall there would not be substantial differences in sedimentation between alternatives, slight differences would exist as it relates to timber volume and log haul. As such, the amount of sediment generated from log haul would be slightly less than Alternative A. Alternative B has the least volume projected to be generated at approximately 22.5 MMBF. Less volume equates to less log haul, thus comparatively, sediment generated from log haul for Alternative B would be the least of the action alternatives.

The same route within Rocky Brook would be used. The difference would be that no log haul would occur from the Mount Walker Units (Units 20, 21, 23, and 24), thus no sediment impacts to the Big Quilcene River and Spencer Creek would occur. There would be approximately 73 stream crossings along the haul route, which is slightly less than Alternative A.

There would be no effect to sediment within the Big Quilcene because no harvest activity would occur in the watershed. Within the Dosewallips River and Upper West Hood Canal

Frontal there would be a long term degrade to the sediment indicator, due to the potential of having temporary roads open across the planning area for several years.

Actual adverse impacts to the aquatic system from increased sediment delivery or turbidity would be small, localized, intermittent, and temporary. There would be little effect to fish or fish habitat. No adverse impacts would be discernable at the watershed scale.

Substrate Embeddedness: Effects would be similar to Alternative A; however, there would be no effect to sediment within the Big Quilcene because no harvest activity would occur in the watershed.

Pool Quality: Effects would be similar to Alternative A; however, there would be no effect to sediment within the Big Quilcene because no harvest activity would occur in the watershed.

Streambank Condition: Effects would be similar to Alternative A.

Drainage Network Increase: Effects would be similar to Alternative A. However, effects would be slightly less because approximately 3.1 miles of new temporary road would be constructed, of which there would be 0.5 miles of construction in Riparian Reserves, and approximately only 3 new stream crossings would be installed in Alternative B.

Road Density and Location: Effects would be similar to Alternative A; however, there would be no effect to road density and location within the Big Quilcene because no road building would occur in the watershed. Although there is slightly less road construction and reconstruction in this alternative than Alternative A, it does not change road densities among alternatives. This indicator would be maintained across the planning area.

Table 22. Road densities by subwatershed for Alternative B.

6th Field Watershed	Current Road Density (mi/mi^2)	Alternative B Road Density (mi/mi^2)[29]
Lower Dosewallips	1.3	1.4
Spencer/Marple	3.4	3.5
Lower Big Quilcene	3.2	3.2

[29] *Increases in road densities as a result of this project would only last during timber sales activities. Temporary roads would be decommissioned after log haul is completed. Road densities would then return to pre-harvest conditions.*

Riparian Reserve: Effects would be similar to Alternative A, except that approximately 130 fewer acres of Riparian Reserve would be treated. Table 23 shows the breakdown of Riparian Reserves proposed for treatment by logging system.

Table 23. Alternative B acres in Riparian Reserve by logging system.

Logging System	Acres
Ground-based	7
Cable	551
Helicopter	196
Total	754

Cumulative Effects

Cumulative effects under this alternative would be similar to Alternative A, however, incremental effects added by this alternative would be slightly less due to less road construction and reconstruction and log haul planned. As a result, Alternative B would not result in unacceptable cumulative effects to the aquatic habitat and fisheries resource when taking other past, present, and foreseeable future activities into account.

Alternative C

Alternative C has the least potential to negatively affect aquatic habitat by sediment delivery to streams primarily from road construction and reconstruction and log haul of all the action alternatives. This alternative has the least amount of road construction and reconstruction in Riparian Reserve (0.1 miles), and no new constructed stream crossings. No temporary roads would be built on landforms that are unstable and sensitive to erosion.

Direct and Indirect Effects

Temperature: Effects would be the same as Alternative A. No effects to stream temperature are anticipated.

Sediment: Mechanisms of sediment delivery to streams and effects to fish would be similar to what is described under Alternative A. However, the magnitude would be less.

Yarding:

Effects of sediment from yarding would be similar to Alternative A. Buffers on all streams are expected to prevent yarding-related sediment from entering streams. Rashin et al. (2006) reported that a 10 meter buffer along streams channels where ground disturbance is

restricted prevented sediment delivery to streams from about 95 percent of harvest-related erosion features.

Alternative C has the least potential to deliver sediment to streams, because of the minor amounts of temporary road construction and reconstruction with no new stream crossings constructed.

Temporary road construction and reconstruction:

Alternative C has the least amount of road construction or reconstruction of all the action alternatives (see Table 24). There would only be approximately 0.7 miles of temporary roads constructed, none of it would be in Riparian Reserve (RR). No new stream crossings would be constructed.

Table 24. Temporary Road Miles in Alternative C.

New temporary roads in RR	0.0
Total new temporary roads	**0.4**
Unclassified roads in RR	0.1
Total unclassified roads	**0.4**
Total new and unclassified temporary roads in RR	0.1
Total new and unclassified temporary roads	**0.7**
Total new stream crossings	0

Alternative C would not build any temporary roads in unstable or erosionally sensitive GMUs.

Log Haul:

While overall there would not substantial differences in sedimentation between alternatives, slight differences would exist as it relates to timber volume and log haul. The amount of sediment generated from log haul would be similar to Alternative A. Alternatives A and C have the most volumes projected to be generated at approximately 32.4 MMBF. More volume equates to more log haul, thus the potential sediment generated from log haul would be highest for Alternatives A and C.

The same route within Rocky Brook would be used. Because of the short distance between the other anticipated log landings areas and paved roads (i.e., Highway 101), which would pose little risk of sedimentation, the majority of sedimentation potential from log haul for the Mount Walker units (Units 20, 21, 23, and 24) would primarily be from landings used on state lands. There would, however, be approximately 59 stream crossings along the haul route across the project area, which would be the least number of crossings of all action alternatives.

Alternative C has the least potential to deliver sediment to streams, because of the minor amounts of temporary road building with no new stream crossings constructed.

Within the Big Quilcene 5HUC sediment effects to aquatic resources is anticipated to be minimal, because of the buffers on streams, the relatively low numbers of stream crossing along the haul route, and the relatively low levels of log haul, this indicator would remain unchanged.

Within the Dosewallips River and Upper West Hood Canal Frontal there would be a long term degrade to sediment, primarily due to log haul for several years. However, actual adverse impacts to the aquatic system from increased sediment delivery or turbidity would be small, localized, intermittent, and temporary. There would be little effect to fish or fish habitat. No adverse impacts would be discernable at the watershed scale.

Substrate Embeddedness: Effects would be similar to Alternative A, in that there would be a long term degrade associated with sediment delivery to streams primarily from log haul that potentially could last for several year. The degree or intensity of effects from Alternative C would be less than Alternative A due to less road construction and reconstruction, and would maintain this indicator.

Pool Quality: Effects would be similar to Alternative A.

Streambank Condition: There would be no new stream crossings associated with new temporary road construction, thus no streambanks disturbance from timber activities would be anticipated. Streambank conditions would be maintained across all watersheds in the planning area.

Drainage Network Increase: Because no new temporary road construction would occur in Riparian Reserves and no new stream crossings would be associated with the road construction and reconstruction, no increase in the drainage network is expected in any of the watersheds, current conditions would be maintained in all the Dosewallips, Upper West Hood Canal Frontal, and Big Quilcene.

Road Density and Location: Alternative C would reconstruct or construct the least amount of temporary roads –approximately 0.7 miles. No new stream crossings would be associated with the construction. Due to the low amount of road construction and reconstruction, this alternative would not change road densities in any of the subwatersheds (see Table 16). As with all alternatives, no temporary roads would be built in unstable or erosionally sensitive GMUs. This indicator would be maintained for all 5th field watersheds across the planning area.

Riparian Reserve: Effects would be similar to Alternative A, except that more of the units would be helicopter logged. Table 25 shows the breakdown of Riparian Reserves proposed for treatment by logging system.

Table 25. Alternative C acres in Riparian Reserve by logging system.

Logging System	Acres
Ground-based	7
Cable	464
Helicopter	413
Total	884

Cumulative Effects

Effects under this alternative would be similar to Alternative A and would not result in unacceptable cumulative effects to the aquatic habitat and fisheries resource. The potential for sediment delivery to streams and road building would be less in this alternative than in Alternative A. Thus, the degree to which these impacts contribute to cumulative effects within the watersheds in the planning area would correspondingly be less.

Alternative D

Alternative D has the second least potential to negatively affect aquatic habitat by sediment delivery to streams primarily from road construction and reconstruction and log haul of all the action alternatives. Alternative D has the second least amount of temporary roads in Riparian Reserve (0.7 miles), and no new constructed stream crossings. Because there are no new stream crossings associated with the road construction and reconstruction in Riparian Reserve, it is anticipated that there would be a minimal effect on sediment delivery to streams. No temporary roads would be built in unstable and erosionally sensitive landforms.

Direct and Indirect Effects

Temperature: Effects would be the same as Alternative A.

Sediment: Mechanisms of sediment delivery to streams and effects to fish are similar to what is described under Alternative A.

Yarding:

Effects of sediment from yarding are similar to Alternative A. Buffers on all streams are expected to prevent yarding-related sediment from entering streams. Rashin et al. (2006) reported that a 10 meter buffer along streams channels where ground disturbance is restricted prevented sediment delivery to streams from about 95 percent of harvest-related erosion features.

Temporary road construction and reconstruction:

Alternative D has the second least amount of road construction and reconstruction of all the action alternatives; see Table 26 for amount of temporary road building. There would be approximately 5.2 miles of new temporary and unclassified roads constructed or reconstructed, of which approximately 0.7 miles would be reconstructed in the Riparian Reserve (RR). No new stream crossings would be constructed.

Table 26. Temporary Road Miles in Alternative D.

New temporary roads in RR	0.5
Total new temporary roads	**3.2**
Unclassified roads in RR	0.2
Total unclassified roads	**2.0**
Total new and unclassified temporary roads in RR	0.7
Total new and unclassified temporary roads	**5.2**
Total new stream crossings	0

Log Haul:

While overall there would not substantial differences in sedimentation between alternatives, slight differences would exist as it relates to timber volume and log haul. The amount of sediment generated from log haul would be slightly less than both Alternatives A and C. Alternative D has the second least volume projected to be generated at approximately 27.4 MMBF. Less volume equates to less log haul, thus, associated sediment potentially generated from log haul for Alternative D would be the second least of the action alternatives.

The same route within Rocky Brook would be used. Because of the short distance between the other anticipated log landings areas and paved roads (i.e., Highway 101), which would pose little risk of sedimentation, the majority of sedimentation potential from log haul for the Mount Walker units (Units 20, 21, 23, and 24) would primarily be from landings used on state lands. There would be approximately 60 stream crossings along the haul route across the project area, which would be less than both Alternatives A and B.

Alternative D has the second least potential to deliver sediment to streams, because of the amount of temporary roads built with no new stream crossings.

Approximately 5.2 miles of temporary road would be constructed or reconstructed. An estimated 0.7 miles of temporary road (new and unclassified) would be reconstructed in

Riparian Reserves. No new stream crossings would be constructed. Effects would be similar to Alternative A

Substrate Embeddedness: Effects would be similar to Alternative A.

Pool Quality: Effects would be similar to Alternative A.

Streambank Condition: There are no new stream crossings associated with new temporary road construction. Effects would be similar to Alternative A.

Drainage Network Increase: Effects would be similar to Alternative A. However, effects would be slightly less because approximately 3.2 miles of new temporary road would be constructed, of which there would be 0.5 miles construction in Riparian Reserves..

Road Density and Location: Alternative D has the second least amount of new and unclassified temporary roads being constructed or reconstructed –approximately 5.2 miles- and no new stream crossing associated with the construction. Road densities would slightly increase in the Lower Dosewallips and Spence/Marple 6HUCs only 0.1 mi./mi.^{2} (see Table 27). Because there would only be a minor increase in road densities and closure of temporary roads after the timber sales that would return road densities to pre-harvest conditions, this indicator would be maintained for all 5th field watersheds across the planning area.

Table 27. Road densities by subwatershed for Alternative D.

6th Field Watershed	Current Road Density (mi/mi^2)	Alternative D Road Density (mi/mi^2)[30]
Lower Dosewallips	1.3	1.4
Spencer/Marple	3.4	3.5
Lower Big Quilcene	3.2	3.2

Riparian Reserve: Effects would be similar to Alternative A. The only difference would be the amount of Riparian Reserve that would be treated and different types of logging systems employed (see Table 28).

[30] *Increases in road densities as a result of this project would only last during timber sales activities. Temporary roads would be decommissioned after log hau lis completed. Road densities would then return to pre-harvest conditions.*

Table 28. Alternative D acres in Riparian Reserve by logging system.

Logging System	Acres
Ground-based	7
Cable	553
Helicopter	237
Total	797

Cumulative Effects

Effects would be similar to Alternative B, because of the similar amounts of road construction and reconstruction and log haul associated with these two alternatives. Like Alternative B, Alternative D would not result in unacceptable cumulative effects to the aquatic habitat and fisheries resource when taking other past, present, and foreseeable future activities into account.

Regional Forester's Sensitive Species List – Fish

Fish species on the Forest Service Region 6 Sensitive Species List that occur within the Lower Dosewallips, Spencer/Marple Creeks, and Lower Big Quilcene subwatersheds are: Puget Sound/Strait of Georgia coho, Puget Sound/Strait of Georgia chum, and Puget Sound coastal cutthroat trout. All sensitive fish species are downstream of proposed timber sale units.

No Action Alternative

Direct, Indirect, and Cumulative Effects

Given that there would be no activities initiated, the No Action Alternative would have no direct, indirect, or cumulative effects on sensitive fish species.

Common to all Action Alternatives (Alternatives A, B, C, and D)

Direct, Indirect, and Cumulative Effects

Based on the analysis of effects to fish habitat indicators, all action alternatives may impact individuals or habitat for Puget Sound/Strait of Georgia coho salmon, Puget Sound/Strait of Georgia chum salmon, and Puget Sound coastal cutthroat trout, but it would not likely contribute to a trend towards Federal listing or cause a loss of viability to the population or species.

Botanical Resources

A pre-field review was performed in order to determine whether the activities proposed in this project pose a potential threat to federally listed Threatened or Endangered species, Survey and Manage species, and Regional Forester's Sensitive species. Aerial photographs, the 2004 Regional Sensitive Plant list, the Olympic National Forest Rare Plant Occurrence GIS cover, the Survey and Manage 2006 GeoBOB database , the Washington State Natural Heritage program, district files, and the Olympic National Forest Plants of Concern Identification Guide (May 1994) were consulted.

Findings from the pre-field review and associated surveys are documented below.

Federally Listed Species

There are no Endangered or Federally listed vascular plants, bryophytes, fungi or lichens documented or suspected on the Olympic National Forest.

There is one Federally Endangered vascular plant, *Arenaria paludicola* (swamp sandwort), that could potentially occur on the Olympic National Forest. This species, however, is currently considered extirpated in Washington with historical sites recorded in Grays Harbor, King, Pacific, Pierce, and San Juan counties (Ziegltrum 1994). Swamp sandwort grows mainly in wetlands and freshwater marshes, from sea level to 1476 feet in elevation, and can grow in saturated acidic bog soils and sandy substrates with high organic content.

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. There would be no direct, indirect or cumulative effects on this Federally Endangered plant. Therefore, the implementation of this project would not directly, indirectly, or cumulatively affect the viability of this species under any alternative.

Regional Forester's Sensitive and Survey & Manage Species

Vascular Plants

The pre-field analysis for Sensitive and Survey and Manage vascular plant species revealed no known sites in the Jackson Thinning project area. Seven species were identified as having potential habitat in the proposed project area (Table 29). Field surveys were conducted for these species in August 2005 and July 2006.

Table 29. Regional Forester's Sensitive and Survey and Manage Plants with potential habitat in the project area.

Scientific name	Status		Habitat
	Forest Service Sensitive	S & M Category	
Cimicifuga elata	Yes	None	Moist, shady woods, low elevation
Coptis asplenifolia	Yes	A	Moist conifer forests and bogs at low-mid elevation
Coptis trifolia	No	A	Wet mossy areas in Western hemlock and silver fir forests
Galium kamtschaticum	Yes	A	Moist, cold conifer forests and mossy areas
Montia diffusa	Yes	None	Low elevation forest
Platanthera orbiculata var. orbiculata	No	C	Mesic-dry forests in the Western hemlock and silver fir zone; shady areas with deep, moist, undisturbed duff
Poa laxiflora	Yes	None	Moist woods of mixed conifer and deciduous stands; riparian areas

S & M category definitions: A—rare, pre-disturbance surveys practical; C—uncommon, pre-disturbance surveys practical.

One occurrence of *Platanthera orbiculata* var. *orbiculata*, a Survey and Manage category C species, was found in Unit 11. Its status of category C denotes that it is uncommon and that pre-disturbance surveys are practical. Also, management of high priority sites is required. The population consists of one individual and is located near the original proposed temporary road within the unit. This population is significant because it is the first documented occurrence of the species on the Olympic Peninsula. For this reason, special consideration would be given to protect this population in order to maintain its viability. According to Management Recommendations for Vascular Plants, December 1998, this species is vulnerable to shifts in environmental conditions and/or changes in the abundance of associated species (including plants, mycorrhizal fungi, pollinators, and herbivores). Specifically, *P. orbiculata* var. *orbiculata* is threatened by forest clearing or litter disturbing events including thinning, clear cutting, or wildfires.

No Action Alternative

Direct, Indirect and Cumulative Effects

The No Action Alternative would have no risk to species viability or a trend toward listing for *Platanthera orbiculata* var. *orbiculata*. No active management activities would occur on the site and current site conditions would not be disturbed. Therefore, there would be no direct, indirect, or cumulative effect to this species.

Alternatives A and B

Direct and Indirect Effects

As mentioned previously, this species is vulnerable to shifts in environmental conditions and changes in the abundance of associated species (including plants, mycorrhizal fungi, pollinators, and herbivores) and, without measures to ensure its protection, could be damaged or obliterated by ground disturbance via tree felling and yarding operations. These effects can be eliminated by incorporating the project design criteria of establishing a no-treatment buffer around the *Platanthera orbiculata* var. *orbiculata* occurrence to protect the population from ground disturbance, and changes in environmental conditions and associated species. The buffer was determined by using the site potential tree height of 125 feet as the minimum distance needed to ensure protection of the orchid from accidental tree felling during harvesting and potential windthrow that may result. Best management practices suggest this distance is also appropriate for maintaining microclimate conditions and the composition and abundance of species associated with round-leaved orchids (e.g., plants, mycorrhizal fungi, and pollinators). Chan et al. (2004) and Brosofske et al. (1997) reported edge effects for some microclimate variables resulting from thinning and clear cut treatments extending 50-60 feet into adjacent, no-treatment buffers. By implementing the required 200-foot buffer (see Chapter 2), which also accounts for potential edge effects, there would be no direct or indirect effect and no risk to species viability or a trend toward listing.

Cumulative Effects

Because there would be no effect to this species in these alternatives, there would likewise be no cumulative effects associated with these alternatives on *P. orbiculata* var *orbiculata*.

Alternatives C and D

Direct and Indirect Effects

If either of these alternatives were implemented, the potential exists for this small population to be damaged by ground disturbance during the helicopter logging operation. By implementing the 200-foot no treatment buffer (see Chapter 2), however, there would be no direct effect and no risk to species viability or a trend toward listing.

Cumulative Effects

Because there would be no effect to this species in these alternatives, there would likewise be no cumulative effects associated with these alternatives on *P. orbiculata* var *orbiculata*.

Bryophytes (mosses and liverworts)

The pre-field analysis for Sensitive and Survey and Manage bryophyte species revealed no known sites in the Jackson Thinning project area. The project area does contain suitable habitat for three of the four Sensitive and Survey and Manage bryophyte species documented

or suspected on the Olympic National Forest two species (Table 30). Field surveys were conducted for these species in August 2005 and July 2006.

Table 30. Forest Service Sensitive and Survey and Manage (S & M) bryophyte species with potential habitat in the Jackson Thinning project area.

Scientific name	Status		Habitat
	Forest Service Sensitive	S & M Category	
Bartramiopsis lescurii	Yes	None	Cool, humid, shady canyons and stream terraces at low elevations, where it occurs on overturned tree roots, rock, soil over rock, and cliff ledges and faces.
Schistostega pennata	Yes	A	Mineral soil on upturned tree roots
Tetraphis geniculata	Yes	A	Cut end of rotten stumps and lower portion of large rotten logs in shaded, humid conditions from low-mid elevation.

S & M category definitions: A – Rare. Pre-disturbance surveys practical.
C – Uncommon. Pre-disturbance surveys practical.

One occurrence of *Tetraphis geniculata* was documented in Unit 6. This species has both Sensitive and Survey and Manage (category A) status. Its status as category A denotes that it is rare, pre-disturbance surveys are practical, and all known sites must be managed. This population is located in the western portion of the unit near a seasonal stream. This occurrence is relatively small, restricted to the cut face of a large, downed, decaying log. This species is vulnerable to activities such as forest thinning that remove forest canopy and the subsequent insolation and desiccation of understory habitats (Draft Management Recommendations, Bryophytes, Version 1.1 1996).

Common to the No Action Alternative and Alternatives B and D

Direct, Indirect, and Cumulative Effects

The No Action Alternative, and Alternative B and D would have no risk to species viability or a trend toward listing for *Tetraphis geniculata*. No active management activities would occur on the site and current site conditions would not be disturbed. Thus, there would be no direct, indirect, or cumulative effect on this species.

Common to the Alternatives A and C

Direct and Indirect Effects

If either of these alternatives were implemented without measures to ensure protection, the potential exists for this small population to be damaged or obliterated by ground disturbance during the tree felling and yarding operations. These effects can be eliminated by incorporating as the project design criteria of establishing a no-treatment buffer to protect the population from ground disturbance.

Key considerations for protecting *T. geniculata* from the proposed activities include protecting the occupied substrate and maintaining microclimate conditions at the site. Based on best management practices and current literature, a minimum distance of 40 feet surrounding the downed log on which the species is growing would be needed to provide physical protection during harvesting activities. In order to maintain microclimate conditions within this buffer and account for potential edge effects influencing microclimate, a 100-foot no treatment buffer was determined to be sufficient to protect the occurrence of *T. geniculata* and adjacent microclimate conditions.

By implementing the required 100-foot radius no treatment buffer listed in the project design criteria (see Chapter 2), there would be no direct or indirect effect and no risk to species viability or a trend toward listing.

Cumulative Effects

Because there are no direct or indirect effects, there would be no cumulative effects associated with these alternatives on *Tetraphis geniculata*.

Fungi

There are 17 Sensitive fungi species that are documented or suspected to occur on the Olympic National Forest. Sixteen of these are also categorized as Survey and Manage species that do not require pre-disturbance surveys (see Table 31). Only one, *Bridgeoporus nobilissimus*, has characteristics that make it feasible to conduct pre-disturbance surveys, as this rare fungus has a perennial conk (Hibler and O'Dell 1998). The other sixteen of the Sensitive fungi are seasonal in nature, with fruiting bodies in the fall or spring, but not predictable from one year to the next.

Table 31. Fungi on Regional Forester's Sensitive Species and Survey and Manage Lists documented or suspected to occur on the Olympic National Forest.

Fungi Species	Status	Ecological Function
Albatrellus avellaneus	Sensitive; Survey & Manage Category B	Mycorrhizal
Albatrellus ellisii	Sensitive; Survey & Manage Category B	Mycorrhizal
Bridgeoporus nobilissimus	Sensitive; Survey & Manage Category A	Wood saprobe
Clavariadelphus occidentalis	Sensitive; Survey & Manage Category B	Mycorrhizal
Cordyceps capitata	Sensitive	Parasite
Gomphus kauffmanii	Sensitive; Survey & Manage Category E	Mycorrhizal
Gyromitra californica	Sensitive; Survey & Manage Category B	Wood/Litter Saprobe
Leucogaster citrinus	Sensitive; Survey & Manage Category B	Mycorrhizal
Phaeocollybia attenuata	Sensitive; Survey & Manage Category D	Mycorrhizal
Phaeocollybia fallax	Sensitive; Survey & Manage Category D	Mycorrhizal
Phaeocollybia oregonensis	Sensitive; Survey & Manage Category B	Mycorrhizal
Phaeocollybia piceae	Sensitive; Survey & Manage Category B	Mycorrhizal
Ramaria cyaneigranosa	Sensitive; Survey & Manage Category B	Mycorrhizal
Ramaria gelatiniaurantia	Sensitive; Survey & Manage Category B	Mycorrhizal
Ramaria stuntzii	Sensitive; Survey & Manage Category B	Mycorrhizal
Sarcodon fuscoindicum	Sensitive; Survey & Manage Category B	Mycorrhizal
Spathularia flavida	Sensitive; Survey & Manage Category B	Litter Saprobe

Survey & Manage Category A – Rare. Pre-disturbance surveys practical.
Survey & Manage Category B – Rare. Pre-disturbance surveys not practical.
Survey & Manage Category D – Uncommon. Pre-disturbance surveys not practical.
Survey & Manage Category E – Rare. Status undetermined.

In the 2004 Survey and Manage ROD, the assumption was made that species that were not considered "survey practical" under the Survey and Manage Standards and Guidelines (most category B & D species, including most fungi), would not require survey under the Sensitive Species Program (USDA & USDI 2004, pg. 6). Rather, other components of pre-project clearances would be utilized to analyze potential risks to the species resulting from project activities. The other components include known range information, review of existing records, inventories and spatial data, potential for suitable habitat, and evaluation of likelihood of occurrence in the project area.

An analysis of 16 of the seasonal fungi species resulted in a low likelihood of occurrence in the proposed project area because the distance to any known site is substantial (> 20 miles) and no suitable late successional forest habitat or legacy components would be disturbed.

Bridgeoporus nobilissimus was not found during surveys conducted on July 8, 2004, and none of the other 16 sensitive fungi species have known sites documented in the project area, based on a review of the Survey and Manage 2006 GeoBob database.

Common to all Alternatives (No Action, A, B, C and D)

Direct, Indirect, and Cumulative Effects

There are no known or suspected occurrences of Sensitive or Survey and Manage fungi species in the project. Therefore, none of the alternatives considered for this project would have any direct, indirect, or cumulative effects on these species.

Lichens

The pre-field analysis for Sensitive and Survey and Manage lichen species revealed no known sites in the Jackson Thinning project area. The project area does contain suitable habitat for 18 Sensitive and Survey and Manage lichen species documented or suspected on the Olympic National Forest (Table 32). Field surveys were conducted for these species in August 2005 and July 2006.

Table 32. Forest Service Sensitive and Survey and Manage lichen species with potential habitat in the project area.

Scientific name	Status		Habitat
	Forest Service Sensitive	S & M Category	
Bryoria pseudocapillaris	No	A	Immediate coast, at sites with frequent fog. On exposed coastal trees in Sitka spruce forest near water.
Dendriscocaulon intricatulum	Yes	A	Mesic forests in TSHE and ABAM Zones, mature old-growth stands, both riparian and not. On lower twigs of suppressed understory trees.
Hypogymnia duplicata	No	C	OG (often ≥ 400 years old) in high precipitation areas
Leptogium cyanescens	No	A	TSHE/ABAM forests, 1400-1600 ft. elevation
Nephroma occultum	Yes	C	OG (often ≥ 400 years old) PSME, TSHE, ABAM forests, mid-upper canopy

Scientific name	Status		Habitat
	Forest Service Sensitive	S & M Category	
Niebla cephalota	No	A	Strictly coastal, on exposed trees or rock at low elevation (<250 ft.) within the coastal fog zone.
Pseudocyphellaria rainierensis	No	A	OG, on conifers in cool, humid forests in the TSHE and ABAM Zones
Cetrelia cetrarioides	Yes	None	On bark, mainly Alnus rubra and hardwoods in moist riparian and valley bottom forests.
Collema nigrescens	Yes	None	On bark of broad-leaved trees and shrubs in low elevation forest, often riparian.
Dermatocarpon luridum	Yes	None	Grows on rocks, boulders and bedrock in streams, rivers or seeps between 1,000-6,500 ft. in elevation. Usually submerged or inundated for most of the year.
Erioderma sorediatum	Yes	None	Found growing on riparian Alnus rubra in coastal fog zone.
Leiodermia sorediatum	Yes	None	On ericaceous shrubs and riparian Alnus rubra in damp, humid habitats.
Leptogium burnetiae var. hirsutum	Yes	None	Typically epiphytic but also on decaying logs, mosses and rock.
Nephroma bellum	Yes	None	In moist forests often on riparian hardwoods.
Peltigera neckeri	Yes	None	On mossy logs, soil and tree bases, especially in wet habitats such as lowland forests.
Peltigera pacifica	Yes	None	On soil, moss, rocks, logs, and tree bases in low elevation, moist forests.
Platismatia lacunosa	Yes	None	On boles and branches of hardwoods and conifers in moist, cool, upland sites as well as moist riparian forest.
Usnea longissima	Yes	None	Epiphytic, fruticose species found in coniferous or hardwood stands and riparian areas.

Survey & Manage Category A – Rare, pre-disturbance surveys practical.
Survey & Manage Category C – Uncommon, pre-disturbance surveys practical.

Usnea longissima, a Sensitive lichen species, was the only Sensitive or Survey and Manage lichen species found. This species was found in Units 1, 2, 5, 16, and 20. In each unit, only one occurrence of the lichen was found. All of the occurrences were relatively small,

consisting mostly of 1-2 strands of the lichen. This species is not effective at dispersing long distances and its viability, both at the local and landscape scale, is closely tied with the presence of a propagule source (Derr et al. 2003). Therefore, the viability of a population could be compromised if the propagule source is isolated from adjacent suitable habitat.

No Action Alternative

Direct, Indirect, and Cumulative Effects

The No Action Alternative would have no risk to species viability or a trend toward listing for *Usnea longissima.* No active management activities would occur on the site, and current site conditions would not be disturbed. Therefore, there would be no direct, indirect, or cumulative effect to this species.

Common to all Action Alternatives (Alternatives A, B, C, and D)

Direct and Indirect Effects

If any of these alternatives were implemented, the potential exists for these small populations to be damaged by tree felling or become isolated from adjacent suitable habitat. These effects can be eliminated by incorporating the project design criteria of establishing a no-treatment buffer around the *Usnea longissima* sites.

Lichen diversity in Pacific Northwest forests is often associated with canopy openings, hardwood trees and shrubs, and remnant large trees (Chan et al. 2004, Neitlich and McCune 1997). All of the *U. longissima* occurrences in the project area were found in association with hardwood trees and shrubs, and canopy openings. The main threat to *U. longissima* from the proposed activities is removing or damaging the porpagule source (host tree or trees). Based on best management practices, a 75-foot radius no treatment buffer would safeguard the propagule source tree(s) and physically protect the occurrence during project activities. Therefore, by implementing the required no treatment buffer listed in the project design criteria (see Chapter 2), there would be no direct effect and no risk to species viability or a trend toward listing.

Cumulative Effects

With the implementation of the project design criteria, there would be no direct or indirect effects to the species. Therefore, there would no cumulative effects associated with these alternatives on *Usnea longissima*.

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." Prevention of invasive plant spread or new infestations, along with timely treatment and monitoring of infestations are key objectives for the Olympic National Forest (2080 letter from Forest Supervisor, 2/4/2005).

Invasive species surveys were conducted during August 2005. Ten invasive vascular plants were documented in the project area.

Table 33. Invasive plants documented in the project area.

Scientific name	Common name	Washington State Weed Classification[31]
Cirsium arvense	Canada thistle	C
Cirsium vulgare	Bull thistle	C
Cytisus scoparius	Scotchbroom	B
Geranium robertianum	Herb Robert	B
Hypericum perforatum	St. John's Wort	C
Hypochaeris radicata	Hairy catsear	B
Lathyrus latifolius	Everlasting peavine	unclassified
Leucanthemum vulgare	Oxeye daisy	B
Phalaris arundinacea	Reed canary grass	C
Senecio jacobaea	Tansy ragwort	B

No Action Alternative

Direct and Indirect Effects

The no-action Alternative would result in continued spread and new infestations of invasive plant species in the project area primarily where existing road use occurs.

Cumulative Effects

Under the No Action Alternative, existing infestations of invasive plant species would likely continue to spread via future road management activities and other forest use and would eventually extend beyond the project boundaries into adjacent areas outside the project area.

[31]*Washington State Weed Classification: B – non-native species presently limited to portions of the state, C – non-native weeds widespread in the state*

Common to all Action Alternatives (Alternatives A, B, C, and D)

Direct and Indirect Effects

Under the action alternatives, there would be newly exposed ground produced in the areas of new and reconstructed roads and helicopter landing sites. These areas would be susceptible to noxious weed and invasive plant colonization, particularly since there are already invasive species documented in the immediate adjacent area that could provide a ready seed source.

In order to control noxious weed colonization and spread under the proposed action, however, weed-spread prevention and weed eradication activities would be implemented before, during and after project activities (see Project Design Criteria and Potential Additional Restoration/Improvement Opportunities). Prevention and control measures have been analyzed and proven effective as documented in the final environmental impact statement for the Pacific Northwest Region Invasive Plant Program (USDA 2005). Implementation of the proposed project with mitigations would provide positive results in the prevention of invasive plant spread and treatment of current infestations.

Cumulative Effects

Past activities that have likely contributed to the spread of invasive plant species include but are not limited to the following:

- Construction of gravel and paved roads providing ease of access to the watershed,
- Past timber harvest activities using machinery imported from other geographic areas containing different invasive species propagules, and
- Erosion control measures and forage seeding projects introducing non-native invasive plant species in seed mixes and straw sediment barriers.

On going road maintenance in the form of blading, ditch pulling and hauling away of associated debris to waste sites is also currently spreading some of these species, as is the use of material for resurfacing from infested rock sources.

Future activities that may impact the spread of invasive plant species either positively or negatively include:

- Timber harvest on adjacent Washington State Department of Natural Resource land that could potentially introduce additional unwanted species to National Forest lands via timber hauling on Forest Service roads.
- Forest Service road decommissioning and culvert replacement projects.
- Proposed forage enhancement projects.
- Proposed additional weed treatment projects.

Many of the activities that occurred in the past took place during a time when there was little or no awareness of the detrimental impacts of invasive plant species, and probably no

consideration was given to this issue during that period resulting in their marked spread upon the landscape. In some cases non-desirable species were introduced with good intent, such as increasing animal forage or for erosion control. The emphasis on prevention and control of invasive plant species is relatively recent. Forest practices and direction have evolved, as have the knowledge and awareness regarding these species.

A number of these future projects would provide opportunities for a reduction in the abundance of invasive species. Road decommissioning would allow these disturbed areas to return to a more natural state, revegetating where possible with native species or non-persistent nonnatives, and over time a canopy would generate that would shade out the less shade tolerant weed species. Revegetation of helicopter landings and temporary roads with native species for erosion control would help occupy a niche that might otherwise be colonized by invasive species. These projects combined with proposed manual and herbicide treatment of weeds would have positive results in the prevention of invasive plant spread and treatment of current infestations.

Recreation

Impacts of this project on recreation, particularly regarding Mt. Walker, was identified as a significant issue.

Mount Walker is one of the few high elevation vista points on Hood Canal which is readily accessible by passenger vehicles from Highway 101, and is an important recreation use area on the eastern side of the Olympic Peninsula. Forest Service Road 2730 (Mt Walker Road) and Mt. Walker Trail # 894 provide access to the two developed observation areas at the summit of Mt. Walker. Mt. Walker Observation Sites are classified in the Recreation Opportunity Spectrum (ROS) class as “Roaded” (USDA 1990b). This class provides the opportunity to experience a high to moderate degree of isolation from the sights and sound of humans, in an environment that is moderately altered and generally accessible by passenger vehicles. The summit of Mt. Walker is a recreation administrative site.

Mt. Walker Trail received 2,037 hikers in 2005 as recorded on the trailhead registers, with just over half of the use occurring during the 4 ½ month period the road is closed during the winter. The trail has a 2,005 foot elevation gain, and is used by many people including organized hiking clubs as an exercise trail (USDA 1990b).

The Mt. Walker trail and viewpoint are part of the Olympic Bird Loop of the Great Washington State Birding Trail. The Loop, created in February 2007, provides opportunities for year-round bird watching on the Olympic Peninsula. Bird watching opportunities on Mt. Walker generally occur from early spring through early fall.

The most recent traffic figures for Mt. Walker Road were taken from traffic counters and identified in the Spencer Pilot Projects (USDA 1992). The traffic count for 1989, the most recent traffic count for Mt. Walker, was 10,000-12,000 vehicles per year, or approximately 39,800 visitors.

Weather conditions on Mt. Walker are affected by a strong marine influence that is typical of the weather patterns in Western Washington and Puget Sound. With an upper elevation of 2,804 feet, weather conditions can change through out the day, with the marine layer burning off in the afternoons. High use recreation occurs on weekends April through Early November and on partly to mostly sunny days; Moderate Use occurs during summer weekdays; and Low Use occurs weekdays before Memorial Day and after Labor Day. The Mt. Walker Road is traditionally gated closed from mid-November to late-March due to icy road conditions at the summit.

No Action Alternative

Direct, Indirect, and Cumulative Effects

The No Action Alternative would not affect recreation opportunities in the project area. Roads and trails within the project area would remain accessible to the public, and would continue to be managed to allow access for driving to scenic vistas, photography, wildlife viewing, firewood or mushroom gathering, hunting, or dispersed camping. The developed observation sites on Mt. Walker would continue to be managed for high recreation use. Mt. Walker Trail would remain open year round, and would continue to allow people to enjoy hiking for exercise or pleasure. Indirect impact include less diverse vegetation and foregoing potential additional funds to improve recreation facilities on Mt. Walker (see page 52). Given that there would be no change to existing recreation resources; there would also be no cumulative effect to recreation resources.

Common to Alternatives A, C, and D

Direct Effects

Public Use: For public safety, project implementation in Units 20, 22 and the north portion of unit 23 in Alternative A would require the closure of public access to Mt. Walker. This is expected to occur during the months of June - February and to last 1 to 3 years for Alternative A. Closures for Alternatives C and D would occur June - February of the first year, then August 6 – February 28 in following years and would last 1-3 years. There would be notices and news releases prior to the closure and subsequent updates as circumstances warrant. Alternative recreation opportunities for hiking, sightseeing would be provided by notification through news releases and postings at the entrance to Mt.Walker Road. During the closure, recreationists would be prohibited from driving or hiking on Mt. Walker. Given the timing of expected project implementation on Mt. Walker, the area would be closed during approximately 75% of the travel season for both vehicle and trail travel during the first year; and approximately 33% of vehicle travel season and 58% of trail travel season during years 2 and 3. Alternatives C and D would allow approximately 25% more time for all travel when public access would be permitted, since helicopter logging in Unit 23 would not require access closure during operations.

Coordination and timing of the logging operations due to wildlife restrictions and weather variables are key issues in the length of time the Mt. Walker Road and Trail would need to

be closed for public entry. Cable logging operations take longer than helicopter logging, but could be completed in less time since weather conditions or availability of a helicopter would have less of an impact on project completion. With a combination of cable and helicopter logging, both could be functioning at the same time. Project implementation of units 20, 22, and the northern portion of Unit 23 could occur simultaneously to lesson the necessary closure of access to Mt. Walker. Operational timing restrictions for Mt. Walker are noted below, followed by estimates of the time required to implement the project on Mt. Walker, and associated periods of public closure.

Restrictions influencing logging operations

- Tree felling may occur any time, except in the north section of unit 20 due to nearby suitable habitat for the northern spotted owl and marbled murrelet.
- Preferred time for logging is summer through the winter due to tree sap flow in the spring.

Helicopter Logging –wildlife restrictions	
August 6 – September 15	2 hours after sunrise and two hours before sunset
September 16- February 28	No hour restrictions
March 1- August 5	No operations, (some operations may be allowed depending on decibel level of helicopter being used)

Cable Logging – Wildlife restrictions	
Operate year round	All units except as noted below.
August 6- February 28	North ½ of Unit 20

Estimated duration of public closure due to project implementation on Mt. Walker

ALT A - CABLE LOGGING		
# Acres		**Total estimated duration for implementation and public closure**
73 acres (Units 20 and 23)	1 acre/day, 5 days/week	Approx 5 months
ALT A-HELICOPTER LOGGING		
139 acres (Units 20 and 22)	Operate 7 days/week (weather dependent)	Approx. 7 months 1 season +
ALT-C & D- HELICOPTER LOGGING		
168 Acres (Units 20 and 22)	Operates 7 days/week (weather dependent)	Approx 7 months, but expect up to 3 seasons due to weather, helicopter availability, and market for logs.

Administrative Recreation Uses and Costs: Yearly trail maintenance within the observation area and on the trail could be suspended for up to 3 years due to closures from the timber sale. This would add to the complexity and time required for trail clearing and maintenance. Costs of maintenance would increase for the first season the trail opens after project implementation on Mt. Walker.

Harvest Effects: Following project implementation, evidence of the harvesting operations from cable logging in Units 20 and 23 (Alternative A) would have the greatest potential visual impact when compared to helicopter logging. Yarding corridors and landing sites located on and adjacent to the road in the Mt. Walker summit administrative recreation site and on the downhill side of road 2730 in Unit 23, evidence of cable logging at the summit of Mt. Walker, and harvesting operations from helicopter logging in Alternatives A, C, and D (noticed as an increase in open space between the remaining trees with little ground cover, and visible stumps and slash within the units) would be observable for approximately 1 year until rhododendrons, salal, and other ground cover filled in under the trees. Project design criteria would be implemented to minimize visual impacts of harvest debris, stumps, lack of vegetation in landing sites, and to discourage usage from developing in openings created by logging operations. In the long-term, visitors would be able to enjoy seeing more diverse vegetation as they drive or hike to the Mt. Walker summit.

Figure 16. Skyline cable yarding corridors (before and after thinning). These pictures look directly down the cable corridors where they are most noticeable. Skyline yarding corridors are constructed prior to thinning (see first picture), so that the variable density thinning prescription takes into account the space created by the corridors. The corridors are less obvious following thinning, as shown in the second picture.

Administrative Recreation Uses and Costs: The Rocky Brook Area is accessed by the 2620 road system and is managed for dispersed recreation. Due to budget constraints, this area is visited by recreation crews only when reports of problems arise, such as illegal dumping or litter. Fire crews make public contact when they patrol the area for illegal and abandoned fires during summer months. Logging activities would temporarily shift dispersed recreation use in the Rocky Brook Area to other road systems; most likely to the nearby Big Quilcene Recreation Area. Interest in firewood permits, questions about access to the Rocky Brook Area, and curiosity about progress of the timber harvest would increase inquiries at the Hood Canal District Ranger Station.

Indirect Effects

Indirect impacts of closing Mt. Walker to public access include higher rates of visitation to nearby recreation areas, including the Dosewallips Rec. Area; Duckabush Rec. Area (Duckabush River Trail, Murhut Falls Trail, & Ranger Hole Trail); Big Quilcene Rec. Area (FS Road 27, Lower Big Quilcene Trail, Notch Pass Trail) Hwy 101 Mt. Walker/Seal Rock Area (Falls View and Rainbow Falls Trails, Seal Rock Day Use Area and Trails, and Dosewallips State Park). Other potential visitors would choose to stay home or plan their trip elsewhere, resulting in a potential impact to the economy of nearby communities. Economic impacts to local businesses are not well known, but would be expected to last until Mt. Walker is reopened to the public.

Cumulative Effects

Over the years, the amount of roads open to the public have continued to decline as private landowners, the Department of Natural Resources, and the Forest Service have closed their roads for security, maintenance cost, or liability reasons. Along with administrative closures, flooding in 2002 washed out the nearby Dosewallips Road and blocked vehicle access to Elkhorn Campground, and eastside Dosewallips entrance into Olympic National Park. Access to Mt. Jupiter Trail is closed due to logging on private lands. Tunnel Creek Trail usage would change from day use to overnight use with potential closure of 2 miles of the 2740 Road. Added to other closures, restricting access to Mt. Walker would shift recreation use to other nearby developed or dispersed recreation sites, or would cause people to find other areas to visit.

Due to declining recreation budgets on the Olympic National Forest, the forest is currently investigating different alternatives to manage and maintain facilities. Closure of access to Mt. Walker would remove this recreation site from inclusion into any considerations of managing recreations sites via concessionaire during the period of project implementation. The incremental affect of the closure of Mt. Walker would contribute to the reduction of recreational opportunities on the eastside of the Olympic Peninsula during the project's implementation on Mt. Walker. This project, however, would not create significant cumulative effects, given that the closure to Mt. Walker would be temporary, and alternative recreation sites are available, including other Forest Service trails and entrance to the Olympic National Park within a couple hours drive.

Alternative B

Direct and Indirect Effects

Public Use: Alternative B would exclude Mt. Walker from logging activities and would not affect recreation opportunities on Mt. Walker. The other units in the Jackson Thinning project are in the Rocky Brook Area off the 2620 road system. There are no developed recreation sites off the 2620 road, and this area is used by the public for dispersed recreation. Alternative B would have some impact on dispersed activities that center around driving to scenic areas, photography, wildlife viewing, firewood or mushroom gathering, hunting, and dispersed camping.

Administrative Recreation Uses and Costs: The Rocky Brook Area is accessed by the 2620 road system and is managed for dispersed recreation. Due to budget constraints, this area is visited by recreation crews only when reports of problems arise, such as illegal dumping or litter. Fire crews make public contact when they patrol the area for illegal and abandoned fires during summer months. Logging activities would temporarily shift dispersed recreation use in the Rocky Brook Area to other road systems; most likely to the nearby Big Quilcene Recreation Area. Interest in firewood permits, questions about access to the Rocky Brook Area, and curiosity about progress of the timber harvest would increase inquiries at the Hood Canal District Ranger Station.

Cumulative Effects

No significant cumulative effects would be associated with this alternative. Interruptions to dispersed recreation activities in the area would return to pre-logging levels within approximately 1-2 years after project implementation.

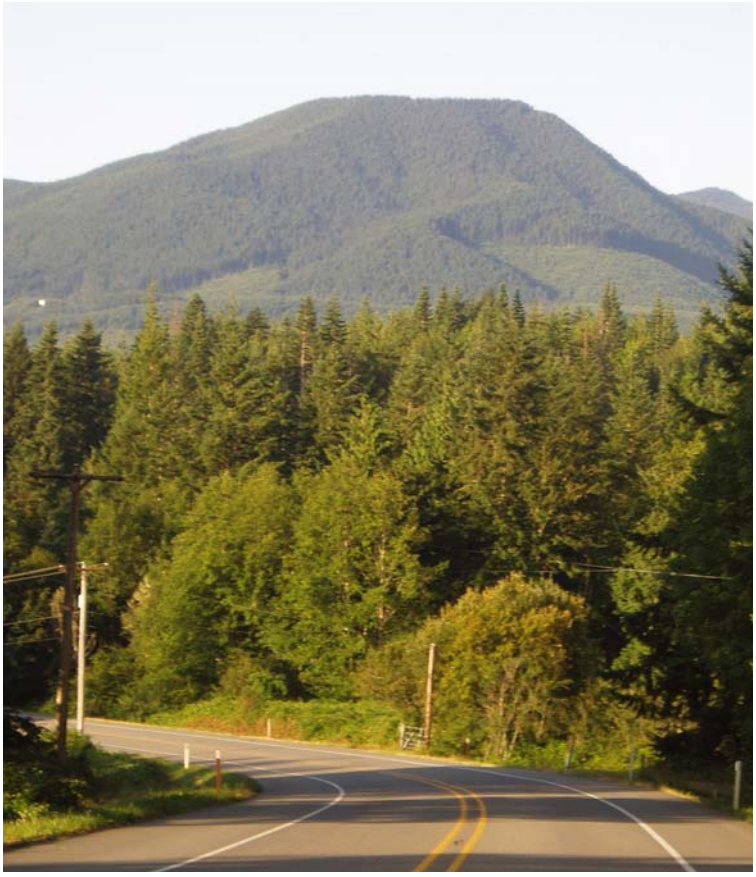
Visual Quality

Mt. Walker and the north and eastern slopes of Buck Mountain (located to the southwest of Mt. Walker) are classified as “common” or “typical” landscapes within the Olympic’s Characteristic Landscape. They consist of steep slopes, which are moderately dissected and covered with a continuous texture of conifer forest from the toe of the slopes to the ridge/mountain tops. On Forest Service land, there are no existing or visible natural openings within the forest canopy as viewed from Highway 101, Mt. Walker Road, Mt. Walker Trail, and waters of Puget Sound (Dabob Bay).

The Olympic National Forest Plan visual quality objectives within the project planning area include “high scenic integrity” (referred to in the Forest Plan as “retention”) for the visual foreground (0-0.5 miles) along Highway 101, Mt. Walker Road, Mt. Walker Trail, and Dabob Bay, and “moderate scenic integrity” (referred to as “partial retention” in the Forest Plan) for the middleground (0.5-5 miles) and background (beyond 5 miles) areas viewed from Highway 101, Mt. Walker Road, Mt. Walker Trail, and Dabob Bay. To meet high scenic integrity requirements, landscape character appears intact. Deviations may be present but must repeat

the form, line, color, texture, and pattern common to the landscape character so completely that at such scale they are not evident. Moderate scenic integrity requirements allow the landscape to appear slightly altered, but noticeable deviations must remain visually subordinate to the landscape character being viewed. Proposed thinning units that are subject to “high scenic integrity” visual quality objectives are Units 20 through 24, all of which are on Mt. Walker and total approximately 530 acres. Virtually all of these units maybe considered within the foreground zone (within 0.5 miles) of Highway 101 or the Mt. Walker Road, although the entire area is not necessarily within visual sight from either travelway. Unit 8 and the eastern portions of Units 11, 17, and 18 fall within the middleground of the Highway 101 visual corridor, and have the visual quality objective of “moderate scenic integrity” (referred to as “partial retention” in the Forest Plan). The remaining project area has visual quality objectives of “low scenic integrity” (“modification”) or “very low scenic integrity” (“maximum modification”), in which the landscape may appear moderately altered or heavily altered.

Figure 17. Current view of Mt. Walker's northeast side from town of Quilcene (Center Road). Evidence of harvesting activities on the lower slopes of Mt. Walker are on non-Forest Service land.



No Action Alternative and Alternative B

Direct, Indirect, and Cumulative Effects

Because no activity would occur under the No Action Alternative, the visual quality on Forest Service land in the project planning area would not change. Alternative B would not include any thinning activities on Mt. Walker, and other units proposed for thinning would not be evident from the Highway 101 corridor. Therefore, there would be no direct, indirect, or cumulative effect to visual quality under either alternative.

Alternatives A, C, and D

Direct and Indirect Effects

Alternatives A, C, and D propose to conduct thinning activities using helicopter and cable yarding systems in areas that have Visual Quality Objectives (primarily Mt. Walker and Unit 8).

Given the sensitivity of visual quality on Mt. Walker, visual modeling of the Mt. Walker area was conducted by the University of Washington's Olympic Natural Resource Center using the Landscape Modeling System and Stand Visualization to create images of how visual quality might be impacted from the proposed thinning. Four viewpoints were selected along Highway 101 that had the best views of Mt. Walker to model how the stand would look untreated and treated. Figure 18 through Figure 21 show selected pictures of how the model depicts Mt. Walker would look unthinned and immediately after thinning when potential visual impacts, if any, would be most evident.

Figure 18. LMS/VS model of the north side of Mt. Walker looking at Unit 20, unthinned.[32] From this perspective, Mt. Walker is in the visual middleground, and a visual quality objective of "moderate scenic integrity" ("partial retention") would apply.

Figure 19. VMS/VS model of the north side of Mt. Walker looking at Unit 20, thinned.[33]

[32] *The VMS/MS modeling does not depict management activities on non-Forest Service land, and such areas are shown as forested areas.*

[33] *Slight distinctions between Figures 18 and 19 are more dicernable in color, as can be seen via the online version of this document at http://www.fs.fed.us/r6/olympic/projects-nu/index.shtml.*

Figure 20. LMS/VS depiction of Mt. Walker Unit 21 unthinned (left) and thinned (right) from the most direct view on Hwy 101. From this perspective, Mt. Walker is in the visual foreground, and a visual quality objective of "high scenic integrity" ("retention") would apply.

Figure 21. Visual modeling of Unit 21 unthinned (left) and thinned (right) from nearest point on Hwy 101. From this immediate foreground perspective of Mt. Walker, the visual quality objective of "high scenic integrity" ("retention") would apply.

Under Alternative A, portions of Units 20 and 23 would be cable-yarded. The rest of the units on Mt. Walker would be helicopter logged. Under Alternatives C and D, all of the proposed thinning units on Mt. Walker would be helicopter logged. Where possible under these alternatives, helicopter and log landings would be located on existing roads, clearings, and other areas that would not be visually evident to the casual forest visitor from the visual foreground of Highway 101, Mt. Walker Road, Mt. Walker Trail, and Dabob Bay.

Figure 3 through Figure 5 in Chapter 1 show the visual changes of a forest stand prior to thinning, immediately after thinning, and one year following thinning. Project design criteria that are applicable to all action alternatives would serve to further minimize visual impacts. Visual impacts to the foreground view would be reduced by locating skyline cable yarding corridors such that drivers do not look directly down one when approaching an intersection on Mt. Walker; leaving a no-cut buffer area of 66 feet on either side of the Mt. Walker Trail; flush cutting stumps within 100 feet of the Mt. Walker trail and the Mount Walker Road; and minimizing disturbance within 100 feet of the Mt. Walker Road. Additionally, because the width of cable yarding corridors are minimized such that some canopy remains over the corridor and match the approximate distance between trees that the surrounding forest would be thinned to, the yarding corridors are not expected to be evident from the middle and background views. There would be a period of time when the landings and cable corridors may be discernable, but this is not expected to be longer than one growing season (1 year) once the vegetation re-establishes.

As viewed from the various travel routes and Mt. Walker summit, past projects of similar nature have shown that this type of management activity would not be evident to the casual forest visitor (see Figure 22 and Figure 23). As shown in Figure 23, cable corridors and log landings would not be evident by looking at the forest canopy from as close as foreground distances. The visual modeling and pictures from similar projects support the conclusion that visual quality objectives on Mt. Walker would still be met under all alternatives (Alternatives A, C, and D) that propose to thin forest stands on Mt. Walker. As stated in the section on effects to recreation, in the long-term visitors would be able to enjoy seeing more diverse vegetation as they drive or hike to the Mt. Walker summit.

Areas proposed for treatment that are not on Mt. Walker would receive similar thinning treatments. The thinning treatments may be more obvious than the thinning proposed on Mt. Walker when viewed in the foreground zone prior to the re-establishment of vegetation, however, due to the presence of stumps, created gaps, and decommissioned unclassified, abandoned and new temporary roads. The middleground and background views would be similar to the pictures shown in Figure 22 and Figure 23. Some breaks in the tree canopy may be visible from roads and gaps created, but they would remain subordinate to the characteristic landscape, particularly when looking up from Highway 101. Because of the low amount of expected alterations to the visible landscape character as seen from Highway 101 of Unit 8 and the portions of Units 11, 17 and 18 that are designated as A2 Scenic, visual quality in these areas would be well within the threshold of the designated “moderate scenic integrity” (“partial retention”) visual quality objective. The same assessment applies for the rest of the project area in complying with associated “low scenic integrity” (“modification”), and “very low scenic integrity” (“maximum modification”) visual quality objectives.

Figure 22. Picture of a recent thinning project. The thinned unit is under old-growth behind the helicopter. All trees had already been cut and were being helicopter yarded when the picture was taken.

Figure 23. Picture of a recently completed commercial thinning project using cable yarding methods from a distance of approximately 1/3 mile. The area shown includes ½ mile of temporary road and approximately 80 landings and skyline yarding corridors.

Cumulative Effects

Clearcut logging activity on private lands in the vicinity of Mt. Walker along Highway 101 are visually apparent. Relative to past and current activities on non-Forest land adjacent to Highway 101 and Mt. Walker, this project, however, is not expected to contribute significantly to diminishing the scenic quality of Mt. Walker or along Highway 101. The thinning activity on Mt. Walker would maintain a closed canopy cover appearance, and visible evidence of landings and cable corridors would be minimized through the implementation of project design criteria and last a short period of time. In the long-term visitors would be able to enjoy seeing more diverse vegetation as they drive or hike to the Mt. Walker summit. Therefore, there would be no significant negative cumulative effects under any alternative.

Economic Viability

Given that the primary Purpose and Need of this project is ecological in nature, the generation of maximum revenue is not a priority. Cost-effectiveness, however, is still an important aspect of any project plan. Because the only certain funding source to accomplish the Purpose and Need is through the sale of wood products that would be removed as part of the treatment, accomplishing the project objectives would not be possible if the project were not commercially viable. Trade-offs also need to be considered between project design features

included that would increase the cost of implementation (e.g., helicopter logging) and the net revenue available for projects that could only be implemented as part of the project through the use of funds available through timber sale receipts (e.g., the decommissioning of system roads or abandoned roads that are in the sale planning area but are not used as part of the timber sale).

The Forest Service's regional TEA.ECON (version 5.2) economic analysis tool was used to evaluate the alternatives. 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, selling value of wood products, and implementation costs. The estimated value of wood products is based on regional selling values and the value that local ranger districts are receiving from actual timber sale offerings. These values take into account tree species, tree size, and wood quality. The estimated implementation cost is also based on regional logging cost values, as well as local timber sale logging costs. These sales have included ground-based, cable, and helicopter costs. The estimated revenue can increase and decrease over time and by sale offering because of fluctuations in local and regional lumber prices. If a timber sale offering is bid higher than the appraised value, then there would be more revenue return to the US Treasury or available for qualifying restoration or improvement projects.

This analysis only takes into consideration identifiable and quantifiable economic benefits and costs and does not include nonquantifiable economic benefits. This may create an inherent bias since cost and budget information is typically more readily available than economic benefit information. Nonquantifiable benefits, such as improved wildlife habitat, however, are reflected in other areas of this chapter for the public's and responsible official's consideration.

The socio-economic environment affected by activities within the Olympic National Forest is discussed in the Olympic National Forest Plan Final EIS (USDA 1990a), the Forest Ecosystem Management Analysis Team (FEMAT) Report (1993), and the Northwest Forest Plan FEIS (USDA and USDI 1994b). The role of the wood products and forestry service contract industries in the economies of the northwest are discussed in these documents.

No Action Alternative

Direct, Indirect, and Cumulative Effects

The no action alternative would have no direct costs or benefits. Because there would be no change from the existing condition, there would be no cumulative effects from this alternative.

Common to all action alternatives (Alternatives A, B, C, and D)

Direct and Indirect Effects

For all action alternatives, the estimated revenue generated would exceed the cost of project implementation. The summary of the financial analysis of each alternative is provided in Table 34. Alternative A would have the greatest present net value, although Alternative B would

have the highest benefit to cost ratio. The alternative with the third and fourth highest present net value and benefit to cost ratios are Alternative D and Alternative C, respectively.

All action alternatives could provide funding and other indirect economic benefits by helping maintain the wood products and forestry service contract industries.

Cumulative Effects

While wood that comes off of the Olympic National Forest lands represents a small percentage of harvest timber on the Olympic Peninsula, each of the action alternatives would contribute wood products to the local economy and support jobs. There would be no adverse cumulative effects to the economy with any of these action alternatives.

Table 34. Summary of Financial Analysis Results[34]

Alternative	Estimated timber volume harvested (MBF)	Product Value (in millions)	Project Cost (in millions)	Present Net Value (in million)	Benefit to Cost Ratio
No Action	0	0	0	0	0
A	32,406	$2.33	$1.06	$1.26	2.19
B	22,504	$1.87	$0.74	$1.23	2.53
C	32,410	$1.57	$1.06	$0.50	1.47
D	27,426	$1.97	$0.90	$1.07	2.19

Heritage Resources

Ethnographic

The Northeast side of Hood Canal on the Olympic Peninsula is within the historic ancestral territory of several tribes including the Chemakum, Klallam, and Twana. Ethnographic observation and recorded origin stories indicate a long history for the traditional territories of the local tribes, the Klallam territory included lands between Discovery Bay and the Hoko Rivers, Twana territory included lands on both sides of Hood Canal, and the Chemakum territory ranged from the mouth of Hood Canal to Discovery Bay (Eells 1985). Although territories have been delineated between the tribes, interaction and intermarriage was common, blurring the boundaries between tribal territories.

At the time of contact with Europeans, a maritime settlement and subsistence focus was common throughout the Hood Canal area and the larger Pacific Northwest region (Eells 1985; Elmandorf 1960). Large, semi-permanent villages were abundant along the coast,

[34] *The financial analysis results are based on best available information on selling values and costs at the time of the analysis and should be used only to compare relative costs and benefits between alternatives. Actual costs and benefits during project implementation may vary from these estimates.*

especially at the mouths of rivers. Large villages also occurred inland, at river and stream confluences, as well as near lakes and prairies, but these were relatively rare. Subsistence was focused on marine resources, with an emphasis on mass-harvesting of salmon during the spring and summer months. During the fall, however, small groups moved inland to hunt and gather terrestrial resources, focusing on deer, elk, and other mammals, riverine fish, and plants and berries. In the winter, when most resources were scarce, groups returned to large semi-permanent villages on the coast and subsisted largely on stored salmon.

The ethnographic data indicates that Native Americans utilized the interior of the Olympic Peninsula not only to procure resources during the fall season, but also for travel. Interior trails were utilized by individuals and groups trading, warring and visiting across the mountains. It further indicates that the use was seasonal and highly mobile.

Prehistoric

Archaeology extends our understanding of Native American culture in the Pacific Northwest back approximately 12,000 years (Ames and Maschner 1999; Matson and Coupland 1995). Within the Olympic Peninsula interior, the vast majority of prehistoric sites are classified as part of the Olcott cultural tradition (Dancy 1968; Grabert and Gaston and Jermann 1975; Grabert and Pint 1978; Munsell 1971; Stilson and Chatters 1981; Schalk and Taylor 1988). Olcott sites date between 10,000 BP and 4,500 BP and are characterized by sparse stone scatters composed of dacite leaf-shaped bifaces, flakes and debris (Bulter 1961; Kidd 1964). Olcott site location, artifact assemblage compositions, and environment reconstruction have resulted in an interpretation of Olcott as part of an interior-focused, highly mobile culture (Shaulk 1988; Matson and Coupland 1995).

European Settlement

The Olympic Peninsula was first sighted from ship deck by 18th century Spanish and English explorers looking for the Northwest Passage and fur traders (Evans 1983). However, settlement of the peninsula did not begin in earnest for another century. Initial homesteaders settled in the lowland prairies and river valleys, but were moving inland by the 1890s. Many of the first homesteaders were farmers and fishermen. However, the vast majority of settlers were involved in the timber industry, which began in the early 19th century and grew rapidly as the California Gold Rush increased the demand for lumber (Evans 1983). Ore deposits also drew prospective, but largely unsuccessful, miners to the area (Righter 1978). Finally, beginning in the 1930s the Conservation Corps (CCC) constructed numerous campgrounds, ranger stations, lookouts, bridges and miles of roads and trails across the peninsula (Righter 1978). In general, historic sites on the Olympic National Forest include logging camps and activity areas, CCC Forest Service buildings, homesteads and recreation residences.

Background research for the report identified two cultural properties within the project vicinity and included an archaeological survey of approximately 25% of the remaining project area. Two cultural properties are located within the Jackson Timber Sale vicinity: the Mt. Walker summit and the CB&N Logging Camp:

The **Mt. Walker summit** is a popular scenic overlook of the Olympic Peninsula. A trail constructed by the CCC to the summit in the 1930s first provided access to the area. A fire lookout and garage were constructed on the north end of the summit in 1931 but removed in 1967. The foundation for the garage remains and a picnic table has been set on it. The additional features on the summit are related to recreation use and include benches and vaulted toilets. Although within the area of potential affect of the Jackson Thinning project, the historic garage foundation would not be affected by the actions associated with this project.

The **CB& N Logging Camp**, 45-JE-29H, is located on the south side of Mt. Turner at the headwaters of Turner Creek (Hollenbeck 1982). Surface survey and aerial photographs indicate the site is 1/8 to 1/4 square miles in area. The camp was part of the Coates, Bishop, and McCash Logging Company which operated in the area for approximately one year in the early 1920s. When logging ceased the camp was abandoned. Evidence of the logging camp at the site today includes sleds, parallel logs for skidding, two small cabins, railroad ties, and many smaller artifacts used in daily life. This site is outside of the area potentially affected by the Jackson Thinning project and so would not be affected. Neither of these cultural properties would be affected by the Jackson Thinning project.

Survey Methodology and Results

Due to very steep side-slopes the remaining project area was determined to have very low probability for the presence of cultural resources. Steep slopes are rarely associated with human occupation or artifacts. In addition, heavy vegetation limited visibility almost exclusively to areas opened to mineral soil by tree falls. Based on the poor visibility and extremely steep slope, it was determined that a 25% survey would sufficient to test for the presence of cultural resources.

The proposed archaeological survey coverage for the Jackson Timber Sale was for 25% coverage, approximately 580 acres. However, due to the extremely steep slopes only 20%, or 454 acres, of the project area was pedestrian surveyed, with an additional 2%, or 55 acres, of adjacent road being walked or driven to identify any small, higher probability areas. Every unit was visited, but not all could be safely surveyed. Those units too steep to survey were toured by paralleling the unit by foot or vehicle along existing roads to identify benches, gaps in the trees or anything else that might increase the likelihood of cultural resources being present; none were identified. Transects of surveyed units were directed to target the flattest, highest probability terrain, while giving some sense of the potential of the overall unit. The surveys conducted were determined to be adequate given actual field conditions, and no cultural resources were identified.

No Action Alternative

Direct, Indirect, and Cumulative Effects

The No Action Alternative would have no effect on any known or as yet undiscovered cultural properties. If no action is taken then there would be no ground disturbance to impact known or as yet undiscovered cultural properties.

Cumulative Effects

The No Action Alternative would have no effect on any known or as yet undiscovered cultural resources. If no action is taken, then there would be no ground disturbance to impact known or as yet undiscovered properties. There would be no added impact to cultural resources over past, current, and foreseeable activities. Therefore, there would be no cumulative effects from this alternative.

Common to all Action Alternatives (Alternatives A, B, C, and D)

Direct and Indirect Effects

Actions common to all alternatives include timber thinning for commercial sale by ground-based, helicopter and cable extraction. These activities would result in direct disturbances to the ground through removal of trees and construction of temporary roads. Indirect disturbances would include soil erosion caused by removal of vegetation. These disturbances would have the potential to impact cultural properties by eroding cultural materials and, thus destroying provenience information. However, since there are no cultural resources identified within the area of potential effect there would be no direct or indirect effects to cultural resources. If cultural properties are found during project implementation, operations would cease until a qualified archeologist determines the appropriate mitigation measures or if any are necessary.

Cumulative Effects

Alternatives A-D proposes to construct temporary roads and thin timber stands which could result in increased erosion from loss of vegetation, a process which has the capacity to remove cultural resources. However, since no cultural properties were identified within the project area, there would be no added impact to cultural resources over past, current, and foreseeable activities and, therefore, no cumulative effects for cultural properties from any of these alternatives.

Other Effects

ACS Consistency

Information from the project area watershed analyses and late successional reserve assessments – Big Quilcene Watershed Analysis (USDA and WDNR 1994), Dosewallips

Watershed Analysis (USDA 1999), Hamma Hamma and West Hood Canal Tributaries Watershed Analysis (USDA 1997), Quilcene Late Successional Reserve Assessment (USDA 1996a), and Hood Canal North Late Successional Reserve Assessment (USDA 1996b) – were used to assess and describe the vegetative natural range of variability (Jackson Thinning EA pages 1-2, 64-72) and the aquatic systems existing condition (Jackson Thinning EA pages 135-154).

All action alternatives would meet and/or not prevent the attainment of the Aquatic Conservation Strategy Objectives at both project and watershed scales. Expected project scale impacts, primarily associated with sediment production and turbidity, would be small, localized, intermittent, and temporary and would have little effect to fish or fish habitat. At the watershed scale changes in turbidity and sediment production would not be detectable.

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 meets Northwest Forest Plan Record of Decision (ROD) standards and guidelines for management of riparian reserves as outlined in the ROD 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.

All alternatives would contribute to a restorative effect on Objective 1 by promoting the development of late-successional forest characteristics in second growth stands in portions of three watersheds and helping to meet the desired future condition for Late Successional Reserves and Adaptive Management Areas described in the Olympic National Forest Land and Resource Management Plan.

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. No treatment “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 streams would maintain the high level of vegetative complexity associated with these areas. Riparian buffer widths would be variable depending on fish presence, slope stability, sediment delivery potential and water quality considerations.

Management requirements and mitigations were developed to retain desirable habitat components in the treated stands.

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.

All action alternatives would contribute to maintaining Objective 2; no-cut buffers along all streams would protect riparian areas from disturbance and maintain connectivity along these corridors.

Alternatives A and B would have stream crossings associated with temporary road construction. All culverts installations involved with temporary roads would be above fish habitat (approximately 0.2 to 1.9 miles for resident fish habitat and 0.5 to 2.0 miles for anadromous fish habitat), so connectivity of fish habitat would not be affected. There is, however, the potential of temporarily affecting aquatic amphibian passage at newly installed culverts. Interference to amphibian passage would occur only for the duration of the project implementation and connectivity would return to pre-project conditions after the culvert is removed after project completion. Individual amphibians may be affected during the period of time that temporary culverts are in place; however it would not rise to the level of affecting amphibian populations in the project area.

Objective 3: Maintain and restore the physical integrity of the aquatic system, including shorelines, banks, and bottom configurations.

All action alternatives would contribute to maintaining Objective 3. Alternatives A and B would have stream crossings associated with temporary road construction. Stream channels would be disturbed during installation and removal of culverts on temporary roads. Streambanks, however, would stabilize one or two seasons after the culverts are removed, as vegetation is reestablished. All stream crossing are in stable landforms, and overall streambank disturbance is expected to be minor.

The physical integrity of the aquatic system would be protected primarily by designating no-cut buffers along all stream channels. Additional mitigations to minimize impacts to the physical integrity of streamcourses and wetlands at the project scale would be applied to unit delineation, road construction/reconstruction, and decommissioning treatments.

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.

All action alternatives would contribute to maintaining Objective 4, by designating no-cut buffers along all streams and by implementing best management practices, management requirements, and required mitigation measures.

Designated riparian no-cut buffers would maintain current streamside shading to protect stream temperatures. Riparian no-cut buffers would also prevent sediment generated from

timber harvesting operations from reaching stream channels. Designated stream buffers are based on slope stability, sediment delivery potential and water quality considerations.

Best management practices, management requirements and mitigations were developed to address potential impacts at the project scale, and to retain desirable habitat components in the treated stands. The measures are described in Chapter 2 under the Project Design Criteria sections for Fisheries; Riparian Areas; and Roads, Landings and Skid Trails. 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, all action alternatives would have a minor impact on water quality from newly exposed stream banks and streambeds when culverts are installed and removed. Based on past observations from large culvert removals and replacements, culvert work would likely create turbidity pulses that last for only a few hours, at most, before water clarity returns to background levels. Construction sites may continue to produce small amounts of sediment and turbidity 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. At the watershed scale, changes in the overall sediment rates would not be detectable.

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.

All action alternatives would contribute to maintaining Objective 5.

At the project 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 would 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 would promote slope stability.

At the project scale, all streams would be protected with a no-cut riparian buffer, minimal impact logging systems and mitigation measures. The measures are described in Chapter 2 under the Project Design Criteria sections for Fisheries; Riparian Areas; and Roads, Landings and Skid Trails. The project includes activities at individual sites that would result in short term increases in sediment production. For example, culvert installations work has the potential to create short term sediment movement. Sediment inputs to streams from culvert work would likely create turbidity pulses that last for a few hours, at most, before water clarity returns to background levels, based on past observations from implementation of large culvert removals and replacements. Construction sites 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 expected sediment production or turbidity would be well within the range of what would typically occur during high winter flows or as a result of natural streambank erosion.

Sediment delivery to streams may also occur from log haul. However, with mitigation measures outlined in Project Design Criteria and the low numbers of truck loads per day with thinning operations, impacts are anticipated to be minor.

At the watershed scale, changes in the overall sediment rates would not be detectable given the high variability in natural rates of sediment input.

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.

All action alternatives would maintain the current instream flow conditions described in Objective 6 at both the project and the watershed scales due to the age of the vegetation and the relatively small portions of the watersheds that would be affected.

A high percentage of each of the watersheds in the planning area is within hydrologically mature vegetation (Big Quilcene Watershed Analysis (USDA and WDNR 1994), Dosewallips Watershed Analysis (USDA 1999), Hamma Hamma and West Hood Canal Tributaries Watershed Analysis (USDA 1997).

All action alternatives 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 is a temporary effect lasting 3-5 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 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.

Objective 7: Maintain and restore the timing, variability, and duration of floodplain inundation and water table elevation in meadows and wetlands.

All action alternatives would maintain the current floodplain inundation and water table conditions (as relate 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 the small portions of the watersheds that would be affected by thinning activities.

All action alternatives would not affect the timing, variability, or duration of floodplain inundation or water table elevation in meadows and wetlands across in any of the 3 watersheds within the Jackson planning area. At the project scale, floodplains are protected with no-cut riparian buffers, 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 any of the 3 project area watersheds.

Objective 8: Maintain and restore the species composition and structural diversity of plant communities in riparian areas 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.

All action alternatives would contribute to maintaining Objective 8. No-cut buffers along all streams would protect riparian areas from disturbance and maintain the existing riparian vegetation.

All action alternatives would require no cut buffers along all riparian corridors and wetlands. These buffers would 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, would also protect channel migration processes.

The prescription would provide retention of larger diameter trees, favoring Pacific silver fir and Douglas-fir since those species tend to be larger than their hemlock neighbors. Variety of the forest stands would be promoted with the retention of the hardwood components.

Objective 9: Maintain and restore habitat to support well-distributed populations of native plant, invertebrate and vertebrate riparian-dependent species.

All action alternatives would contribute to maintaining Objective 9. No-cut buffers along all streams would protect riparian areas from disturbance and maintain the existing riparian conditions.

At the site specific scale, all action alternatives would require no cut buffers along riparian areas. This would help maintain the existing microclimates that are especially important for species that are extremely 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 would contribute to the landscape heterogeneity of both untreated and treated stands. The retention of cedars, minor hardwoods and untreated areas or “skips” would provide 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.

All action alternatives would provide 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.

Fuels/Fire

The planning area has had approximately five large fires since 1860 of 1,000 acres or larger usually resulting in stand replacement. Stand replacement fires are characterized by fire moving through the canopies killing off the tree needles or a surface fire burning through the duff damaging and or killing the root system of trees. Some fires like the Ludlow-Quilcene fire which reached Mount Walker were caused by slash burning while others had their intensity increased by untreated slash, but most fires appear to be human caused or have unknown causes. Prior to 1860s the fire return interval for large fires appears to be around 200 years with fires covering large areas of the north half of the Hood Canal Ranger District. Most fires in the planning area are believed to have been stand replacing fires burning under high winds from the East resulting in fires growing quickly for one or two days and then burning slowly until extinguished. Fires for the past ten years have been mostly human caused.

Fire Management Analysis 3 using the 2005 Standard Fire Behavior Fuel Models was used for fire prediction modeling. Fuel Models provide a quantitative basis for rating fire danger and predicting fire behavior using mathematical fire behavior models developed by Rothermel in 1972. Weather inputs for fire behavior calculations were those that have contributed to fires that have historically contributed to fires being over five acres on the Olympic Peninsula. The following conditions were used for the analysis: temperature of 75 degrees F, 5 mph mid-flame winds, and 1 hour fuel moistures of 6%.

The current fuel model characteristics in the planning area are fuel model FB 8 and FB10 interspersed with each other. Fuel surveys show a range from 2 tons to 12 tons per acre of dead and down wood debris. The expected fire behavior in a fuel model FB 8 is predicted to be surface fire with a flame length of 1 foot and a rate of spread of 2 chains (66 feet) an hour. The expected fire behavior in a fuel model FB10 is predicted to be a surface fire in units with high canopy heights otherwise a passive crown fire is predicted. Fire behavior for a surface fire is predicted to have a flame length 4 feet to 5 feet with a rate of spread of 4 to 8 chains an hour. Fire behavior for a crown fire is difficult to predict but is estimated to be a flame length of 7 feet and a rate of spread of 11 chains an hour. The fire behavior in the FB10 fuel model stands, especially those with low crown heights, could exceed the initial attack capabilities for the Olympic National Forest.

After the stands are thinned, approximately 8 to 18 tons per acre would be added to existing fuels. In 1 to 2 years fuel loadings would decrease as fine fuels and needles fall to the ground and decay (Fine fuels are dead and down dead material 0 to 0.25 inches in diameter.). The additional fuels would move all the treated units to a uniform Fuel Model FB 10, eliminating the FB 8 fuel model areas that normally allow successful initial attack. Fire behavior in thinned stands is predicted to have flame lengths of 5 to 6 feet and a rate of spread of 8 to 13 chains an hour with a size 1 to 4 acres in an hour. Fire behavior in stands that have low canopy heights would transition from a surface fire to a crown fire which could lead to rates of spread of up 25 chains an hour with flame lengths exceeding 10 feet. A passive crown fire is predicted to be 10 plus acres within the first hour. The post thinning fire behavior is expected to exceed the initial attack capabilities for the Forest. Parts of the planning area lay within the

wildland urban interface zone for the Brinnon community and homes along Highway 101. The urban interface increases the necessity of being able to successfully initial attack a fire.

The goal of fuels mitigations is to allow fires to be contained during initial attack to protect life, property and resources. Fuel treatments in thinned areas adjacent to roads, where the greatest risk of a fire starting, and adjacent to private property would move the fuel profile characteristics of those areas to a fuel model FB 8. The predicted fire behavior is flame lengths of 1 to 2 feet, a rate of spread of 3 chains per hour and a fire size of half acre one hour after starting. This fuel profile would allow time for suppression resources to arrive and take action before the fire reaches the heavier fuels farther inside the units. Treated areas would also provide tactical options to firefighters in the wildland urban interface zone (e.g., the Brinnon area) in the event of a large fire. To meet these parameters, final fuels loading in the treated areas would average six tons per acre or less and fuel depth average one foot for 1-hour (less than 0.25 inch diameter), 10-hour (0.25 inch to 1 inch diameter), and 100-hour (1 inch up to 3 inch diameter) sized fuels. The mitigations included for all action alternatives would increase the chance of a successful initial attack until the 1- to 100-hour fuels from the added thinning slash has decayed, which would be approximately 15 to 20 years. After this time span, the fuel models characteristics are expected to similar to a FB 8 fuel model throughout the stands.

Parklands, Prime Farmlands, Wetlands, Wild and Scenic Rivers, or Ecologically Critical Areas

The project planning area does not contain parklands, prime farmlands, or wild and scenic rivers, nor does the project area contain any 404 listed wetlands. Areas that may be considered ecologically critical, such as critical habitat for the northern spotted owl, are discussed in previous sections of this chapter.

Wilderness and Inventoried Roadless Areas

The project does not contain and would not impact any wilderness or inventoried roadless areas.

Clean Water Act

All three watersheds have 303d listed waterbodies that have exceeded Washington State water quality temperature standards of 16 degrees Celsius. All of these listed stream segments are off National Forest, in the lower reaches of the Dosewallips River, Marple Creek, and Big Quilcene River (Washington State Department of Ecology 2004).

Because of the no cut buffers and that the silivicultural prescription would be a thinning smaller trees and leaving larger, dominant trees in the stand, the shade component to all streams would not change. None of the alternatives would cause an increase to stream temperatures, see temperature section.

Clean Air Act

Due to the project's design, there would be reduced pile burning of harvest-generated fuels as a result of timber being felled away from roads, and landing slash being yarded back into the units. Any planned burning of activity slash (e.g., along public roads and adjacent to private property), however, would be done following all State and Federal laws including the Clean Air Act.

Scenic Quality

The Olympic National Forest Plan visual quality objectives within the project planning area are "high scenic integrity" ("retention") for the visual foreground (0-0.5 miles) along Highway 101, Mt. Walker Road, Mt. Walker Trail, and Dabob Bay, and "moderate scenic integrity" ("partial retention") for the middleground (0.5-5 miles) and background (beyond 5 miles) areas viewed from Highway 101, Mt. Walker Road, Mt. Walker Trail, and Dabob Bay. The rest of the project area has visual quality objectives of "low scenic integrity" ("modification") or "very low scenic integrity" ("maximum modification"). While some changes to scenic quality may be observed in the short term, scenic quality objectives would be met under all alternatives (see Visual Quality section).

Irreversible and Irretrievable Commitment of Resources, Unknown Risks and Precedents

Irreversible Commitments

Irreversible commitments are those that cannot be reversed or replaced, except in the extreme long-term.

Rock Resource. Any rock that is removed from quarries or rock pits and used during construction of roads for surfacing and other needs would not be replaceable.

Soil productivity. Restoration through decompaction treatments to the temporary roads, skid trails and landings would initiate recovery of productivity and revegetation, but soil productivity would be lost or reduced to some degree on temporary roads and landings due to soil displacement, as represented by the detrimental soils condition. Potential effects of the proposed activities on soil productivity would be due to compaction, puddling, displacement, erosion, severe burning and loss of soil organic matter. The extent of detrimental soil condition, however, is still well within Forest Plan standards and guidelines.

Irretrievable Commitments

Irretrievable commitments are those that are lost for a period of time. There are no known irretrievable commitments to resources associated with this project.

Unknown risks or precedents

This project is consistent with current scientific and ecosystem management concepts and does not involve unknown risks or precedents.

Public Health and Safety

Public health and safety would be protected by adherence to Occupational Safety and Health Administration (OSHA) and other laws. Public access to Mt. Walker would be prohibited during operations there for public safety.

Socio-economic Effects

Employment and personal income would be generated by the estimated 22.5 to 32.4 million board feet that may be produced by the action alternatives (Alternatives A through D). While small in the context of the Olympic Peninsula economy overall, these benefits would contribute to social and economic well-being of the local economy.

Environmental Justice

The effects of the proposed action and the alternatives thereto are discussed throughout Chapter 3 of this document. These effects are expected to be similar for all human populations regardless of nationality, gender, race, or income level. None of the alternatives entails any known inequitable distribution of social or environmental consequences to a particular group or segment of society.

Impacts to the gathering of special forest products such as salal were identified as having the potential to disproportionately affect minority populations. Given little, if any, evidence of salal harvesting in the proposed units, however, it is expected that there would be little negative impacts to salal harvesting opportunities.

Therefore, there are no known negative effects of any of the alternatives on civil rights, women, or minorities.

Climate Change

While there is ongoing research on the potential impacts of global climate change in the region and while no specific forest management recommendations have been published regarding global climate change, a brief review of climate change research in the region was conducted to assess predicted changes in climate and relate the changes to impacts climate change may have on the desired outcomes of, and the potential impacts from, this project.

Although El Niño/Southern Oscillation and the Pacific Decadal Oscillation comprise the primary factors for climate variability in the Pacific Northwest (Climate Impacts Group 2006b), the influence from global climate change is a growing concern. According to the Climate Impacts Group, based out of the University of Washington, climate modeling for the Pacific Northwest predict a future rate of warming of approximately 0.5 degrees Farenheit per decade for the Pacific Northwest through at least 2050, relative to the 1970-1999 average temperature (2006b). Temperatures are projected to increase across all seasons, although most models project the largest temperature increases in summer (June-August), and the average temperatures could increase beyond the year-to-year variability observed in the Pacific Northwest during the 20th century as early as the 2020s. Nakawatase and Peterson (2006) studied the effects of climate variability on forest growth across the western and northeastern Olympic Mountains. Their results suggest that warmer temperatures predicted for the Olympic Mountains would result in decreased productivity at high elevations (i.e. subalpine forest types) in the northeastern region of the Olympic Mountains as a result of decreased summer soil moisture. Growth in low- to mid-elevation Douglas-fir and western hemlock forests, however, would depend on the combined effect of potential decreases in precipitation and increased temperature in the summer.

Whether and how increasing temperatures resulting from global climate change would alter predicted forest response to the proposed commercial thinning under any of the action alternatives would depend on specific site conditions in relation to temperature and soil moisture availability on tree growth. If temperature were to increase while precipitation changes minimally, as predicted by the Climate Impacts Group, tree evapotransportation would increase nonlinearly, leading to more frequent drought stress (Littell 2007, *pers comm*). Douglas-fir, in particular, is sensitive to low soil moisture (Climate Impacts Group 2004b). A moderate density commercial thinning could decrease competition for water during the summer while limiting additional evaporation from the soil and transpiration from the understory in the summer (Littell 2007, *pers comm*). Such thinning could also maximize the duration of snowpack in spring by having an open enough canopy that more snow accumulates in the ground rather than on the forest canopy, yet, is still shaded from melting by the sun in the spring. The resulting increased available moisture, in turn, could reduce the risk of dead or drought-stressed trees created by increasing temperatures and changes in precipitation caused by climate change and that would be susceptible to fire and disease in the near-term. Given that late-successional and old-growth forests are generally thought to be more resilient to climate change, the aim of this project to promote late-successional and old-growth forest conditions should also serve to better protect the forest from climate change impacts. Increasing forest habitat connectivity would also allow species to reach new locations as climate change alters existing habitat (Climate Action Group 2004a). As noted in the

background section of Chapter 1 and elsewhere in this document, watershed analysis documents and project-specific analysis describe the general current conditions in and around the project area as being fragmented habitat with limited quality, quantity, and distribution of mature and old-growth forest. Diversifying forest structure and promoting the development of late successional habitat characteristics in simplified, second-growth stands as proposed in this environmental assessment would aid to more quickly increase the amount and connectivity of old-growth habitats. Under the No Action Alternative, simplified, second-growth forests would be left to continue through the stand development without intervention, and opportunities to accelerate development of late-successional and old growth forest characteristics would be foregone.

Comments provided during public scoping raised the concern that climate change may increase the risk of roads causing landslides and downstream flooding. According to the Climate Impacts Group (2006a, 2007), however, while changes in precipitation are less certain than changes in temperature, most models predict modest changes in regional precipitation through the mid-century. Models suggest that there will be slight decreases in summer precipitation and slight increases in winter changes, but little change in the annual mean by mid-century. Winter precipitation changes are predicted to be largest in December – February, but still within the range of year-to-year variability observed during the 20th century. A larger percent of the precipitation, however, will fall as rain rather than snow with the warmer temperatures, but natural year-to-year and decade-to-decade fluctuations in precipitation are likely to be more noticeable than longer term trends associated with climate change. While an increased likelihood of extreme precipitation events may also be a result of climate change, there is little information to confirm the increased risk for the Pacific Northwest region. The environmental effects to soils analyzed earlier in this section details slope stability conditions being low risk. Given the fact, however, that no new permanent roads would be constructed as part of this project, that the temporary roads built are expected to be decommissioned within five years of their construction, and that road management requirements listed in the Project Design Criteria section of this document would minimize impacts to water quality and fish habitat (e.g., culverts that remain for more than 1 year must be able to accommodate 100-year peak flows, as required by Appendix A of the MOU between the Washington Department of Fish and Wildlife and USDA Forest Service, Pacific Northwest Region, Regarding Hydraulic Projects Conducted by the USDA Forest Service, Pacific Northwest Region), global climate change is not expected to discernably increase the risk of the roads used in this project causing landslides and downstream flooding.

Tiering and Forest Plan Consistency

This Environmental Assessment is tiered to the Final Environmental Impact Statement for the 1990 Olympic National Forest Land and Resource Management Plan (LRMP) (USDA 1990a, USDA 1990b). The LRMP was amended 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 1994b), commonly known as the Northwest Forest Plan, and its amendments. This document also tiers to the April 2005 Final Environmental Impact Statement (FEIS) for the Pacific Northwest Region Invasive Plant Program: Preventing and Managing Invasive Plants (USDA 2005a). This analysis references

the Olympic National Forest's LRMP, its Road Management Strategy (USDA 2000), the Olympic National Forest Access and Travel Management (ATM) Plan (USDA 2003b), the Olympic National Forest Strategic Plan (USDA 2004), Big Quilcene Watershed Analysis (USDA and WDNR 1994), Dosewallips Watershed Analysis (USDA 1999), Hamma Hamma and West Hood Canal Tributaries Watershed Analysis (USDA 1997), the Quilcene Late Successional Reserve Assessment (USDA1996a), the Hood Canal North Late Successional Reserve Assessment (USDA 1996b), the October 2005 Record of Decision for the Pacific Northwest Region Invasive Plant Program: Preventing and Managing Invasive Plants Final EIS (USDA 2005b), the Olympic Adaptive Management Area Guide (USDA 1998), and the project analysis file.

The analysis performed by the interdisciplinary team found that the actions proposed under the alternatives are consistent with the Forest Plan. The Plan identified goals and objectives of:

- Protecting and enhancing conditions of late-successional and old-growth forest ecosystems in Late Successional Reserves;
- Developing and testing new management approaches to integrate and achieve ecological and economic health, and other social objectives in Adaptive Management Areas;
- Restoring and maintaining the ecological health of watersheds and aquatic ecosystems contained within them as listed in the Aquatic Conservation Strategy objectives; and
- Managing specific landscapes in such a manner that their scenic values are protected, maintained, and/or enhanced as viewed from major travel routes, use areas, or water bodies.

The project's purpose and need is consistent with Forest Plan goals, and impacts to resources as evaluated in this EA have been found to be consistent with Forest Plan direction and standards and guidelines. Descriptions of the effects of implementing the various alternatives and Forest Plan consistency rationale can be found in the individual resource sections in this chapter.

The entire project planning area is on National Forest land and complies with all federal, state, and local laws and regulations.

Analysis File

The analysis file is considered an integral part of the environmental assessment. The analysis file includes:

- Olympic National Forest Programmatic Biological Assessment Project Consistency Evaluation Form
- Public comment letters
- Cultural resources report
- Specialist Reports

For more information on the analysis file, please contact Tim Davis at 360-956-2375.