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4-463 Summary of Conclusions

- Affected Environment

- Evaluation of the alternatives by components of the affected environment

4.5.4 Habitat-Based Assessment of Other Fish and Wildlife Resources

Summary of Conclusions

Alternative B generally provides additional amounts and quality of the most limiting habitats when compared to Alternative A. A distinct advantage offered by Alternative B, when compared to Alternative A, is the certainty it provides. Alternative C provides greater habitat quality and quantity than Alternative B and provides the same certainty. Many east-side habitats do not differ in treatment under the alternatives. For the OESF, Alternatives 2 and 3 provide greater certainty than Alternative 1. In general, Alternatives 2 and 3 also provide greater amounts and quality of limiting habitats.

Matrix 4.5.4a: Management Strategies for HCP (excluding OESF)

	Alternative A No Action	Alternative B Proposed HCP	Alternative C
Uncommon Habitats			
West-side units	No specific provisions for uncommon habitats. Wildlife habitat objectives developed as required under FRP Policy No.22	Same as Alternative A with additional mitigation provided for: (1) talus fields larger than 1 acre: no harvest, 100-foot buffer with 60% canopy coverage; Forested talus; maximum harvest of 1/3 (vol.), yarding generally cannot physically disrupt talus, includes provision for mining of talus and road construction, (2) caves important to wildlife: 250-foot no-harvest buffer around entrance, 100-foot no-harvest buffer around passages that may be disturbed by surface activities, new caves explored and mapped prior to management; (3) cliffs: mining of rock from cliffs for road construction avoided when materials can otherwise be reasonably acquired, site-specific prescriptions developed; (4) oak woodlands: retention of large dominant oaks, maintenance of 25-50% canopy cover, encroaching conifers removed, dead and dying oaks retained, prescribed burns where appropriate; and, (continued)	Same as Alternative B.

	Alternative A No Action	Alternative B Proposed HCP	Alternative C
Uncommon Habitats (continued)			
West-side units (continued)		(5) very large, old trees: large trees will be specified for retention with preference given to wildlife trees; applicable safety standards will be followed; attempt will be made to retain at least 2 live trees per acre harvested and at least 1/2 of the trees retained from the largest diameter class available; three snags per acre and three other green recruitment trees per acre; leave trees may be clumped.	

Matrix 4.5.4b: Management strategies for alternatives related to the OESF Planning Unit

	Alternative 1 No Action	Alternative 2 Unzoned Forest Proposed OESF	Alternative 3 Zoned Forest
Uncommon Habitats			
Uncommon Habitats	No specific provisions for uncommon habitats, development of wildlife habitat objectives required under FRP Policy No. 22.	Same as HCP Alternative B treatment of cliffs, caves, talus fields, and very large, old trees, except greater latitude for experimentation related to integrating conservation and production. Attention to protecting known nesting, denning and/or roosting sites, but no special surveys unless unique circumstances. Combined riparian, marbled murrelet, and spotted owl strategies will increase the presence of large, old trees.	Same as Alternative 2.

Affected Environment

Introduction

Specific strategies to protect spotted owls, marbled murrelets, and salmonids have been presented in Chapter 2 and, under all alternatives, actions taken with regard to these species and riparian areas in general have been delineated. Numerous other wildlife species have been addressed individually to ascertain the impacts of the alternatives, and some of these species have specific protective actions proposed under one or more of the alternatives. In addition, protective measures are provided under the alternatives for special habitats such as cliffs, caves, talus slopes, and oak woodlands in the five west-side planning units and the OESF.

DNR anticipates that the proposed HCP will provide regulatory certainty with regard to all species (e.g., invertebrates, vertebrates, as well as yet undiscovered species) which may occur in habitats on DNR-managed lands in the five west-side planning units and the OESF. These species may number substantially over 200. NEPA requires an assessment of the likely impacts to all wildlife resources, including the area on the east side of the Cascades where DNR is currently seeking ESA protection only in relation to the spotted owl, and some other listed species. It is impracticable to analyze each of these species separately regarding their individual habitat and life-history needs relative to the considered actions under the alternatives. Rather, the HCP and this document propose a habitat-based approach to conservation and assessment of impacts. The primary assumption with regard to impacts to these other species is that if adequate amounts of habitat of sufficient quality are provided and other factors do not preclude the use of that habitat, then these species will persist. The question is whether the combination of the described protective measures, natural diversity within the habitats on DNR-managed lands, and the diversity of treatments to be implemented under each of the alternatives would provide a sufficient amount of habitat. This section discusses the impacts upon habitat quality and quantity that may result from each of the alternatives. Example species are sometimes used to display concepts and to accentuate the diversity of species being discussed through the use of this habitat-based approach.

Habitat categories

Habitat categories addressed by this section include a variety of forest stands, physiographic features, and even individual trees. It is impossible to anticipate every habitat that could be used by every species. However, an attempt has been made to address the meaningful and identifiable categories. Some species require or depend upon more than one habitat category. Some species may be much more restrictive in their use of habitats and may depend upon only specific types of habitats within the coarse categories discussed in this section. For instance, some species are not only reliant on wetlands, but on those wetlands classified as bogs. As much as possible, forested habitats were divided according to forest structure and composition in a way that should be meaningful to forest-dwelling wildlife. Age classes of forested habitats were used as a surrogate for structure and composition in making estimates for this assessment. Conifer-dominated forests were classified as structurally complex forest (including fully functional forest and interior forest); closed-canopy forest; dense pole forest; regeneration

forest; open forest; and, on the east side, open, multi-aged forest. Other categories are wildlife trees, wetlands, riparian areas, aquatic habitats, caves, cliffs, talus rock, oak woodlands, prairies, subalpine and alpine habitats, and other habitats.

Sources of data

Preliminary estimates of age classes for conifer-dominated forest stands were provided by DNR for the OESF and the remainder of the west-side planning units. These projections were made using several very coarse assumptions and are therefore not very precise. However, these projections do include the effects of the owl and murrelet strategies, as well as riparian and unstable-slope strategies. As much as possible, the projections factored in the likely silvicultural treatments to occur as a result of the strategies. Theoretical 40-, 60-, and 80-year rotations were projected in managed upland stands for comparison purposes only.

Assumptions necessary to facilitate comparisons

Several assumptions were necessary to fill gaps in available data and the lack of details in some prescriptions. Actions under the alternatives are variable. This is particularly true under the No Action alternative because there is no guarantee that those actions will be conducted.

1. Although there is considerable uncertainty associated with the No Action alternative, some aspects were relatively more certain. It is assumed, for instance, that DNR would continue to honor the Hoh Agreement (Hoh Tribe and DNR 1993) regarding protection of riparian areas within portions of the OESF. In all alternatives, protection of unstable slopes was assumed to result in older forest. However, many of these areas might not be capable of supporting trees long enough to develop old-forest conditions and some unstable slopes might be harvested once appropriate techniques or knowledge are available. Further, some harvest may actually reduce the risk of failure on some slopes.

Organization of this section

For the remainder of this section, each habitat category, or subset thereof, (1) will be described or defined; (2) the current situation, in terms of amount and quality of habitat, will be discussed; (3) impacts by alternatives will be discussed; and, (4) a comparison will be made between the alternatives. Impacts of each alternative will be described in the following order: west-side planning units (exclusive of OESF), east-side planning units, and then OESF. Where possible, subsections and alternatives were combined to reduce repetition.

Evaluation of The Alternatives by Components of The Affected Environment

Structurally Complex Forests

AFFECTED ENVIRONMENT

Structurally complex forests are those which are stocked with large trees. A variety of tree diameters and heights are evident. Mortality within the stand (or residual trees,

snags, and logs) provides cavities in standing snags, downed logs, deformities in standing live trees, large horizontal branches, and a complex canopy with conifer establishment occurring under openings in the canopy. For the purposes of this discussion, conifer stands greater than 70 years of age were considered to be structurally complex forest. Species using this habitat category range from the Johnson's hairstreak butterfly to the northern goshawk.

West-Side Planning Units
Currently, NRF management areas as proposed in Alternative B are 44 percent complex forest, proposed Dispersal management areas are 18 percent complex forest, and the remainder of the units are 26 percent complex forest. As a whole, these areas are 27 percent complex forest.

East-Side Planning Units
East-side forest habitats are not described in terms of age classes. Uneven-aged stands comprise the majority of east-side stands and conditions are described in more qualitative terms. Currently, 29 percent of DNR-managed lands on the east side are considered to be owl habitat (DEIS Table 4.3.5). Many 70-year-old stands may begin to approximate owl habitat on the east side of the Cascades where stands tend to be more diverse with regard to species and age composition.

OESF Planning Unit
According to preliminary estimates, about 20-30 percent of the OESF is composed of stands over 70 years of age.

ALTERNATIVES A AND 1
West-Side Planning Units
Complex forest will likely be provided as a result of spotted owl conservation, marbled murrelet protection, and other actions such as unstable-slope protection. The owl conservation strategy will only occur within owl circles under the No Action alternative; however, there is no guarantee regarding the amount of these complex forests that will exist. The level of protection may decrease as owls perish or relocate, and surveys document such change. However, habitat modeling efforts assumed no such decline in sites or relaxations in regulatory environment. The quality of habitat may be reduced where the 40 percent threshold is met and younger (i.e., Type C) habitat develops allowing harvest of older habitat (i.e., Type A or B).

Areas protected for murrelets will yield patches of uncertain size, shape, amount, and distribution but would likely be of high quality. It is expected that murrelet sites will occur more frequently near marine waters and at low elevations. Landscapes with significant patches of older forest may contain proportionally more murrelet sites as well.

Riparian buffers may contribute to complex forests, but a review of recent applications of DNR policies indicates such treatments are not guaranteed. Unstable slopes may be deferred from harvest until more is learned about how these slopes can be managed without increasing the risk of mass wasting and erosion. It is possible that in the short

term, and even in the long term to some degree, that unstable slopes will contribute somewhat to complex forests.

Based on DNR estimates, 30 percent of DNR-managed lands on the west side (exclusive of the OESF) would be in this habitat category at year 2096. This estimate includes riparian areas, unstable slopes, and murrelet sites, as well as habitat provided for owls. Based on average rotations of 60 years (40-80 years), it could be expected that those stands which fall outside such areas would provide 0 percent (0-12 percent) complex forests. As mentioned earlier (DEIS Table 4.2.1.5), most owl sites occur in proximity to federal lands. Thus, it is expected that under the No Action alternative the distribution of complex forests may be determined largely by the distribution of owl sites.

East-Side Planning Units

East-side forest habitats are not described in terms of age classes. It is expected that uneven-aged management will prevail in most cases on the east side. A significant amount of even-aged management may occur in the short term in areas where forest health is an issue. Where habitat is encumbered by owl circles, little to no harvest would be likely. In other areas, it is expected that fairly aggressive selective harvests would be employed and two distinct age classes would exist in most stands. Stocking of very large trees would be light and retention of snags would be minimal. It is projected that at year 2096, 17 percent of the east-side lands would be in NRF habitat.

OESF Planning Unit

As described above, the No Action alternative would, to a lesser degree, contribute complex forest as a result of owl and murrelet conservation, riparian buffers, and unstable-slope protection. Distribution of the resulting forests would be determined by the distribution of owl and murrelet sites, stream types, and unstable slopes. The level of riparian protection that would occur under the No Action alternative in the OESF is somewhat more certain due to the Hoh Agreement and given the degree of concern about mass wasting, sedimentation, and salmon that exists in this region. It is therefore more likely that larger and more robust buffers would be utilized in the OESF than in the remainder of west-side planning units. Preliminary stand-age projections indicate that 40-50 percent of the OESF could be in stands over 70 years of age at year 2096.

ALTERNATIVE B

West-Side Planning Units

While there is no guarantee these complex forests will exist under the No Action alternative, there is a commitment that this habitat class will be provided under Alternative B. As in the No Action alternative, complex forest would be provided as a result of owl conservation, marbled murrelet protection, and other actions. The owl conservation strategy will only occur in designated landscapes under Alternative B. The goal for those designated landscapes is that 50 percent of the designated area (by WAU) be developed and maintained in foraging habitat. Like the No Action alternative, the murrelet strategy may provide some additional complex forest, but would be uncertain regarding the shape, size, amount, and distribution of such stands. For the most part, these stands will be largely determined by the occurrence of murrelets. Since important

components of the murrelet strategy under Alternative B would be determined in the future after an interim period of research, it is unknown how much complex forest this alternative will contribute. Analysis completed with regard to murrelet habitat amounts and potential occupancy rates found in Section 4.2.2 and Table 4.2.31 may provide a basis for this estimate.

Alternative B would provide more complex forest in riparian areas in most geographic areas compared with the No Action alternative. The riparian management zones would likely provide complex forests now or in the future. The wind buffer prescription may provide some complex forest, but it is difficult to estimate. Those factors which are necessary to avoid impacts to salmonid would be maintained. The protection afforded unstable slopes would be the same as presented under the No Action alternative.

Based on DNR estimates, 31 percent of DNR-managed lands in west-side planning units (excluding the OESF) would be in this habitat category at year 2096. This estimate includes riparian areas, unstable slopes, and murrelet sites, as well as habitat provided for owls. Based on average rotations of 60 years (40-80 years), it could be expected that those stands which fall outside such areas would provide 0 percent (0-12 percent) complex forests. However, the older forests produced and maintained in riparian areas, murrelet sites, and other such areas would benefit from the protection provided by surrounding stands if those stands are of sufficient development to buffer the effects of sun, wind, and predators. The distribution of complex forests will be determined largely by the location of proposed NRF management areas and Dispersal management areas. At year 2096, it is expected that 39 percent of the Dispersal management areas, 59 percent of the NRF management areas, and 25 percent of the remaining areas would be in complex forest.

East-Side Planning Units

The riparian strategy is identical under all alternatives on the east side of the Cascade mountains. Areas east of the Cascade mountains would not be managed for murrelets, and therefore no additional habitat would be provided. The sole difference between alternatives on the east side is related to the owl strategies. East-side forest habitats are not described in terms of age classes. It is expected that uneven-aged management will prevail in most cases on the east side. Within the NRF management areas, habitat goals (50 percent NRF) will be met by a combination of retaining habitat or growing habitat. Many stands in these NRF management areas will be harvested during the plan. It is expected that these areas would receive a selective harvest which would retain multiple (i.e., more than two) age classes and large numbers of snags. This would hasten the return or achievement of NRF characteristics thereby allowing harvest of other areas to continue in the dynamic scheme intended. Outside NRF management areas, it is expected that fairly aggressive selective harvests would be employed as described in the No Action alternative. It is expected that 9 percent of east-side, DNR-managed lands will provide NRF habitat at year 2096.

ALTERNATIVE C

West-Side Planning Units

Alternative C would resemble Alternative B with some exceptions. The NRF management areas would have a goal of 60 percent NRF instead of 50 percent NRF. This aspect of Alternative C may not result in drastic short-term changes from Alternative B because many areas are habitat and habitat-growth limited. Eventually, there will be some increase observed in older forests. The main difference between Alternatives B and C would likely occur as a result of the additional 83,000 acres of west-side NRF management areas provided under Alternative C.

Alternative C would retain all marginal and suitable murrelet habitat prior to development of a long-term plan. It is not certain that the long-term plan would be any different than that developed under Alternative B, but a greater number of options would be retained in preparation for the long-term plan. This might result in more or better distributed complex forest in the long term.

The riparian strategy would only allow entry into riparian buffers for enhancement purposes. It is expected that this will result in complex forests being developed in the no-harvest and minimal-harvest areas as well as the low-harvest areas. Alternative C would provide 50-foot no-harvest areas around nonforested wetlands as well.

It is expected that Alternative C would provide greater amounts of complex forest than either Alternative A or B. Even if the 60 percent NRF goal resulted in no more complex forest, the approximately 83,000 acres of additional NRF management areas would likely result in more complex forest at year 2096. At year 2096, it is expected that 50 percent of DNR-managed lands in the west-side planning units (excluding the OESF) would be in this habitat category. It is also expected that 58 percent of the NRF management areas, 48 percent of the Dispersal management areas, and 49 percent of the remaining areas would be in complex forest.

East-Side Planning Units

The difference between Alternatives B and C would be the 60 percent NRF goal and the additional NRF management areas. This would result in greater amounts and better distribution of complex forest on the east side than Alternative B and greater assurances than under Alternative A.

ALTERNATIVE 2

Under this alternative, the objective is that at least 40 percent of the OESF would be in forest stages similar to complex forest at year 2096. This would include sites protected for murrelets, riparian areas, and unstable slopes. Given the topographic nature of the OESF and the concern regarding unstable slopes, it is uncertain how much additional protection would be needed to meet the 40 percent target. Much of this habitat category may occur on steep and unstable slopes. However, because of the 11 landscape planning units and the need to meet this target for each such unit, it is expected that the complex forest will be well distributed. The number of murrelet sites is also expected to be higher than other HCP planning units but would not be any more certain regarding the characteristics of such sites. The level of management within riparian buffers is

somewhat vague and it is therefore uncertain how much complex forest would be provided in these areas. However, complex forest is also expected to be retained or developed within 50 feet of nonforested wetlands. Preliminary DNR estimates indicate that 60-70 percent of the OESF would be in stands over 70 years old at the year 2096.

ALTERNATIVE 3

Under this alternative, it is expected that the owl strategy will contribute 100 percent of 5,000 acres in forests which are greater than 100 years old, 50 percent of 78,000 acres as sub-mature forest, and another 40 percent of 74,000 acres of owl habitat. Assuming this would all be complex forest at year 2096, about 26 percent of the OESF would provide complex forests. However, many areas outside these designated owl zones would also contribute complex forests as a result of the riparian and unstable-slope strategies described above. The distribution of complex forest would appear to be more centralized around the owl zones in Alternative 3, but riparian areas and unstable slopes would likely result in the distribution of this habitat category throughout most landscapes. It is expected that at year 2096, 36 percent of DNR-managed lands in the OESF would be NRF habitat. DNR estimates that 60-70 percent of the OESF would be in stands exceeding 70 years of age at year 2096.

COMPARISON AMONG ALTERNATIVES AND REMARKS RELATIVE TO CUMULATIVE EFFECTS

West-Side Planning Units

Alternative C is expected to provide the most complex forest (50 percent) followed by Alternative B (31 percent). Alternative A would provide complex forests (30 percent) in some areas where neither Alternative B or C would provide any (e.g., southwest Washington). Alternative C provides complex forest in some areas not provided for under Alternative B (e.g., the Straits Planning Unit). The largest difference between the alternatives is the lack of certainty provided by Alternative A and the greater amounts and distribution of complex forest provided by Alternative C.

East-Side Planning Units

In east-side areas designated for NRF development or maintenance, it is expected that adequate quantity, quality, and juxtaposition of complex forests will be provided for most of the species with requirements for this habitat category. These areas tend to be adjacent to or near federal reserves and will support the ability of the federal lands to provide the needed habitat. In addition to the NRF management areas delineated in Alternative B, Alternative C would provide additional NRF management areas in the White Salmon area and several other portions of the state. This would help provide additional complex forests for other species in those areas. Under the No Action alternative, owl territories are particularly dense in these same areas and would be expected to provide complex forests in these same general areas but with far less certainty than the action alternatives. Both action alternatives would likely provide more complex forest than the No Action alternative.

OESF Planning Unit

Alternatives 2 and 3 are expected to provide the most complex forest at year 2096 (60-70 percent) in comparison to the No Action alternative (40-50 percent). Complex forest

would be better distributed across all 11 landscape planning units under Alternative 2 when compared to Alternatives 1 and 3.

Remarks Relative to Cumulative Effects

The need for contributions of late seral forest by nonfederal lands will be highest in those areas where little federal land exists such as southwest Washington, the Puget trough, low-elevation portions of the Olympic Peninsula, and areas in the White Salmon/Klickitat region. Nonfederal lands at low elevations are needed to conserve late-successional-dependent species (FEMAT 1993; Thomas et. al. 1993). In the No Action alternative, there are few spotted owl territories remaining in southwest Washington (the South Coast Planning Unit and the extreme western portion of the Columbia Planning Unit) and the prospect for these territories persisting is not good without the contributions from nonfederal landowners. Under the action alternatives, very little to no provision is made for owls in southwest Washington. Under Alternative C, 43,000 acres of experimental areas may prolong, but would not guarantee, long-term persistence of owls or complex forest. The No Action alternative may provide more complex forest in southwest Washington than the action alternatives, depending on site persistence, site movements over time, and other factors. As described above, the action alternatives may favor some landscapes at the expense of other landscapes, more so than the No Action alternative. Both the action and no-action scenarios may cause or perpetuate gaps (large areas with no late seral forest) in certain landscapes due to existing ownership patterns.

The impacts upon species requiring complex forest in southwest Washington will be particularly severe given the lack of contribution by federal lands. Species whose range may be disrupted by these alternatives may include, for example, the Keen's myotis, Pacific fisher, and late seral herbaceous plants and fungi. Some species may rely on these landscapes in greater proportion than others, and may be more affected by actions in this landscape. For instance, species which depend on late seral/complex forests in the low-elevation, Sitka spruce zone may be most affected. Currently, relatively small amounts of complex forest persist in southwest Washington placing a higher ecological value on those remaining stands. Without the buffering effect of more conservatively-managed federal lands, actions to harvest these habitats will have impacts which will be higher in proportion to the impacts resulting from harvest of similar habitats in other areas. Some actions will also limit the potential for this forest category to develop in the future.

Fully Functional Older Forest (Subset of Structurally Complex Forest)

AFFECTED ENVIRONMENT

For the purposes of this analysis, this subset of the mature, structurally complex forest was examined separately. The richness and species diversity of these habitats may provide for the needs of species beyond what is provided by stands which are merely structurally complex. It was assumed that forests older than 150 years in age would begin to satisfy these needs. In the OESF, the amount of habitat that is either older than 100 years or older than 200 years will be discussed.

West-Side Planning Units
Currently, NRF management areas as proposed under Alternative B are 15 percent older forest, Dispersal management areas are 3 percent older forest, and the remainder of the planning units are 2 percent older forest. As a whole, these areas are 4 percent older forest.

East-Side Planning Units
East-side forest habitats are not described in terms of age classes. Uneven-aged stands comprise the majority of east-side stands and conditions are described in more qualitative terms. Also, given the nature of east-side stands in lower elevations, there may be less distinct differences between a complex forest and an older forest than there are on the west side.

OESF Planning Unit
Within the OESF, preliminary estimates indicate that about 15-20 percent of the forest stands are older than 100 years and less than 2 percent are over 200 years old.

ALTERNATIVES A AND 1

West-Side Planning Units
There are no guarantees that older forests will be retained or developed. Although current guidelines may remain in place, where circles are near 40 percent habitat, substitution of younger Type C owl habitat may occur. Owls may also perish or relocate, allowing harvest of additional habitat. Murrelet sites will contribute to older forest because little management will occur within these sites. Little older forest is likely to occur in riparian areas. Some older forest may be found in conjunction with unstable slopes until more is learned about harvesting these slopes without placing them at greater risk for erosion and mass wasting.

Based on DNR estimates, 16 percent of DNR-managed lands on the west side (exclusive of the OESF) would be in this habitat category at year 2096. This estimate includes riparian areas, unstable slopes, and murrelet sites, as well as habitat provided for owls. Based on average rotations of 60 years (40-80 years), it could be expected that none of those stands which fall outside such areas would provide older forests. As mentioned earlier, most owl sites occur in proximity to federal lands. Because a major portion of the older forest provided in the No Action alternative will occur as a result of the protection afforded regulatory owl circles, it is expected that under the No Action alternative the distribution of older forests may be determined largely by the distribution of owl sites.

East-Side Planning Units
Because east-side stands are not assigned to age classes, it is very difficult to assess this habitat category in terms of age. With the exception of short-term restraints on harvest that would be expected within owl circles, nothing in this alternative designates no-harvest zones; and frequent entries in stands may remove many of the structures required to achieve all functions in an older forest.

OESF Planning Unit

At year 2096, it is expected that all of the complex forest (40-50 percent of the OESF) would be in stands over 100 years old and about 10-15 percent of the OESF would be in stands over 200 years of age. About 20 percent of the stands over 100 years and almost all stands over 200 years would likely be previously unharvested stands (unharvested since date of stand initiation).

ALTERNATIVE B

West-Side Planning Units

Under this alternative, some older forest is expected to occur in the 300-acre nest patches provided in the owl strategy during the research and transition phases of managing these sites. Most murrelet sites would be expected to eventually become older forest as would the 25-foot no-harvest riparian buffer and possibly even the 25- to 100-foot minimal-harvest zone.

Based on DNR estimates, 12 percent of DNR-managed lands on the west side (excluding the OESF) would be in this habitat category at year 2096. This estimate includes riparian areas, unstable slopes, and murrelet sites, as well as nesting habitat provided for owls. The distribution of older forests will be determined largely by the location of the 20,400 acres of owl nesting patches. At year 2096, it is expected that 12 percent of the Dispersal management areas, 32 percent of the NRF management areas, and 9 percent of the remaining areas would be in older forest.

East-Side Planning Units

Because east-side stands are not assigned to age classes, it is very difficult to assess this habitat category. Nothing in this alternative designates sizable no-harvest zones, and frequent entries in stands may remove many of the structures required to achieve all functions in an older forest.

ALTERNATIVE C

West-Side Planning Units

Under this alternative, older forest is expected to occur in the entire area provided in the owl strategy because this alternative does not provide for degradation of older forests. Most murrelet sites would also be expected to eventually become older forest, as would the 100-foot minimal harvest riparian buffer and portions of the low-harvest riparian buffer. The 50-foot no-harvest buffer of nonforested wetlands would also provide older forest in time. In Alternative C, it would be expected that 25 percent of DNR-managed land in the west-side planning units (excluding the OESF) would be in this habitat category at year 2096. It is also expected that 31 percent of the NRF management areas, 24 percent of the Dispersal management areas, and 23 percent of the remaining areas would be in complex forest.

East-Side Planning Units

As in Alternative B, nothing in this alternative designates sizable no-harvest zones. However, the owl strategy would prohibit degradation of old-forest habitat which is counted toward the NRF objectives.

ALTERNATIVE 2

This alternative contains an objective of 20 percent forest with structure equivalent to that normally found in forest at least 100 years in age, and it is likely that large portions of that 20 percent would be in this habitat category during the first 40-60 years. As mentioned above, most murrelet sites would eventually provide older forest as would the 50-foot zone around nonforested wetlands. The OESF riparian strategy may also provide some older forest. According to preliminary estimates, it is expected that 50-60 percent older forest would be provided at year 2096 and that 10-15 percent forest over 200 years old would be present as well. About 5 percent of the forest stands over 100 years old and about 90 percent of the stands over 200 years old would have been previously unharvested.

ALTERNATIVE 3

This alternative may provide some older forest within owl zones, most likely within the central areas known as nest groves, where 100 percent of 5,000 acres will be forest of about 100 years or more in age. As in Alternative 2, murrelet sites, riparian areas, and wetland buffers may provide some older forest. According to preliminary estimates, it is expected that 60-70 percent of the OESF stands will be over 100 years of age and about 15 percent will be over 200 years of age. About 10 percent of stands over 100 years and about 95 percent of those over 200 years would be previously unharvested stands.

COMPARISON AMONG ALTERNATIVES AND REMARKS RELATIVE TO CUMULATIVE EFFECTS

West-Side Planning Units

It is estimated that Alternative A would provide more older forest (16 percent) than Alternative B (12 percent) or C (25 percent), but this would not be guaranteed. It is likely that Alternative C would provide more than Alternative B based primarily on the 60 percent NRF target, the additional NRF management areas, and the higher habitat-quality standards.

East-Side Planning Units

Although it is difficult to assess each alternative quantitatively regarding stand structures relative to age classes on the east side, it is possible to perform a relative assessment between the alternatives. A portion of owl habitat may be considered fully functional older forest. In the No Action alternative, these habitats are expected to be distributed, but often of short duration as owls are expected to move or expire in marginal habitats. In Alternative B, these habitats would be less distributed but more certain in the long term. Under Alternative C these habitats are more certain, well-distributed, and likely to be of a greater amount.

OESF Planning Unit

The amounts of forest older than 100 years of age for the OESF would be 43 percent for Alternative 1, 64 percent for Alternative 2, and 67 percent for Alternative 3. For stands older than 200 years of age these amounts are expected to be 14 percent for Alterative 1, 12 percent for Alternative 2, and 16 percent for Alternative 3. Older forest in Alternative 1 would be distributed according to current owl circles but would not have any commitments associated with it. Older forest in Alternative 2 would be distributed across

all 11 landscape planning units. Older forest in Alternative 3 would be concentrated around strategic locations regarding owls (owl zones).

Remarks Relative to Cumulative Effects
As described earlier for complex forests, some landscapes may be deficient in complex forest. These same areas are also the most likely to be deficient in older forest. In the absence of federal lands or contributions by federal lands, the conditions for a number of species dependent on these forests may thus be impacted, or at least would not improve.

Interior Forest (Subset of Structurally Complex Forest)

Affected Environment
For the purposes of this discussion, interior forests are those structurally complex forest (greater than 70 years) which are of a sufficient distance (100-300 feet) from the edge of younger stands or nonforested areas to maintain conditions which are characteristic of nonfragmented forests. Murrelets and a number of other forest-nesting birds are subject to high predation rates when exposed to forest patches with high edge-to-area ratios. A number of species dependent on moist, stable conditions are negatively effected by changes in microclimate which occur in the vicinity of edges.

Alternatives A and 1
West-Side Planning Units
With regard to the contribution made by owl sites, the amount would depend to a large degree on the existing situations present in current owl circles. The contribution received from murrelet sites would depend on whether murrelet sites were of sufficient size and shape to provide interior forest conditions. Riparian buffers may contribute complex forest, but may be too narrow to provide interior forest unless they are adjacent to mature stands. However, many species will benefit by widely-distributed complex forest components within buffers. Other species require interior forest with complex structure and would derive benefit only when buffers are adjacent to other complex forest. Unstable slopes may be deferred from harvest until more is learned about how these slopes can be managed without increasing the risk of mass wasting and erosion. It is possible that in the short term, and the long term to some degree, unstable slopes will make some contribution to interior forests. However, many such slopes are incapable of growing or supporting older forests. The stage of forest development on these unstable slopes varies across the landscape. One common factor is that they are located adjacent to or nearby streams or seeps. Although we do not know the size or shape of these patches, adjacency to the riparian corridor system should compliment the forests found within those corridors.

East-Side Planning Units
Although it is difficult to assess each alternative quantitatively regarding stand structures relative to age classes on the east side, it is possible to perform a relative assessment between the alternatives. The No Action alternative would provide habitat in regulatory circles where habitat already existed and patterns of retention would not necessarily favor larger patch size.

OESF Planning Unit

The amount of interior habitat provided through the riparian and murrelet strategies may be minimal. Where these areas occur in proximity to one another or in proximity to unstable slopes, areas may coalesce into patches of habitat sufficient to provide some interior forest. Owl circles by themselves are also unlikely to provide large amounts of interior forest, but in conjunction with the above strategies may make a contribution.

ALTERNATIVE B

West-Side Planning Units

Interior forest is likely to occur within the NRF management areas as the 50 percent goal is achieved. The 500-acre patches are likely to contain a considerable amount of interior forest. The contribution received from murrelet sites would depend on whether murrelet sites were of sufficient size and shape to provide interior forest conditions. The situation with regard to riparian and unstable-slope areas is the same as discussed under the No Action alternative.

East-Side Planning Units

This alternative, which would eventually supply 50 percent of significant landscape areas in owl habitat, would logically be expected to produce significant amounts of interior forest in those areas.

ALTERNATIVE C

West-Side Planning Units

Interior forest provided under Alternative C would be similar to Alternative B, but would be slightly greater in amount due to the 60 percent goal and the additional NRF management areas. In addition, all older forest in these areas that contributes to owl habitat would not be subject to actions which might degrade its value as is the case in Alternative B.

East-Side Planning Units

This alternative, which would eventually supply 60 percent of significant landscape areas in owl habitat or better, would logically be expected to produce significant amounts of interior forest in those areas.

ALTERNATIVE 2

Interior forest is likely to occur to some extent within the OESF as the 40 percent goal is achieved. The contribution received from murrelet sites would depend on whether murrelet sites were of sufficient size and shape to provide interior forest conditions. The situation with regard to riparian and unstable-slope areas is essentially the same as discussed under the No Action alternative.

ALTERNATIVE 3

The amount of interior forest would be determined in part by the relationship of nest groves and owl zones. Murrelet sites, riparian buffers, and unstable slopes are identical to Alternative 2.

West- and East-Side Planning Units

Alternatives B and C would provide larger amounts of interior forest than is estimated under Alternative A. The distribution of such interior forest is likely skewed toward the NRF management areas. Other areas may be dependent upon riparian areas, unstable slopes, and murrelet sites for interior forest. This may likely leave insufficient amounts of interior forest, for some species, across large landscapes under any of the alternatives.

OESF Planning Unit

Alternative 2 would likely produce the greatest amounts of interior forest when compared to Alternative 3 and Alternative 1. Patch size and adjacency is likely to increase as the amount of complex forest increases beyond 40 or 50 percent.

Closed-Canopy Forest

AFFECTED ENVIRONMENT

Closed-canopy forest (closed forest) is defined as those coniferous forests between 40 and 70 years of age. They are old enough so that they have undergone some stem exclusion and competition mortality and the trees in these stands have developed diameter; have achieved some lift to the lower portion of the canopy as self-pruning occurs; and have well-developed, deep canopies. However, these stands are young enough that they have not developed the complex structures characteristic of the previous habitat category. Most species relying on closed forests (e.g., tanagers) are likely able to substitute older, more complex stands when those are available. Where sufficient understory exists, species such as deer and elk may derive benefits from these closed-canopy stands when phenology is delayed so that a greater quality of forage is available late in the growing season, when thermal cover is provided in the summer and winter, and when hiding cover is provided by boles and undergrowth; but, older forests may provide even greater benefits.

West-Side Planning Units

Currently, NRF-management areas are 30 percent closed forest, Dispersal management areas are 47 percent closed forest, and the remainder of the units are 41 percent closed forest. As a whole, these areas are 40 percent closed forest.

East-Side Planning Units

Due to the lack of age-specific data on east-side stands, it is difficult to assess the amount of this habitat category which would likely be present. Many of the stands are expected to be managed on an uneven-aged basis. Where sufficient numbers of overstory trees are left, the stand may be considered as a closed forest. In other situations, the removal of most overstory trees or the naturally sparse nature of overstory trees might result in the more open uneven-aged stage discussed later. It is expected that, in either event, the needs of many species would be met. Species relying on forests which provide thermal cover, hiding cover, and other needs which are based more upon a more-or-less continuous canopy, and less so on characteristics such as found in older types, would

likely find sufficient habitats in even and multi-aged stands where one or a number of species predominate in the overstory and sufficient canopy cover remains.

OESF Planning Unit
Within the OESF, preliminary estimates indicate that about 5-10 percent of stands are currently in the closed-canopy forest stage.

ALTERNATIVES A AND 1

West-Side Planning Units
Due to the existing age distribution of forested stands on DNR-managed lands, it is expected that there will be a ready supply of mid-seral forests for many decades, regardless of which alternatives are implemented. Silvicultural options in mid-seral forests can increase or decrease the amount of time stands will remain in this stage before obtaining late-successional characteristics. These silvicultural options exist to a similar degree under all alternatives.

Based on DNR estimates, 29 percent of DNR-managed lands on the west side (exclusive of the OESF) would be in this habitat category at year 2096. This estimate includes riparian areas, unstable slopes, and murrelet sites, as well as habitat provided for owls. Based on average rotations of 60 years (40-80 years), it could be expected that those stands which fall outside such areas would provide 33 percent (0-38 percent) closed forests. It is reasonable to assume that between owl circles, riparian buffers, wetland buffers, unstable slopes, and general silviculture, closed forest would likely be provided in fair amounts across all landscapes. Under the No Action alternative, there is no guarantee for any rotation age or habitats. A change from a rotation which averages 60 years to one which averages 40 years may significantly alter this assessment.

East-Side Planning Units
Under all alternatives, it is expected that uneven-aged management would retain and grow stands with significant amounts of overstory trees. Even-aged management is also likely to continue on the east side especially considering the need for action relative to the forest health issue. Rotations are also expected to be sufficiently long to provide closed-canopy forest although there are no guarantees of this under the No Action alternative. However, it is also likely that these even-aged stands would then be converted to uneven-aged management as time progresses.

OESF Planning Unit
Based on preliminary estimates, it is expected that 30-35 percent of the OESF would be in closed forest at the year 2096.

ALTERNATIVE B

West-Side Planning Units
In the long term, there is greater certainty that mid-seral stands will be provided under the action alternatives because they are an intermediate stage necessary to obtaining late seral characteristics. Under this alternative, DNR would be managing in a manner to provide late seral habitats in some landscapes that would include harvests of some late seral habitat while developing other late seral habitat. This would ensure a continuing but

dynamic amount of mid-seral forests that would be guaranteed under this alternative. Substantial areas will also be managed as spotted owl dispersal habitat which will provide mid-seral forests in those areas.

Based on DNR estimates, 31 percent of DNR-managed lands on the west side (excluding the OESF) would be in this habitat category at year 2096. This estimate includes riparian areas, unstable slopes, and murrelet sites, as well as habitat provided for owls. The distribution of closed forests would be influenced little by the location of NRF management areas and Dispersal management areas. At year 2096, it is expected that 30 percent of the Dispersal management areas, 22 percent of the NRF management areas, and 33 percent of the remaining areas would be in closed forest.

East-Side Planning Units

Under all alternatives, it is expected that uneven-aged management would retain and grow stands with significant amounts of overstory trees. Even-aged management is also likely to continue on the east side especially considering the need for action relative to the forest health issue. Rotations are also expected to be sufficiently long to provide closed-canopy forest although there are no guarantees of this under the No Action alternative. However, it is also likely that these even-aged stands would then be converted to uneven-aged management as time progresses.

ALTERNATIVE C

West-Side Planning Units

At year 2096, it is expected that 22 percent of DNR-managed lands in the west-side planning units (excluding the OESF) would be in this habitat category. It is also expected that 21 percent of the NRF management areas, 29 percent of the Dispersal management areas, and 21 percent of the remaining areas would be in closed canopy forest. More areas would be managed for NRF, and fewer would be managed as dispersal habitat.

East-Side Planning Units

Under all alternatives, it is expected that uneven-aged management would retain and grow stands with significant amounts of overstory trees. Even-aged management is also likely to continue on the east side especially considering the need for action relative to the forest health issue. Rotations are also expected to be sufficiently long to provide closed-canopy forest although there are no guarantees of this under the No Action alternative. However, it is also likely that these even-aged stands would then be converted to uneven-aged management as time progresses.

ALTERNATIVE 2

This alternative includes an objective that would maintain at least 40 percent of each landscape planning area as young forest marginal or higher quality habitat. Under this alternative, the harvest of stands younger than 100 years of age is distributed through time to strike a balance with regrowth. It is estimated that at year 2096, 5-10 percent of the OESF would be in closed forest.

ALTERNATIVE 3
This alternative includes an objective that would retain 40 percent of 40,000 acres as young-forest marginal habitat (51-70 years). It is estimated that at year 2096, about 5 percent of the OESF would be in closed forest.

Comparison Among Alternatives and Remarks Relative to Cumulative Effects

West-Side Planning Units

Little difference exists between alternatives. The No Action alternative might produce 29 percent closed-canopy forest at year 2096, but results under this alternative are highly variable. It is estimated that Alternative B will contribute about 31 percent closed forest and that Alternative C will contribute about 22 percent.

When examining the amount of closed-canopy forest or older, more advanced habitat categories which may exist at year 2096 in comparison to the current amount (67 percent), the No Action alternative would contribute 59 percent and Alternative B would contribute 62 percent. Distribution under Alternative B would likely be 81 percent in the NRF management areas, 69 percent in the Dispersal management areas, and 58 percent in the remaining areas. In comparison, Alternative C would provide about 72 percent, with 78 percent of NRF management areas, 77 percent of Dispersal management areas, and 70 percent of the remaining areas.

Silvicultural techniques which are designed to produce late seral characteristics would be applied in NRF management areas under Alternatives B and C and in riparian areas under Alternative C.

East-Side Planning Units

The amounts of this habitat category are not likely to differ significantly by alternative. For all alternatives, it is difficult to assess the amount which would be present, but it is also likely that closed-canopy forest and older categories will constitute a major portion of the forested habitat categories.

OESF Planning Unit

The amount of closed forest differs significantly between alternatives. Alternative 1 would provide 30-35 percent closed forest in comparison to the action alternatives (5-10 percent). However, there is very little difference when considering that more advanced forests can substitute for closed forest for many species. All alternatives provide about 70-75 percent closed and older forests.

Remarks Relative to Cumulative Effects

Species which rely on closed-canopy forest or older categories for security and thermal cover, such as black-tailed deer and elk, may be impacted. Fragmentation of remaining forest patches by roads and intervening harvests may have synergistic effects which could increase vulnerability of these game species, and may alter adult male to female ratios, thereby impacting recreational and economic opportunities as well (Montana Department

of Fish, Wildlife, and Parks 1985; Basile and Lonner 1979; Lyon 1979). It is expected that these effects would be greatest in the areas where DNR-managed lands are interspersed with numerous smaller and privately-owned tracts, and less so where DNR-managed lands are in contiguous blocks or adjacent to federal lands. Closed forest may not provide the structures and benefits needed by many species which depend on structurally complex, interior forest, but closed forest may provide a sufficient buffer to these older stands so that microclimate variability is reduced and those older stands function more thoroughly as interior forest.

Reduction in the amount and patch size of closed forests and older categories in certain landscapes (e.g., southwest Washington and the eastern portions of the Klickitat Planning Unit) may impact species utilizing contiguous forests such as the northern goshawk, and fragmentation and isolation may impact a number of low-mobility species.

Open Multi-Aged Stands

AFFECTED ENVIRONMENT

This habitat category is not a likely forest stage on the west side. Douglas-fir is considered the most desirable species in areas where it can be grown and is relatively shade-intolerant. Even-aged harvests with the intent of planting Douglas-fir following harvest will retain too few overstory trees to produce this habitat category on the west side outside of the hemlock zone and sitka spruce zones. Partial harvests done for wildlife and resource objectives will leave too many trees to be considered in this habitat category. Partial harvests like thinnings will mainly be aimed at improving health and vigor of the dominant age class (exceptions to this may include experimental management in the OESF). On the west side, opening of stands will bring a quick response from understory plants, natural regeneration may occur by some shade-tolerant species, but they would not likely progress far before they were suppressed. However, where such stands might occur on the west side, they are discussed by age of dominant trees for the purposes of this assessment.

On the east side, uneven-aged management is highly likely (although some heavier removals are also possible, especially where forest health concerns exist). Natural fire regimes may also result in this stand type. These stands are most likely located where there is a species or a number of species, such as ponderosa pine, which are compatible with this management and natural fire regimes. Habitats included herein would be east-side stands with multispecies or ponderosa pine that would be relatively open, and would contain overstory trees with a canopy which has been elevated above the ground by self-pruning or fire, and would contain younger trees at various ages of development.

ALL ALTERNATIVES

These stands would be most likely located where species composition is compatible with this management. Overstory trees in these stands would be opened enough so that significant natural or artificial underplanting would occur. Management would be directed at both the older trees and the younger trees as future crop trees. Two age classes would be most common, three age classes would be less common, and a true

multi-aged stand would be uncommon. True multi-aged stands would be more likely to be unmanaged or lightly managed and would closely resemble the fully functional older forest discussed earlier. Three-age stands would tend to resemble the structurally complex forest habitat. Basically, these stands will be relatively common under all alternatives on the east side. They will be most common outside owl circles (No Action alternative) or outside NRF management areas (action alternatives).

Dense Pole Forest

AFFECTED ENVIRONMENT

The dense-pole stage of forest development occurs during the early stages of stem exclusion, usually between 20 and 40 years old. Stems are closely spaced and numerous and little understory exists. The lower limit of the canopy begins to raise as self-pruning of branches occurs. Generally, there is insufficient canopy lift to allow larger birds, such as spotted owls, to penetrate. Other birds such as warblers and, in some of the older pole forest, waxwings and grosbeaks, would make use of this habitat category. Snowshoe hare may make use of this stage for hiding cover.

West-Side Planning Units

Currently, proposed NRF management areas are 14 percent dense pole, Dispersal management areas are 22 percent dense pole, and the remainder of the units are 15 percent dense pole. As a whole, these areas are 16 percent dense pole forest.

East-Side Planning Units

The amount of this habitat is difficult to assess without age-class information, but it is likely fairly low. There are stands in the transition zone between the pine and fir zones where dense regrowth of Douglas-fir and grand fir has occurred under an overstory of very open pine and Douglas-fir, which are larger and fire-resistant trees. It is extremely difficult to assess the amount of this habitat category.

OESF Planning Unit

Within the OESF, preliminary estimates indicate that about a quarter of the land base is currently in this habitat category.

ALL ALTERNATIVES

West-Side Planning Units

Based on DNR estimates, 15-20 percent of DNR-managed lands on the west side (exclusive of the OESF) would be in this habitat category at year 2096. This estimate includes riparian areas, unstable slopes, and murrelet sites, as well as habitat provided for owls. Based on average rotations of 60 years (40-80 years), it could be expected that those stands which fall outside such areas would provide 33 percent (25-50 percent) dense pole forests. It is expected that there would be little difference between areas. For instance, at year 2096 under Alternative B, it is expected that dense pole forests would encompass 13 percent of NRF management areas, 16 percent of Dispersal management areas, and 23 percent of the remaining areas. At year 2096 under Alternative C, it is

expected that dense pole forests would encompass 13 percent of NRF management areas, 10 percent of Dispersal management areas, and 18 percent of the remaining areas.

East-Side Planning Units
This habitat category is expected to be common under all alternatives given the concern about forest health and the likely occurrence of clearcuts for the purpose of changing species composition and reinitiating the successional stages. It is expected that planting of species appropriate to those sites will occur followed by management directed at achievement of natural forest conditions (e.g., relatively open, multi-aged, multispecies stands or stands dominated by older, fire-resistant ponderosa pine and Douglas-fir). It is also expected that, on smaller scales, fires would continue to reinitiate forest development of many stands which would eventually result in dense pole forest patches.

OESF Planning Unit
The amount of this habitat type decreases under all alternatives. Alternative 1 would retain the most (about 20 percent) in comparison with Alternatives 2 and 3 (5-10 percent).

REMARKS RELATIVE TO CUMULATIVE EFFECTS

Most managed timberlands will continue to provide regular supplies of pole timber. It is highly unlikely that timber managers will manage on rotations much shorter than 40 years. In areas adjacent to federal reserves, the amount of pole timber available in the future may be greatly influenced by natural and stochastic events. Stochastic events such as fire, flood, disease, and windthrow will continue to create early seral openings that will eventually become pole forests.

Regeneration Forest

AFFECTED ENVIRONMENT

These forests are defined as those forests which are 10 to 20 years old and are composed of shrubs and saplings. They are old enough that their branches are beginning to intertwine and outcompete many of the shrubs. Canopies are very dense from the ground upward. Sparrows, thrushes, and porcupines are expected to use this habitat category.

West-Side Planning Units
Currently, proposed NRF management areas are 10 percent regeneration forest, Dispersal management areas are 10 percent regeneration forest, and the remainder of the units are 13 percent regeneration forest. As a whole, these areas are 12 percent regeneration forest.

East-Side Planning Units
Even-aged management is less common than uneven-aged management; however, there is a significant portion of the harvest which removes enough of the overstory to produce open stands and then regeneration stands through regrowth. It is difficult to assess the quantity of these habitats in the absence of age-class data. In the short term, even-aged management will occur frequently in areas of forest-health concern.

OESF Planning Unit
Within the OESF, about a quarter of the stands are currently at this stage.

ALL ALTERNATIVES

West-Side Planning Units
Based on DNR estimates, 10-11 percent of DNR-managed lands on the west side (exclusive of the OESF) would be in regeneration forest at year 2096. This estimate includes riparian areas, unstable slopes, and murrelet sites, as well as habitat provided for owls. Based on average rotations of 60 years (40-80 years), it could be expected that those stands which fall outside such areas would provide 17 percent (12-25 percent) regeneration stands. It is expected that there would be little difference between areas. For instance, at year 2096 under Alternative B, it is expected that regeneration forests would encompass 5 percent of NRF management areas, 8 percent of Dispersal management areas, and 12 percent of the remaining areas. At year 2096 under Alternative C, it is expected that regeneration forests would encompass 7 percent of NRF management areas, 7 percent of Dispersal management areas, and 8 percent of the remaining areas for an overall average of 8 percent. It is expected that species such as the snowshoe hare will find sufficient amounts of foraging habitat throughout the planning period.

East-Side Planning Units
Even-aged management will continue to be less common than uneven-aged management. However, there will likely be a significant portion of the harvest which will remove enough of the overstory to produce open stands that will eventually grow to become regeneration stands. It is difficult to assess the quantity of these habitats in the absence of age-class data. In the short term, actions to address forest health issues will likely continue to produce abundant amounts of this forest habitat category.

OESF Planning Unit
It is estimated that at year 2096, the No Action alternative would provide less of this habitat (about 5 percent or less) than the action alternatives (about 10 percent).

REMARKS RELATIVE TO CUMULATIVE EFFECTS

As mentioned above under the dense pole forest, managed timberlands will continue to provide regular supplies of regeneration stage timber. Under the action alternatives, NRF management areas may contain less early seral forest where harvesting is restricted by the strategy employed and existing dearth of late seral forest (i.e., NRF goals are not met), and where there are unusually large amounts of land in the mid-aged forest which are not ready for harvest. In areas adjacent to federal reserves, the amount of regeneration stage available in the future may be greatly influenced by natural and stochastic events. Stochastic events such as fire, flood, disease, and windthrow will continue to create early seral openings that will eventually become regeneration forests. These processes may be particularly important in riparian areas where some species, such as Nashville, orange-crowned, and Wilson's warblers depend on thickets or shrubs.

Open forest stage

AFFECTED ENVIRONMENT

This habitat category is defined as the earliest of the seral stages, from 0-10 years of age. The overstory has been removed and herbs and low shrubs dominate the vegetation. Young conifer and deciduous trees are also present.

West-Side Planning Units

Currently, NRF management areas are 3 percent open forest, Dispersal management areas are 3 percent open forest, and the remainder of the units are 5 percent open forest. As a whole, these areas are 5 percent open forest.

East-Side Planning Units

Even-aged management is less common than uneven-aged management. However, there is a significant portion of the harvest which removes enough of the overstory to produce open stands. It is difficult to assess the quantity of these habitats in the absence of age-class data.

OESF Planning Unit

Within the OESF, preliminary estimates indicate about 20 percent of stands are currently in the open forest stage.

ALL ALTERNATIVES

West-Side Planning Units

Based on DNR estimates, 4-6 percent of DNR-managed lands on the west side (exclusive of the OESF) would be in this habitat category at year 2096. This estimate includes riparian areas, unstable slopes, and murrelet sites, as well as habitat provided for owls. Based on average rotations of 60 years (40-80 years), it could be expected that those stands which fall outside such areas would provide 17 percent (12-25 percent) open forests. It is expected that there would be some difference between areas. For instance, at year 2096 under Alternative B, it is expected that open forests would encompass 2 percent of NRF management areas, 6 percent of Dispersal management areas, and 7 percent of the remaining areas. At year 2096, under Alternative C, it is expected that open forests would encompass 3 percent of NRF management areas, 6 percent of Dispersal management areas, and 4 percent of the remaining areas.

East-Side Planning Units

Fires will continue to provide large and small areas of this habitat category. In the short term, even-aged harvests to address forest health issues will continue to provide abundant amounts of this category. In the long term, it is expected that even-aged management will continue to form a portion of the actions occurring on the east side although it may become relatively less common in comparison to the uneven-aged harvests.

OESF Planning Unit

Based on some very preliminary estimates, the No Action alternative would provide less open forest stage (less than 5 percent) than either Alternative 2 or 3 (10-15 percent).

REMARKS RELATIVE TO CUMULATIVE EFFECTS

Conversion to nonforestry would be one of the few likely threats to the availability of this stage. Conversion to agriculture often provides many species with similar habitat or forage needs. Under the action alternatives, NRF management areas may contain less early seral forest where harvesting is restricted by the strategy employed and existing dearth of late seral forest (i.e., NRF goals are not met), and where there are unusually large amounts of land in the mid-aged forest which are not ready for harvest. In areas adjacent to federal reserves, the amount of open forest stage available in the future may be greatly influenced by natural and stochastic events. Stochastic events such as fire, flood, disease, and windthrow will continue to create early seral openings (open forests). These processes may be particularly important in riparian areas where harvest will no longer be used to create openings. This is especially true for species such as the little willow flycatcher which may rely on areas of shrubs and deciduous trees in and adjacent to riparian areas.

Management in the recent past has created abundant amounts of such habitat, but has also decreased the quality of this open-forest habitat through active management to control vegetation competing with targeted regeneration species. Many species, such as band-tailed pigeons, depend upon the seeds and berries produced by broad-leaved plants in this forest stage.

As in the above age class, availability of open early seral stages will usually be the converse of late seral availability. Some local areas may experience short-term reductions in the amount of this ephemeral stage. Under all alternatives, there will be adequate amounts of early seral openings for all wildlife species native to this region. However, the usefulness of this habitat may vary somewhat by alternative. The character of these stands often changes rapidly during the 10-year period. Amounts of forage and berries produced begin to decrease as newly planted trees grow taller and begin to shade and suppress the herbaceous and shrub layers. Treatments to enhance the growth of trees and reduce competition with other vegetation often diminish the usefulness of these earlier stages to wildlife. In addition, when these units are either too large, too distant from older forests, or lack residual structure, they may not be used by all species. Western bluebirds forage in open areas, but require cavities for nesting. In addition to older mature stages, olive-sided flycatchers will utilize this forest stage in areas of abundant snags. Canopy openings and edges provide ideal foraging environments. Elk also forage in open areas but require nearby security and thermal cover. Road management (in terms of the amount of open road or sighting of roads in specific locations) is not likely to differ significantly by alternative but will greatly affect species which use open areas and are subject to human-induced disturbance or mortality.

Under the action alternatives, it is likely that a steady, albeit possibly lower, supply of this stage would be provided over time. Due to considerations of residual trees and other harvest practices, the quality of this habitat may be improved under the action alternatives. In many areas, some species such as Columbian black-tailed deer may experience slight short-term and localized reductions from current population levels, regardless of which alternative is implemented, due to age-class distribution of forests across all the ownerships. In some areas, early seral stages are overabundant and are not

sustainable. Local distribution of open units in the future may depend on harvest scheduling and the availability of harvest-aged timber.

Wildlife Trees

AFFECTED ENVIRONMENT

Snags, large wildlife trees, cavities, and downed logs are important forest-habitat structures that provide many functions important to wildlife species. Vaux's swift depend upon large, hollow snags for nesting and roosting sites. These structures are usually common in unmanaged stands as well as stands managed for wildlife objectives. However, these structures may be of limited supply in managed stands where there are no specific wildlife objectives or as a result of past natural events and past management activity.

ALTERNATIVES A AND 1

The No Action alternatives would meet the minimums established by state regulations (WAC 222-30-20(11)). These are the only alternatives affecting management of east-side stands.

ALTERNATIVES B AND 2

Alternatives B and 2would employ a leave tree strategy which would focus on leaving at least two large trees per acre in harvested areas. This strategy would leave three snags per acre as well as three additional green recruitment trees per acre harvested. Large trees left in harvested units would be selected for characteristics important to wildlife and will provide habitat for many species which utilize openings. For example, bluebirds, violet-green swallows, kestrels, and Lewis' woodpeckers utilize snags and trees with cavities when they occur within and adjacent to open areas. Rufous hummingbirds utilize trees for nesting in very early stages of forest succession and rely on dense stems and foliage for nesting sites. Other species, such as sapsuckers, nuthatches, and flying squirrels would use snags once surrounded by forests of sufficient development. Greater experimentation regarding wildlife leave trees would be expected within the OESF. These alternatives should provide a much greater quality of leave trees and snags than the No Action alternative.

Alternatives C and 3

Alternatives C and 3 would employ a leave tree strategy which would focus on leaving at least two large trees per acre in harvested areas. Large trees left in harvested units would be selected for characteristics important to wildlife and will provide habitat for many species which utilize openings. For example, bluebirds, violet-green swallows, kestrels, and Lewis' woodpeckers utilize snags and trees with cavities when they occur within and adjacent to open areas. Rufous hummingbirds utilize trees for nesting in very early stages of forest succession and rely on dense stems and foliage for nesting sites. Greater experimentation regarding wildlife leave trees would be expected within the OESF. These alternatives should provide a much greater quality of leave trees than the No Action alternative, but would not provide any additional snags.

COMPARISON AMONG ALTERNATIVES AND REMARKS RELATIVE TO CUMULATIVE EFFECTS

The minimum leave trees under the No Action alternative might not provide sufficient habitat for these species because there is no particular focus on the value of large trees for wildlife. As the stands mature, the legacy trees provide habitat for different guilds of species at different times. Trees left under all alternatives should provide sufficient legacy trees once the stands become mature, but large, higher-quality wildlife trees would be of greater number under the action alternatives. Snags would not be guaranteed in the short term (early seral stands) under any of the alternatives.

None of the other alternatives guarantee the provision of snags above current state regulations. Estimates of snags needed for wildlife purposes are usually expressed as a number per acre harvested. Often, snags and green leave trees are clumped as a result of harvest-unit logistics. Many harvest operations are made logistically more simple by clumping all leave trees in one or two clumps at the edge of the harvest unit. Clumping leave trees in this manner benefits some species, while distributing leave trees benefits others. Those species which depend upon undisturbed sites would benefit from clumping, which may include many ground-dwelling animals such as amphibians. Clumping may provide a refugia from which some species can later disperse into the surrounding unit as it matures. Northern saw-whet owls and flycatchers may utilize clumps of leave trees and snags adjacent to open areas. Some species would benefit more from a distributed pattern of leave trees rather than leaving single clumps. Many species, such as the northern flying squirrel, are territorial during at least part of the year. Flying squirrels have home ranges on the order of 1-10 acres and are believed to defend a territory during the breeding season (Madden 1974). Single clumps would reduce the number of flying squirrel territories that a stand would be able to support. However, a strategy which would provide clumps of leave trees and snags every 5 acres, such as proposed in Alternatives B and 2, would likely serve the needs of flying squirrels and other such species quite well. Flying squirrels are important prey species for several forest carnivores, including spotted owls. Important considerations with regard to wildlife are the amount, quality, and distribution of leave trees and snags. Vaux's swift, fisher, and marten require hollow snags which are often in short supply. Some species of trees, which rot more rapidly in the core leaving a structurally-sound shell surrounding a softer or hollow core, provide superior cavity-nesting opportunities for many species. Alternatives B and 2 will provide emphasis on the retention of these structures.

Wetlands

AFFECTED ENVIRONMENT

Wetlands are often varied and are important for a number of species. Young fish mature in wetlands. Many species of amphibians, such as the Cascades frog, are associated with wetlands. Some species utilize wetlands during portions of their life cycle or to fulfill certain requirements. Great blue herons feed in wetlands. Sphagnum bogs support a unique set of species such as Beller's ground beetle and Hatch's click beetle.

ALTERNATIVES A AND 1

The No Action alternatives will adhere to state regulatory minimums and policy standards under DNR's Forest Resource Plan, so long as these policies are retained. State

regulations would only buffer wetlands which are greater than 0.5 acre; the No action alternative might buffer wetlands as small as 0.25 acre. Also, if current policy is continued, wetlands would be treated as described in Matrices 1a and 1b, Chapter 2. Wetlands between 0.25 and 1 acre in size would receive a 100-foot buffer, while larger wetlands may receive a buffer of up to a site potential tree height. This is the only alternative affecting management of east-side wetlands and adjacent stands.

Buffers and forested wetlands activities would maintain 120 square feet of basal area with emphasis on windfirmness. Also, ground-based equipment would generally be precluded, natural surface and subsurface drainage conditions would be maintained or restored, and no roading would occur without on-site mitigation.

ALTERNATIVE B

Alternative B, like the No Action alternatives, will adhere to state regulatory minimums and to higher policy standards under DNR's Forest Resource Plan. If these policies and regulations were to be discontinued in the future, Alternative B would continue to provide the indicated level of protection for wetlands. Alternative B would buffer wetlands as small as 0.25 acre. Wetlands would be treated as described in Matrix 1a, Chapter 2. Wetlands between 0.25 and 1 acre in size would receive a 100-foot buffer, while larger wetlands would receive a buffer of up to a site potential tree height.

Buffers and forested wetlands activities would maintain 120 square feet of basal area with emphasis on windfirmness. Ground-based equipment would generally be precluded, natural surface and subsurface drainage conditions would be maintained or restored, and no roading would occur without on-site mitigation.

ALTERNATIVE C

In addition to the prescription contained in Alternative B, Alternative C would include a number of additional provisions. Bogs would be buffered even if they were only 0.1 acre in size, as would small interconnected wetlands or those connected to a typed water. Wetlands within 200 feet of unstable hillslopes would have the buffer increased by 50 percent on the half of the wetland closest to the unstable slope.

Buffers and forested wetlands would still maintain 120 square feet of basal area, but the trees would be representative dominants and co-dominants and would be windfirm. No ground-based equipment would be allowed within 50 feet of the wetland's edge or 100 feet of bogs. In addition, there would be no harvest allowed within 50 feet of nonforested wetlands.

ALTERNATIVES 2 AND 3

Buffers are expected to be based on tree height and should average over 100 feet on wetlands from 0.25 to 1 acre, and 150 feet on wetlands greater than 1 acre. Buffers and forested wetlands would still maintain 120 square feet of basal area, but the trees would be representative dominants and co-dominants. In addition, there would be no harvest allowed within 50 feet of nonforested wetlands. In addition, this conservation strategy would be integrated with a research and monitoring program.

COMPARISON AMONG ALTERNATIVES AND REMARKS RELATIVE TO CUMULATIVE EFFECTS

The action alternatives (Alternatives B, C, 2, and 3) buffer wetlands greater than 0.25 acre. The No Action alternatives (A and 1) may do this if current policy is maintained. Alternative B would ensure that the Forest Resource Plan policies were continued as a minimum. Alternatives C, 2, and 3 also provide buffers on smaller bogs and additional protection for all bogs. The leave tree strategy in wetland buffers should be more robust under the action alternatives because buffers will be guaranteed to be at least 100 feet wide on the average, as opposed to 25-50 feet under current state regulations. In addition, state regulations only require that a small number of larger trees be retained. However, the action alternatives would retain at least 120 square feet of basal area while the No Action alternatives might only retain 75 trees per acre which could be as small as 6 inches in diameter in western Washington or 4 inches in eastern Washington.

Therefore, it is expected that snag and cavity-dependent species which live adjacent to forested and nonforested wetlands would fare better under the action alternatives than under the No Action alternatives. Greater amounts of large woody debris (important loafing sites for turtles and ducks) would be provided in the action alternatives. Greater protection for the microclimate would also be protected by the action alternatives. Smaller forested and nonforested wetlands, which may contribute significantly to the total acreage of protected wetlands, would be protected more thoroughly under the action alternatives than under the No Action alternatives.

The treatment of nonforested wetlands in open areas (e.g., within prairie areas) does not differ among any of the alternatives. These habitats are particularly sensitive in areas of remnant prairies. Many sensitive plant species in the state are associated with ponds or wetlands located in remnant prairies such as those found in the Puget lowlands. Spotted frogs have become extremely rare in western Washington and once depended upon low-elevation wetlands with nonwoody vegetation. Impacts to these species would not vary by alternatives. Road construction and development likely pose the greatest threats for these species, rather than timber harvesting.

Riparian Corridors

AFFECTED ENVIRONMENT

Riparian areas include the areas described in Sections 4.2.3, 4.3.2, and 4.4.2, which include forested areas adjacent to streams and wetlands which influence those aquatic and wetland habitats and are in turn influenced by those habitats as well. Many species dependent on moist environments or dependent on aquatic environments for a portion of their life history requirements are often dependent on riparian habitats.

ALTERNATIVES A AND 1

The No Action alternatives presume that the policies under the Forest Resource Plan would continue. These actions were described earlier in terms of buffer size and actions within those buffers. However, these treatments may or may not continue in the future. OESF actions would be more likely to continue due to the Hoh Agreement regarding riparian actions in portions of the OESF (Hoh Tribe and DNR 1993). Regulations established for riparian protection through promulgation of state regulations, or de facto

state regulations which result from completion of watershed analysis would be expected to continue and that DNR would adhere to those regulations. The buffers provided by the No Action alternative are likely sufficient for use as travel corridors; however, there is no guarantee that they will continue to be as wide as provided in the recent past. This represents the only alternative affecting management of east-side riparian corridors.

ALTERNATIVE B

Alternative B provides specific protection for many habitat components of riparian ecosystems. Buffer widths are established with consideration to stream type and size and site potential tree height. Possible treatments expected for riparian buffers are described in Chapter 2. Additional buffers may be prescribed for retention in wind-prone areas, but it is not possible to predict how often or under which situations these will occur. Alternative B provides wind buffers of a prescribed width on the windward side only of fishbearing streams where necessary because there is potential for windthrow. The occurrence of wind buffers would be more likely to occur in exposed stands along coastal areas.

Activities which may occur within the buffer will be addressed through adaptive management. The management decisions for the no-harvest area (0-25 feet), the minimal harvest area (25-100 feet), and the low harvest area (100 feet to the buffer's edge) will be developed to achieve the desired biological and economic conditions described earlier in this document. Alternative B would permit actions so long as there were no negative impacts to salmonid habitat, or current conditions are maintained. This would mean that water quality, sedimentation, temperature, and large woody debris would all be considered and management activity would be decided by DNR on a site-specific basis.

In addition to providing large woody debris, shade, and other characteristics desired for aquatic species, the goals of the riparian areas include providing snags, downed logs, cavities, and characteristics important to riparian wildlife. Riparian areas are important sources of cavities for certain species, such as cavity-nesting ducks (e.g., wood ducks, Barrow's golden-eye, hooded mergansers, and buffleheads).

ALTERNATIVE C

Alternative C would place wind buffers on both sides of all fishbearing streams. Alternative C would only allow management actions conducted for restoration and enhancement. Alternative C is most likely to maintain more sensitive species and would likely involve fewer areas in management actions.

ALTERNATIVES 2 AND 3

The OESF action alternatives would provide wind buffers along both sides of all streams but the widths may vary, so the most wind-prone areas would receive the most protection.

COMPARISON AMONG ALTERNATIVES AND REMARKS RELATIVE TO CUMULATIVE EFFECTS

The action alternatives would provide substantially more riparian habitat protection than the No Action alternatives. The action alternatives may lack detail in the description of potential actions to fully assess the impacts to all aquatic and terrestrial species at this time, but Alternative B establishes a process to ensure the necessary characteristics are achieved. None of the action alternatives specify the density and size of trees to remain.

Frequent entries for timber harvest could, in some situations, decrease the production of large trees, snags, and eventually large woody debris. However, most riparian sites would only be entered when adjacent units are harvested. Some uniquely large trees may be removed in the interims. Large trees, snags, and downed logs would likely exist in greater amounts than on adjacent upland sites.

Alternatives B and C might result in greater and more rapid re-establishment of conifers in riparian areas where conifers originally existed, compared with Alternative A. Although short-term impacts from actions such as alder removal and conversion to conifers may impact immediate large woody debris levels and shading, as well as other parameters of the riparian buffer, these restoration actions are protected to have positive benefits for many species in the long term.

The action alternatives appear to provide adequate buffers for use by many wildlife species as travel corridors and they would be guaranteed. However, for some of the species more sensitive to disturbance such as grizzly bears, they may not be adequate, especially in areas near roads where the need for cover may be greatest.

Remarks Relative to Cumulative Effects
It is expected that many species requiring moist conditions or older forests may eventually use riparian areas for specific life-history requirements or as travel/dispersal corridors. The benefit of these corridors will be proportional to their adjacency to other needed habitats. For example, riparian corridors will provide raptor dispersal or nesting habitat if adjacent stands are in advanced seral stages. As another example, links for amphibians to nearby wetlands or other off-channel habitat may prove important to the use of those habitats. It is expected that the action alternatives will provide wider and better buffers than the No Action alternative, and that the action alternative buffers would result in better connectivity to other habitats.

East-Side Planning Units
There are no differences among the alternatives regarding the east-side riparian strategy. The only difference between the alternatives on the east side is for owls and other listed species. As described earlier, composition of upland forests may vary between these alternatives and in turn further impact or benefit riparian habitats accordingly. Greater amounts of older forest along riparian areas would help maintain the riparian microclimate, reduce effects of edge on predation rates, provide additional habitats for moist-forest-dependent species, and would contribute to the riparian ecosystem in a number of additional ways. The riparian strategy for the east side is to follow the No Action alternative (state regulations and current policy). As mentioned earlier, there are no guarantees regarding buffer widths and treatments, and application of these standards may not be consistent between areas.

Aquatic Habitats

AFFECTED ENVIRONMENT

A description of aquatic habitats was provided in Sections 4.2.3, 4.3.2, and 4.4.2. These habitats include all standing water and running water at the surface-to-air interface and

beneath the surface of the water. Species dependent on the aquatic to habitat category include life-long residents such as sculpins and other resident fish, and part-time residents such as amphibians. Some of these species, such as tailed frogs and bull trout, have more stringent requirements than others.

ALL ALTERNATIVES

A complete description of impacts was given in earlier in this document and addressed by individual components of the aquatic system. Further analysis was also provided under salmon and bull trout in Section 4.5.2. One assumption made in this analysis is that bull trout and salmonids, being temperature and water-quality sensitive and having requirements for undisturbed substrates and free passage, represent species which can serve as indicators for other aquatic species.

COMPARISON AMONG ALTERNATIVES AND REMARKS RELATIVE TO CUMULATIVE EFFECTS

Organisms dependent on aquatic systems would likely fare better under the action alternatives. Combinations of more robust wetland protection, riparian corridors, and the treatments of stable and unstable uplands should all contribute to improved water quality which would include temperature, sediment, and seasonal flow regimes which more closely emulate those found naturally. Shading and microclimate protection should help keep water temperatures at normal levels. Salmonids, especially bull trout, may be the species which are most likely to be influenced by water-quality and passage issues in the forested environments. It is assumed that provisions to address these salmonids will provide the needed habitat quality and quantity for other fish and aquatic species. Irregular stream flows may be the most limiting factor to some aquatic species, such as mollusks. Wetlands can help to moderate stream flows through attenuation of flood-peaks during storm events, and by discharging ground water during low-flow periods. Alternatives C, 2, and 3 are more protective of factors that influence wetland hydrology and may therefore benefit stream flows more than Alternative A, 1, or B. The proposed HCP would not cover (and this analysis does not include) actions which may be taken regarding water diversion or direct manipulation of stream flows. It is expected that the riparian prescriptions in most areas should adequately address stream flows, large woody debris, bank stability, sedimentation, pool-riffle ratios, and channel morphology. Under all alternatives, the protection for aquatic habitats is expected to be enhanced by protection of unstable slopes. Protection of aquatic habitats would be greater under the action alternatives than under the No Action alternatives.

Caves

AFFECTED ENVIRONMENT

Caves are important habitats for many species, and may be important for as yet undiscovered species. Some species are adapted specifically for life in caves and some of these only occur in one or a few caves (e.g., the campodeid dipluran *Haplocampa* spp., the stygobiont copapod *Stygonitocrella* spp.; WDW 1994). Cave dwellers often depend on the relatively stable conditions found in caves. The locations of some caves on DNR-managed lands are likely unknown.

ALTERNATIVES A AND 1

No specific provisions would be provided for this habitat category. This is the only alternative affecting management with regard to east-side caves.

ALTERNATIVES B, C, 2, AND 3

Buffers around cave passages (100 feet) and cave entrances (250 feet) as well as equipment-restricted areas were described in Chapter 2. Caves would be mapped prior to management activities and locations would be kept confidential.

COMPARISON AMONG ALTERNATIVES AND REMARKS RELATIVE TO CUMULATIVE EFFECTS

Buffers at cave entrances are particularly important to maintaining constant environmental conditions in terms of temperature and relative humidity. Bats often locate their hibernation roosts according to temperature gradients. Townsend's bats are very dependent on caves for hibernation. Drastic fluctuations in winter cave temperatures would be devastating for hibernating bats. Moisture fluctuations would impact amphibians, invertebrates, and fungi. The No Action alternative would offer no specific protection to caves whereas the action alternatives would provide 250-foot buffers at entrances and 100-foot buffers on each side of cave passages. In addition, there would be an effort to locate roads away from entrances and passages under the action alternatives, which would help maintain the integrity of the cave. The action alternatives provide a much greater level of protection to cave habitats and their resident and temporary residents.

Cliffs

AFFECTED ENVIRONMENT

Cliffs are defined as a steep, vertical, or overhanging rock face. No estimate of the number and locations of cliffs was available for this assessment.

ALTERNATIVES A AND 1

No specific provisions would be provided for this habitat category. Alternative A is the only alternative affecting the management of cliffs on the east side.

ALTERNATIVES B AND 2

These alternatives state that mining of rock from cliffs for road construction would be avoided when practicable, that an evaluation will be conducted to identify important wildlife features which may exist, and that site-specific prescriptions would be developed where appropriate.

ALTERNATIVES C AND 3

These alternatives state that mining of rock from cliffs for road construction would be avoided when materials can otherwise be reasonably acquired and that site-specific prescriptions may be developed.

COMPARISON AMONG ALTERNATIVES AND REMARKS RELATIVE TO CUMULATIVE EFFECTS

Alternatives B and 2 provide for an assessment of wildlife values and establishing a site-specific plan when necessary to protect those values. The other action alternatives offer

little additional protection over the No Action alternative. Unless species are present that would require additional actions (i.e., peregrine falcons), it is assumed that little protection would be provided unless it came at no economic cost. The action alternatives may contribute to maintaining most cliff areas intact. However, only Alternatives B and 2 address the maintenance of vegetation within and adjacent to cliff areas for the use of nesting birds or for the maintenance of shelter from the elements. All alternatives could result in some level of impact to cliff-dependent species.

Talus

AFFECTED ENVIRONMENT

Talus fields are homogeneous areas of rock rubble, usually coarse and angular, ranging in average size from 1 inch to 6.5 feet, derived from and lying at the base of a cliff or very steep, rocky slope. Talus field inventories were not available for this analysis, but talus is not an uncommon feature in portions of the Cascades and Olympic mountains.

ALTERNATIVES A AND 1

The No Action alternative offers no specific protection for talus fields. This is the only alternative for protection of talus on the east side.

ALTERNATIVES B AND 2

Alternatives B and 2 would provide a 100-foot buffer around talus fields over 1 acre in size (1/4 acre in some key areas). Talus fields would not incur any harvest; however, within the buffer, harvest might occur so long as it maintained 60 percent canopy coverage. In forested talus areas outside those buffers, harvest can occur so long as no more than 1/3 of the volume is removed during each rotation. Within talus fields and associated buffers, road building will be avoided, provided that the routing of roads around such areas can be accomplished in a practical manner that is consistent with other objectives of a comprehensive landscape-based road network plan. These buffers should help maintain the integrity and microclimate of the talus fields, as well as provide a supply of coarse woody debris.

ALTERNATIVES C AND 3

These alternatives would provide a 100-foot buffer around talus fields over 1 acre in size. Talus fields would not incur any harvest; however, within the buffer, a harvest of up to a third of the volume might occur during each rotation. The talus field itself would not be harvested and, if it were capable of supporting large trees, it might provide shade and a supply of downed logs. Yarding would generally not disrupt talus under the action alternatives, yet there is no guarantee of how often or to what extent disruption might occur.

COMPARISON AMONG ALTERNATIVES AND REMARKS RELATIVE TO CUMULATIVE EFFECTS

It appears that talus-dependent species would be better off under the action alternatives than under the No Action alternative because the talus field itself would not be subject to timber harvest and yarding would often avoid talus fields. Alternatives B and 2 provide a forested buffer around talus fields as well as protection of forested talus. Disruption will

be much less frequent under these alternatives. However, under Alternatives C and 3, it is unclear to what extent the nature of those habitats would be maintained for the long-term survival of species given the lack of certainty regarding disruption of the talus fields and the treatment of the immediately surrounding timber.

Oak Woodlands

Affected Environment

A description of oak woodlands was provided earlier in this document. Oaks occur in the Puget trough area, the Columbia Gorge area, and scattered areas on the west side, but mostly on the east side.

Alternatives A and 1

Under the No Action alternative, oak woodlands are not currently harvested; however, there is no specific prescription for management of these woodlands and no guarantee they would not be harvested sometime in the future. The majority of oak woodlands occur on the east side and would thus be afforded little to no protection.

Alternatives B, C, 2, and 3

The action alternatives address oak woodlands in several meaningful ways. Dominant (open-form) oaks would be retained, as would standing dead and dying oaks, oaks with cavities, and downed logs. Underburns may be used when appropriate and encroaching conifers would be selectively removed. Removal of conifers would be especially beneficial on the west side of the Cascade Range. Approximately 25 to 50 percent of the canopy coverage would be retained.

Comparison Among Alternatives and Remarks Relative to Cumulative Effects

It is likely that these actions would result in retention and restoration of existing oak woodlands which support species such as the western gray squirrel, Lewis' and acorn woodpeckers, white-breasted nuthatches, and many cavity nesters, whereas the No Action alternative would not.

Prairies

Affected Environment

Prairies and other grasslands as described herein are those lands where the climax vegetation under natural regimes of fire, drought, and other naturally occurring events would be maintained as vegetation mainly composed of grasses and forbs.

All Alternatives

The project boundary does not include grasslands in central and eastern Washington. Activities covered under this project do not include grazing or grassland management. Therefore, the alternatives do not vary significantly regarding prairies. Remnant prairies are a concern in the Puget Lowlands; however, it is expected that under all the alternatives, DNR's primary actions in these areas would be restoration or no action. Several species of gopher, butterflies, and sensitive plants may benefit or be impacted

depending on the actions taken. DNR does manage a number of prairie areas, such as Mima Mounds, within the range of the proposed HCP. They are not part of the HCP, but would continue to be managed separately as NRCAs or NAPs. NRCAs and NAPs would not be covered by the proposed HCP. Their retention and management for perpetuation of natural processes would likely count as mitigation so long as the conservation and management of these areas continue.

Remarks Relative to Cumulative Effects

West-side prairies have been devastated by development and fire suppression. Fire suppression has resulted in conifer encroachment and loss of prairies. This has probably impacted a number of species more severely in the state of Washington than forest management.

Subalpine meadows and shrub fields

Affected Environment

These habitat classes include many of the nonforested areas at high elevations which support vegetation. Blueberry fields and avalanche chutes, as well as wet meadows, are all examples of these habitats. Very few DNR-managed lands are at elevations that would include these habitat classes. Most of these areas are likely under federal ownership.

All Alternatives

DNR manages several areas with subalpine meadows, such as portions of Mount Si, as NRCAs or NAPs. NRCAs and NAPs are not part of the HCP, but would continue to be managed separately as NRCAs or NAPs. NRCAs and NAPs would not be covered by the proposed HCP, but their retention and management for perpetuation of natural processes would likely count as mitigation so long as the conservation and management of these areas continue.

Subalpine meadows and shrub fields are, by definition, not timbered, but may be surrounded by high-elevation timber types which do not regenerate or grow very quickly or reliably. These habitat classes support several species which can be impacted by disturbance. Grizzlies utilize these habitats for foraging but require nearby escape cover to help minimize human-bear interactions. Mountain goats forage in these areas when escape cover (cliffs) are nearby. Mountain goats also need older forests nearby for use during critical periods. The largest threats to these habitat classes include human disturbance. Humans, by their presence, disrupt normal behavior and energy balances of this habitat's residents and trample and manipulate its vegetation.

Alpine tundra, krumholtz, and glaciers

Affected Environment

Even more so than the previous habitat class, this is a very rare habitat class for DNR-managed lands (if present at all). Most of these habitats are under federal ownership.

ALL ALTERNATIVES

No timber harvest actions are planned for these areas and there is not any significant difference among the alternatives. Access to these areas is probably the sole factor under DNR's control. Under the action alternatives, it is expected that there will be fewer open roads adjacent to federal reserves, especially within and immediately adjacent to the grizzly bear recovery zone in the Cascades.

General Cumulative Effects

In the foreseeable future the cumulative impacts to species may increase with the promulgation of the proposed 4(d) special rule for the northern spotted owl. Loss of habitat in certain landscapes, such as southwest Washington, would likely impact many species dependent on late seral habitats. Continued development along Puget Sound and throughout the Puget trough will impact species whose ranges include or are concentrated within these areas regardless of the habitat types. Those species dependent on extremely young stands of mixed conifer/hardwood would probably be impacted the least.

Availability of habitat to those species normally utilizing those habitat categories can be influenced by several factors, including patch size and connectivity to other habitats. Many species are poor dispersers. Low-mobility species may not be able to pioneer all patches of habitat as they develop. Riparian corridors will form the basis for connectedness under all alternatives. Roads may also form barriers to some low-mobility species. Roads can create physical barriers for elk, particularly when associated with large accumulations of slash on steep slopes. Elk usually are able to find ways around such barriers within a short distance.

Roads and their associated disturbances can reduce the availability of surrounding habitats. It is estimated that habitat effectiveness for elk is reduced to one-half when there are about 2 miles of road per section[1]. Lyon (1979) found that 3 miles of road per section removed virtually all effective habitat for elk in Montana. Other researchers have documented year-round avoidance of areas near roads. These effects, however, are very much interrelated with the effects of local and landscape levels of cover. Some species are affected to a greater degree by road densities. Excessive road densities (greater than 1 mile per section) may also preclude use of those areas by grizzly bears. Direct mortality of many species also increases in proximity to open roads. Other species may be impacted in other ways. Dust accumulation near roads may inhibit necessary functions for some smaller animals. The use of herbicides, pesticides, and fertilizers may have impacts upon the usability of habitats for may species and may contribute to direct mortality as well. This will be particularly true for many invertebrates or for species dependant on sensitive broad-leaved plants. Additional impacts and exclusion from habitats may occur from activities which are unrelated to this plan. However, the expected impacts to reducing habitat availability are relatively similar under all alternatives.

[1] A section is a subdivision of a Township in the U.S. Public Land Survey system, representing a piece of land normally 1 square mile in area (containing 640 acres as nearly as possible).

4-503 4.6 Soil

4-504 4.6.1Alternative A

- Five West-Side Planning Units

- Three East-Side Planning Units

4-505 4.6.2 Alternative B

- Five West-Side Planning Units

- Three East-Side Planning Unit

4-506 4.6.3 Alternative C

- Five West-Side Planning Units

- Three East-Side Planning Unit

4-507 4.6.4 OESF Alternative 1

4-507 4.6.5 Alternative 2

4-508 4.6.6 OESF Alternative 3

4.6 Soil

Soil can be defined as the material at the earth's surface which is capable of supporting plants. It is the ecosystem element located at the interface of the climatic, geologic, water, and biologic ecosystem elements. It is a dynamic, natural, three-dimensional body composed of weathered mineral and organic material that provides plants with air, water, root anchorage, and nutrients.

Issues raised during scoping that relate to soils include mass-wasting potential and sedimentation related to water quality and fish habitat issues. Information related to these issues, including road-building and maintenance activities, can be found in the west-side and OESF riparian discussions (Sections 4.2.3 and 4.4.2) and water quality (Section 4.8). Section 8.3.1 of DNR's environmental impact statement for the Forest Resource Plan (DNR 1992a) addresses geology, soils, and erosion issues in relation to current policy and activities. In addition, questions about soil productivity were raised during scoping for the HCP. This section's assessment of impacts on soil focuses on the maintenance of long-term soil productivity. Information about the underlying geology and vegetative zones of each planning unit, which relates to all three issues, can be found in Appendix B - Geology/ Soils/Vegetation.

Forest management relies on soil productivity to support a healthy forest ecosystem and produce desired forest products. Soil productivity is a soil's capacity to support vegetation, and long-term productivity is a soil's capacity to sustain the natural growth potential of plants over time (USDA and USDI 1994a).

Forest management can adversely affect long-term soil productivity through erosion (surface erosion and mass wasting), displacement and compaction, and alteration of chemical composition and of soil communities. The extent to which long-term productivity is affected by forest management is unknown, but it is generally recognized that poor management has the potential to reduce natural soil productivity (USDA and USDI 1994a). Potential adverse affects to soils are controlled by the Washington Forest Practices Rules which require a SEPA environmental checklist for timber harvest where the potential for mass wasting exists (WAC 222-16-050) and require that timber harvest leave land in a condition conducive to future timber production (WAC 222-30-020). In addition, the Forest Resource Plan (DNR 1992b) directs the department to provide, where appropriate, extra protection for soils to ensure the long-term productivity of trust assets.

Adverse impacts to long-term soil productivity are directly related to the frequency and intensity of forest management activities. Sites with the least management-induced disturbance have the highest likelihood of maintaining long-term soil productivity. Sites with more frequent or more intensive management-induced disturbance have a lower likelihood of maintaining soil productivity, but adherence to forest practices rules and Board of Natural Resources policies should prevent an unacceptable degradation of soils.

4.6.1 Alternative A

Five West-Side Planning Units

Under Alternative A, DNR management in the five west-side planning units will be consistent with Board policies and compliant with the Washington Forest Practices Rules (Title 222 WAC). DNR would manage wetlands for no overall net loss of naturally occurring wetland acreage and function (Policy No. 21; DNR 1992b). Riparian management zones would be established on all Type 1, 2, 3, and 4 Waters and when necessary along Type 5 Waters (Policy No. 20; DNR 1992b). Based on current practices in DNR-managed riparian areas, soils in riparian management zones would be subject to a minimal level of management-induced disturbance, but if management objectives change, so could the level of disturbance. No harvest would occur on hillslopes identified in the field as having a high potential for mass wasting.

At present, most timber in suitable marbled murrelet habitat is deferred from harvest, but as much as one-third of DNR-managed suitable murrelet habitat might be harvested under the No Action alternative. Forest land from which marbled murrelet habitat is harvested would subsequently be managed on an even-aged system. Typically, even-aged management is based on either an economic rotation or a maximum volume rotation. Currently, the most widely used harvest age is based on an economic rotation, which is approximately 50-60 years in west-side forests. Maximum volume rotations are approximately 80-100 years, the age at which stand mean annual increment culminates. Typically, over a single harvest cycle, entries into a forest stand are made for precommercial thinning, commercial thinning, and final harvest. Damage to soil productivity can occur during commercial thinning and final harvest. The conversion of old forest to even-aged management subjects virgin soils to a regime of management-induced disturbance.

Old forest that is outside of spotted owl circles, not on unstable hillslopes, or in riparian management zones, and not marbled murrelet habitat, could be harvested. Management for spotted owls would continue on a circle-by-circle basis. No old forest would be allowed to develop in circles that are below the 40 percent minimum, and any old forest lost to natural or human-caused disturbance would not be replaced. The geographical shift of an owl activity center also alters the location of its owl circle, and this may release old forest for harvest. In the west-side planning units, forest land from which old forest is harvested would subsequently be managed on an even-aged system.

Three East-Side Planning Units

DNR management in the east-side planning units will be consistent with the same policies. However, forest land from which old forest is harvested would generally be managed on an uneven-aged system. In addition, these units are out of the known range of the marbled murrelet and are therefore not affected by marbled murrelet policies.

The predominant form of harvest in east-side DNR-managed forests is partial cutting where 30-35 percent of stand volume is removed on a 20-year cutting cycle. The conversion of old forest to intensive uneven-aged management results in more frequent

management-induced disturbance. However, it is anticipated that adherence to Board of Natural Resources policies should prevent an unacceptable degradation of soils.

4.6.2 Alternative B

Five West-Side Planning Units

Under Alternative B, DNR would continue to manage in a manner consistent with Board policies and in compliance with the Washington Forest Practices Rules (Title 222 WAC). DNR would manage wetlands for no overall net loss of naturally occurring wetland acreage and function. The riparian conservation strategy of Alternative B establishes riparian management zones which consist of a riparian buffer and a wind buffer. Along most streams, the riparian buffer is wider than the riparian management zones of Alternative A. Based on the primary management objective of riparian buffers -- to maintain or restore salmonid habitat -- soils in riparian management zones would be subject to a minimal level of management-induced disturbance. This level of disturbance is expected to be less than or equal to that of Alternative A. Wind buffers will protect the riparian buffers of Type 1, 2, and 3 Waters in areas of high windthrow potential. Windthrow along the edges of clearcuts can cause significant disturbance to soils. No harvest would occur on hillslopes identified in the field as having a high potential for mass wasting.

The short-term marbled murrelet conservation strategy allows the harvest of marginal habitat and unoccupied higher quality habitat. Forest land from which marbled murrelet habitat is harvested would subsequently be managed on an even-aged system. The amount of murrelet habitat converted to even-aged management should be less than under Alternative A. All old forest that is outside of NRF management areas and riparian management zones, not on unstable hillslopes, and not marbled murrelet habitat could be harvested. Forest land from which old forest is harvested would subsequently be managed on an even-aged system. In NRF management areas, at least 50 percent of the DNR-managed land designated for NRF management would be NRF habitat at any one time. The 50 percent habitat prescription would be applied to watershed administrative units (WAUs). This WAU prescription requires that forests be managed on a longer harvest rotation. In effect, the frequency of management-induced disturbance would be reduced in areas managed for NRF habitat. Overall, more owl habitat would be converted to short-rotation (50 to 60 years) even-aged management than under Alternative A.

Compared to Alternative A, riparian areas would be subject to less frequent and less intensive management-induced disturbance, but in upland areas there could be an increase in the land area subject to management-induced disturbance. However, it is anticipated that adherence to Board of Natural Resources policies should prevent an unacceptable degradation of soils. Relative to Alternative A, there should be a reduction in adverse impacts to soils.

Three East-Side Planning Units

In the east-side planning units, management in riparian areas and wetlands is the same as under Alternative A, rather than having additional riparian strategies applied as on the west side. In NRF management areas, at least 50 percent of the DNR-managed land designated for NRF management would be NRF habitat at any one time. The 50 percent habitat prescription would be applied to WAUs. This WAU prescription requires that forests be managed on a longer harvest rotation. In effect, the frequency of management-induced disturbance will be reduced in areas managed for NRF habitat. Overall, more owl habitat would be converted to uneven-aged management than under the No Action alternative.

Compared to Alternative A, riparian areas would be subject to the same level of management-induced disturbance, but in upland areas there would be an increase in the land area subject to management-induced disturbance. However, it is anticipated that adherence to Board of Natural Resources policies should prevent an unacceptable degradation of soils. Relative to Alternative A, there should be no significant difference in adverse impacts to soils.

4.6.3 Alternative C

Five West-Side Planning Units

DNR management of the five west-side planning units under Alternative C is similar in approach to Alternative B, but provides greater retention of older forests. Alternative C establishes wider riparian buffers and added protection from windthrow than Alternative B. The marbled murrelet conservation strategy does not allow the harvest of marginal habitat or unoccupied higher quality habitat and, over the long term, the amount of murrelet habitat converted to even-aged management should be less than under Alternative B. In NRF management areas, at least 60, rather than 50, percent of the DNR-managed land designated for NRF management would be NRF habitat at any one time. Overall, less owl habitat would be converted to short-rotation even-aged management than under Alternatives A or B and the frequency of management-induced disturbance in riparian, murrelet and owl NRF habitat would be less.

In areas where forest management is conducted through short-rotation even-aged management, it is anticipated that adherence to Board of Natural Resources policies should prevent an unacceptable degradation of soils. Relative to Alternative A, there should be a reduction in adverse impacts to soils.

Three East-Side Planning Units

Compared to Alternatives A and B, riparian areas on the east side would be subject to the same level of management-induced disturbance. In NRF management areas, as in the west-side units, at least 60 percent of the DNR-managed land designated for NRF management would be NRF habitat at any one time, requiring that forests be managed on a longer harvest rotation than Alternative B. The area of uplands subject to management-induced disturbance is the same as Alternative B, but the frequency of disturbance is less.

Overall, less owl habitat on the east side would be converted to uneven-aged management than under Alternative A or B.

In areas where forest management is conducted through intensive uneven-aged management it is anticipated that adherence to Board of Natural Resources policies should prevent an unacceptable degradation of soils. Relative to the Alternative A, there should be a no significant difference in adverse impacts to soils.

4.6.4 OESF Alternative 1

As with Alternative A for the west-side and east-side planning units, DNR would manage forests in a manner consistent with Board policies and compliant with the Washington Forest Practices Rules (Title 222 WAC). Based on current practices in DNR-managed riparian areas, soils in riparian management zones would be subject to a minimal level of management-induced disturbance, but if management objectives change, then so could the level of disturbance. Potential soil productivity impacts related to marbled murrelet and spotted owl management are the same as for Alternative A for the west-side planning units. It is anticipated that adherence to Board of Natural Resources policies should prevent an unacceptable degradation of soils.

4.6.5 OESF Alternative 2

The riparian conservation strategy of this alternative establishes an inner-core buffer similar to the riparian management zones of Alternative 1. In addition, these mass-wasting buffers are protected by a wind buffer. Based on the primary management objective of riparian areas -- maintain and aid restoration of the composition, structure, and function of aquatic and riparian ecosystems -- soils in the inner-core buffer would be subject to a minimal level of management-induced disturbance. No harvest would occur on hillslopes identified in the field as having a high potential for mass wasting. DNR would manage wetlands for no overall net loss of naturally occurring wetland acreage and function.

The short-term marbled murrelet conservation strategy allows the harvest of marginal habitat and unoccupied higher quality habitat (as does Alternative B in the west-side planning units). Forest land from which marbled murrelet habitat is harvested would be subject to more frequent management-induced disturbance. The amount of murrelet habitat harvested should be less than under Alternative 1.

The mission of the OESF is to integrate the production of forest commodities with the conservation of ecological values. Consequently, DNR-managed lands in the OESF will be managed under a variety of stand prescriptions. Some stands may be managed under even-aged short rotations. Other stands may be managed under an uneven-aged system that retains the composition, structure, and function of late-successional forests. The entire OESF would be managed so that each landscape planning unit contained at least 40 percent spotted owl habitat, 20 percent of which would be old forest habitat. This will require longer harvest rotations than Alternative 1. Special stand prescriptions to accelerate or maintain owl habitat may be developed. What these prescriptions might be is unknown, but it is reasonable to assume that they will be less detrimental to soil productivity than short-rotation even-aged management.

Compared to Alternative 1, riparian areas would be subject to less frequent and less intensive management-induced disturbance. In upland areas subject to intensive management it is anticipated that adherence to Board of Natural Resources policies should prevent an unacceptable degradation of soils. Given the mission of the OESF, it is anticipated that soil productivity will be an important area of research. Compared to Alternative 1, this should reduce adverse impacts to soils.

4.6.6 OESF Alternative 3

Under Alternative 3, DNR would continue to manage in a manner consistent with Board policies and compliant with the Washington Forest Practices Rules (Title 222 WAC). The riparian conservation strategy is the same as Alternative 2.

The mission of the OESF is to integrate the production of forest commodities with the conservation of ecological values. Consequently, DNR-managed lands in the OESF will be managed under a variety of stand prescriptions. Some stands may be managed under even-aged short rotations. Other stands may be managed under an uneven-aged system that retains the composition, structure, and function of late-successional forests.

The short-term marbled murrelet conservation strategy does not allow the harvest of marginal habitat and unoccupied higher quality habitat (as does Alternative C in the west-side planning units). Over the long term, the amount of murrelet habitat harvested should be less than under Alternative 2. All old forest that is outside spotted owl zones and riparian areas, not on unstable hillslopes, and not marbled murrelet habitat could be harvested. In owl zones, the habitat specifications for the nest grove, core, and range areas would determine the intensity and frequency of forest management within these areas. The requirement that the core and range areas contain 50 and 40 percent owl habitat, respectively, will require longer harvest rotations than Alternative 1. Special stand prescriptions to accelerate or maintain owl habitat may be developed. What these prescriptions might be is unknown, but it is reasonable to assume that they will be less detrimental to soil productivity than short-rotation even-aged management.

Compared to Alternative 1, riparian areas would be subject to less frequent and less intensive management-induced disturbance, but in upland areas there could be an increase in the land area subject to management-induced disturbance. It is anticipated that adherence to Board of Natural Resources policies should prevent an unacceptable degradation of soils. Given the mission of the OESF, it is anticipated that soil productivity will be an important area of research. Compared to Alternative 1, this should reduce adverse impacts to soils.

4-509 4.7 Air Quality

4-509 4.7.1 Affected Environment

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4-509 Prescribed burnings

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4.7 Air Quality

4.7.1 Affected Environment

An issue raised during scoping was the impact on air quality by the proposal. While the HCP proposal would not affect this resource, the agencies opted to briefly discuss the issue. The topography and climate west of the Cascade mountains create a combination of natural conditions that periodically accumulate air pollutants. These conditions include peculiar local and regional wind patterns, abundance of moisture, fog, and stable atmospheric conditions with accompanying low-level inversions. Topography especially influences wind patterns in Puget Sound, the Columbia River Gorge, and other areas such as the Spokane and Lewiston-Clarkston valleys. Lowlands tend to accumulate contaminants when pollutant sources are present. Winter and spring air turbulence and precipitation in western Washington help dissipate air pollution. During the summer, hydrocarbons and nitrogen oxides react under the influence of sunlight to cause smog, odor, and poor visibility. In eastern Washington, the most significant feature affecting accumulation of air pollutants is the occurrence of stable atmospheric conditions. These conditions persist for extended periods in populated valleys (DNR 1992a).

Sources of air contaminants are motor vehicle fumes, industrial processing losses, industrial fuel use, home heating, and refuse disposal. The contaminants are primarily sulfur oxides, particulates, carbon monoxide, nitrogen oxides, fluorides, and hydrocarbons. Dust and smoke from agricultural and forestry practices contaminate the air on a localized, short-term basis.

Air quality data show the greatest concentrations of air pollution are in King, Pierce, Snohomish, and Spokane Counties. Most air pollutants in the Puget Sound region are released along the eastern shore of Puget Sound between Everett and Tacoma. During periods of stable air, contaminants are concentrated in a relatively small area near the point of emission. During moderate or strong winds, contaminants move great distances but are rapidly diluted or dispersed to small concentrations (DNR 1992a).

4.7.2 Forest management

The principle ways in which forest management practices adversely affect air quality are smoke from prescribed burning and air-borne dust from logging roads.

Prescribed burning

The U.S. Clean Air Act (42 U.S.C. § 7401 et seq.) is designed to reduce air pollution, protect human health, and preserve the nation's air resources. To regulate air quality, the Clean Air Act sets a number of standards (referred to as National Ambient Air Quality Standards (NAAQS)) addressing particulates from wildfire and prescribed burning. Washington State's implementation of the Clean Air Act is guided by existing laws, regulations, and DNR's Smoke Management Plan (DNR 1993). DNR's Smoke Management Plan is designed to meet the requirements of the Clean Air Acts of the United States and of Washington State (RCW 70.94), the forest fire protection laws of Washington State (RCW 76.04), and the Washington Forest Practices Act (RCW 76.09.905).

Preparing a site for reforestation and reducing the risk of wildfire are the typical reasons for prescribed burns. The use of prescribed burns for site preparation has become less common as concerns for air quality have increased. Prescribed burns are regulated by the Washington State Smoke Management Plan (DNR 1993). The plan requires a 50 percent reduction in statewide prescribed burn emissions by the year 2000. This level of reduction has already been achieved on state and private land. DNR may burn between 500 and 1,000 acres per decade for site preparation. RCW 76.04.660 specifies that landowners responsible for the existence of extreme fire hazard are "required to abate, isolate and reduce the hazard." In addition, Policy No. 10 of the Forest Resource Plan (DNR 1992b) directs the department to take preventive measures beyond what is required by law. The negative impacts of prescribed burns on air quality likely have a net positive impact -- particulate emissions from wildfires are, on average, three to four times that from prescribed underburning. DNR may burn between 300 and 1,000 acres per year for wildfire risk reduction.

DNR's 1995 annual report (DNR 1995a) states that, by the end of 1993, public and private land managers achieved more than a 50 percent reduction in particulate emissions from forest debris fires. This far exceeds the 20 percent reduction required under the state Clean Air Act.

Air-borne dust from logging roads

Air-borne dust is regulated through the road maintenance standards of the Washington Forest Practices Board (WAC 222-24) and the safety standards of the Department of Labor and Industries (WAC 296-54). The amount of air-borne dust is a function of road quantity, quality, and use. Department policy has limited the size of harvest areas to a maximum of 100 acres (DNR 1992b). As the size of harvest units has shrunk, the miles of logging road have necessarily grown. It is reasonable to expect that between 800 and 1,000 miles of new road will be constructed in the HCP planning area over the next decade. The quality of roads on DNR-managed land meets or exceeds the standards of the Washington Forest Practices Board (WAC 222-24). The state legislature has directed DNR to utilize the "multiple use concept" in the management of state-owned lands under its jurisdiction (RCW 79.68). The general public is allowed free access to many DNR-managed roads, and this increases the level of road usage. In general, the adverse impacts of air-borne dust are localized and short term.

Forest land and air quality

One of the essential ecological benefits of forested lands is the enhancement of air quality. Plants enhance air quality through the process of photosynthesis, in which plants consume carbon dioxide and produce oxygen. In addition, through photosynthesis, trees serve as reservoirs for the long-term terrestrial storage of carbon dioxide, the gas most closely associated with global warming. Trees also retard the spread of wind-carried particulates by either trapping the material on their leaves' surfaces or slowing wind speed to the point that particulates cannot remain suspended. Harvesting timber temporarily removes the air quality benefits provided by forests.

4.7.3 Alternatives

The impacts to air quality are approximately the same for all alternatives, but the HCP alternatives may result in some improvement of air quality. The amount of site preparation involving prescribed burns should not be altered by the alternatives. The amount of prescribed burns for wildfire risk reduction could increase slightly under the HCP alternatives, particularly in the east-side planning units. The eastern Cascades are prone to large wildfires, and spotted owl nesting habitat possesses the ideal structural characteristics for stand-replacing fires -- a multi-layered canopy and plentiful down woody debris. Underburning owl habitat in an owl circle to reduce extreme fire hazard could be construed as incidental take. The HCP alternatives may provide more flexibility to conduct prescribed burns. The reduced risk of wildfire may yield a net positive impact to air quality.

Air-borne dust should be reduced under the HCP action alternatives. DNR has already begun a shift toward more intensive road management, and the incorporation of road network management into the HCP alternatives demonstrates a commitment to the continual improvement of the road network. Public access to and use of DNR-managed roads is expected to remain at a high level, but the level of use is the same for all alternatives.

The forested land base remains the same for all alternatives. Therefore, the forest processes which enhance air quality -- photosynthesis, carbon dioxide storage, particulate interception, and air flow moderation -- should be approximately the same for all alternatives.

4-513 4.8 Water Quality

4-513 4.8.1 Affected Environment

4-515 Planning Unit Overview

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4.8 Water Quality

Water resources include both surface water and ground water. Although the evaluation of potential impacts on water quality is addressed in various riparian sections, the agencies opted to discuss the general subject here. This section briefly describes the issues of water quality and quantity, and the current water quality status of DNR-managed lands within the HCP planning area. It closes with cross-references to other sections that evaluate the potential water-related environmental consequences of the alternatives.

4.8.1 Affected Environment

The principal influence on surface water movement is the hydrologic regime, which refers to the combined effects on water of climate, soils, geology, topography, and vegetation.

The quantity of surface water is determined by: (1) the amount of precipitation, and, (2) the extent of losses to the atmosphere or to deep percolation into the ground. Precipitation is controlled by climate and is not significantly influenced by forests or their management. Loss to the atmosphere by evaporation and transpiration of plants is a function of climate interacting with vegetation and soils. These functions are influenced by the forest condition. Whether water that has moved through the soil will become surface flow or go into ground water aquifers depends largely on the region's geology. Water movement in natural streams is a function of water volume, channel geometry and channel slope or gradient. In unmanaged forest areas, the most common disturbance is trees and other vegetation entering streams. In places where this debris is temporarily stabilized, flows may back up and increase in depth.

In general, the forests in Washington contain waters of high quality. Sedimentation as a result of natural or man-made forces is the most common cause of degraded water quality. An estimated 80 percent of water quality deterioration is associated with this process. Forest vegetation acts a stabilizing influence that minimizes the effect of sedimentation on water quality.

Sedimentation includes the processes of erosion, sediment transport, and deposition. Deposition is the temporary or permanent stoppage of sediment movement. Surface water quality is not affected if sediment is deposited before reaching a water body. Once sediment reaches streams, deposition can occur several times over. As flow velocities and volumes increase, sediment is moved downstream. If flow volume or velocities decrease, deposition can occur. The amount of sediment suspended or moved along the streambed therefore depends on surface water movement.

Sediment affects water quality in several ways. It creates a turbid (muddy) condition that restricts light in the stream environment. Nutrients combined with, or attached to, the sediment particles are added to surface water. Oxygen-demanding materials associated with sediment can reduce dissolved oxygen content. Sedimentation may also introduce harmful minerals into surface water.

The high absorption capability of forest soils, combined with the uptake of vegetation, does not allow many dissolved solids to be leached and enter surface water. As a result,

surface waters usually have low concentrations of dissolved solids. In the mature forest, the nutrient cycle generally approaches a steady state; only small amounts of nutrients are discharged in the drainage water. Volumes of dissolved solids are therefore usually small in stream flow from forested areas and primarily reflect the area's geology.

Streamside vegetation can also temporarily degrade surface water quality. Water quality in a small stream is often related to the amount of autumn leaves that fall into the stream channel: dissolved oxygen and pH, decrease but water color, specific conductance, iron, magnesium, and bicarbonate ions all increase as more leaves enter the water. Deciduous litter, which is primarily deposited in autumn, decomposes faster than coniferous litter. Water quality is therefore affected to a greater extent by deciduous than coniferous litter.

The temperature of surface water is another quality modified by a forest. Streamside vegetation prevents extreme daily fluctuation in temperature during low flows and high energy input by providing shade and absorbing energy. With lower temperatures, dissolved oxygen concentrations are higher. Temperature is critical for the survival of various fish species, and it can also affect water quality. Algae, for example, bloom in warm water and can interfere with fish habitat and recreation. Changes in water temperature as a result of timber harvesting are typically noted in small rivers and streams.

Ground water means all water below the ground surface. It includes two types of water storage and movement: aquifers and subsurface flow.

Aquifers contain water that has percolated through the soil mantle or channel bottoms; they are geologic formations capable of storing water and allowing its lateral movement. In general, water movement through aquifers is slow and little affected by immediate precipitation. The presence of aquifers is determined by the geology of a region. In western Washington, most of the area underlain by aquifers is in the glaciated Western Washington Lowlands Province and near the coast of the Olympic Peninsula Province. In the forested areas of eastern Washington, aquifers are mostly limited to the vicinity of the channels of major drainages. Most aquifers consist of sedimentary materials; others include basalt formations. They are usually deep below the surface, up to several thousand feet.

Subsurface waters, on the other hand, typically enter the soil and are stopped by an impervious layer of bedrock or consolidated materials. If the land surface is on an incline, lateral movement occurs within or just below the soil. Movement is often rapid and sensitive to immediate precipitation. Subsurface flow is the most common in Washington's forested areas, especially in mountainous areas. Movement of subsurface flow is determined by the topography and characteristics of soil and subsoil. Subsurface flow is also strongly influenced by the forest condition and management activities.

The quantity of ground water at any time is determined by the amount of water percolating through the soil, the amount in storage below the soil surface and in aquifers, and the amount either removed for domestic purposes or entering stream channels and other surface water bodies. Trees and plants remove water from soil by the process of

transpiration. This loss of water in soil creates a moisture content that is less than the maximum amount the soil can hold. When precipitation or snowmelt are absorbed, water is held in the soil until the maximum level of moisture content is reached.

Ground water quality is not as sensitive as that of surface water to forest conditions and management. In general, the quality of ground water in aquifers depends more on aquifer and local geology than on forest influences. Subsurface flows are more sensitive to forest influences. Forest soils serve as excellent filters through which water percolates. Dissolved and suspended solids and organic compounds are filtered or absorbed by forest soil. As a result of this natural filter, ground water recharged from forest land is generally of good quality.

Forested watersheds in Washington are an important source of public water supplies, mostly as surface water. The quality of surface water from state-managed forest land is generally good, making forests a valuable source of drinking water that typically requires little treatment. Activities in forest watersheds can affect public water supplies in two related ways; quantity and quality, which in turn can affect the usable quantity of water. The department manages state forest land in several major watersheds used for public water supplies, including the Sultan, Tolt, and Green River basins in western Washington and Buck Creek watershed in eastern Washington. Whether the department's activities significantly affect public water supplies depends on the proportion of watershed areas managed by the department and the type and timing of activities.

Planning Unit Overview

The following tables (4.8.1-4.8.9) summarize water resources and related influences on water for the nine planning units in HCP area.

Table 4.8.1: Summary of water resources and related influences on DNR-managed lands in the North Puget Planning Unit

(Source: Data compiled from DNR's GIS. Data for unstable hillslopes based on Shaw and Johnson (in press) slope morphology model)

	Length on HCP lands (miles)	Percent of each stream type in the stream network (based on length)	Density on HCP lands (miles per square mile)	Area on HCP lands (acres)	Percent of HCP lands
Streams					
Type 1	90.4	4	.15		
Type 2	16.5	1	.03		
Type 3	177.1	8	.29		
Type 4	426.4	20	.69		
Type 5[1]	1,474.9	67	2.38		
Open Water				1,830	
Land in rain-on-snow zone				151,280	
Roads			1.55		
Unstable Hillslopes				48,426	12

[1] Untyped streams are treated as Type 5 for the purpose of this analysis.

Table 4.8.2: Summary of water resources and related influences on DNR-managed lands in the South Puget Planning Unit

(Source: Data compiled from DNR's GIS. Data for unstable hillslopes based on Shaw and Johnson (in press) slope morphology model)

	Length on HCP lands (miles)	Percent of each stream type in the stream network (based on length)	Density on HCP lands (miles per square mile)	Area on HCP lands (acres)	Percent of HCP lands
Streams					
Type 1	35.1	3	.15		
Type 2	6.3	1	.03		
Type 3	75.6	7	.33		
Type 4	146.4	13	.64		
Type 5[1]	825.4	76	4.83		
Open Water				1,016	
Land in rain-on-snow zone				64,664	
Roads			2.81		
Unstable Hillslopes				12,567	9

[1] Untyped streams are treated as Type 5 for the purpose of analysis.

Table 4.8.3: Summary of water resources and related influences on DNR-managed lands in the Columbia Planning Unit

(Source: Data compiled from DNR's GIS. Data for unstable hillslopes based on Shaw and Johnson (in press) slope morphology model)

	Length on HCP lands (miles)	Percent of each stream type in the stream network (based on length)	Density on HCP lands (miles per square mile)	Area on HCP lands (acres)	Percent of HCP lands
Streams					
Type 1	78.1	2	.17		
Type 2	5.5	<1	.01		
Type 3	179.2	6	.40		
Type 4	488.7	15	1.08		
Type 5[1]	2,524.0	77	5.58		
Open Water				187	
Land in rain-on-snow zone				119,176	
Roads			2.66		
Unstable Hillslopes				32,326	11

[1] Untyped streams are treated as Type 5 for the purpose of analysis.

Table 4.8.4: Summary of water resources and related influences on DNR-managed lands in the Straits Planning Unit

(Source: Data compiled from DNR's GIS. Data for unstable hillslopes based on Shaw and Johnson (in press) slope morphology model)

	Length on HCP lands (miles)	Percent of each stream type in the stream network (based on length)	Density on HCP lands (miles per square mile)	Area on HCP lands (acres)	Percent of HCP lands
Streams					
Type 1	18.4	3	.11		
Type 2	15.8	3	.09		
Type 3	60.3	10	.35		
Type 4	85.2	15	.49		
Type 5[1]	397.2	69	2.28		
Open Water				1,144	
Land in rain-on-snow zone				18,848	
Roads			2.58		
Unstable Hillslopes				10,336	9

[1] Untyped streams are treated as Type 5 for the purpose of analysis.

Table 4.8.5: Summary of water resources and related influences on DNR-managed lands in the South Coast Planning Unit

(Source: Data compiled from DNR's GIS. Data for unstable hillslopes based on Shaw and Johnson (in press) slope morphology model)

	Length on HCP lands (miles)	Percent of each stream type in the stream network (based on length)	Density on HCP lands (miles per square mile)	Area on HCP lands (acres)	Percent of HCP lands
Streams					
Type 1	59.7	2	.16		
Type 2	16.1	1	.04		
Type 3	164.2	6	.44		
Type 4	328.2	12	.88		
Type 5[1]	2,153.0	79	5.77		
Open Water				412	
Land in rain-on-snow zone				16,807	
Roads			2.85		
Unstable Hillslopes				15,370	6

[1] Untyped streams are treated as Type 5 for the purpose of analysis.

Table 4.8.6: Summary of water resources and related influences on DNR-managed lands in the Chelan Planning Unit

(Source: Data compiled from DNR's GIS. Data for unstable hillslopes based on Shaw and Johnson (in press) slope morphology model)

	Length on HCP lands (miles)	Percent of each stream type in the stream network (based on length)	Density on HCP lands (miles per square mile)	Area on HCP lands (acres)	Percent of HCP lands
Streams					
Type 1	1.3	1	.05		
Type 2	0	0	.00		
Type 3	1.3	1	.05		
Type 4	6.6	3	.27		
Type 5[1]	202.8	95	8.28		
Open Water				5	
Land in rain-on-snow zone				11,550	
Roads			2.70		
Unstable slopes[2]					

[1] Untyped streams are treated as Type 5 for the purpose of analysis.
[2] Unstable hillslope calculations were done for the west-side and OESF planning units only.

Table 4.8.7: Summary of water resources and related influences on DNR-managed lands in the Yakima Planning Unit

(Source: Data compiled from DNR's GIS. Data for unstable hillslopes based on Shaw and Johnson (in press) slope morphology model)

	Length on HCP lands (miles)	Percent of each stream type in the stream network (based on length)	Density on HCP lands (miles per square mile)	Area on HCP lands (acres)	Percent of HCP lands
Streams					
Type 1	10.1	2	.08		
Type 2	1.7	0	.01		
Type 3	22.4	5	.18		
Type 4	67.0	15	.53		
Type 5[1]	362.6	78	2.87		
Open Water				41	
Land in rain-on-snow zone				69,779	
Roads			2.38		
Unstable slopes [2]					

[1] Untyped streams are treated as Type 5 for the purpose of analysis.
[2] Unstable hillslope calculations were done for the west-side and OESF planning units only.

Table 4.8.8: Summary of water resources and related influences on DNR-managed lands in the Klickitat Planning Unit

(Source: Data compiled from DNR's GIS. Data for unstable hillslopes based on Shaw and Johnson (in press) slope morphology model)

	Length on HCP lands (miles)	Percent of each stream type in the stream network (based on length)	Density on HCP lands (miles per square mile)	Area on HCP lands (acres)	Percent of HCP lands
Streams					
Type 1	8.3	1	.04		
Type 2	6.6	1	.03		
Type 3	38.7	5	.19		
Type 4	111.9	16	.54		
Type 5[1]	552.0	77	2.67		
Open Water				126	
Land in rain-on-snow zone				97,043	
Roads			2.64		
Unstable slope[2]					

[1] Untyped streams are treated as Type 5 for the purpose of analysis.
[2] Unstable hillslope calculations were done for the west-side and OESF planning units only.

Table 4.8.9: Summary of water resources and related influences on DNR-managed lands in the OESF Planning Unit

(Source: Data compiled from DNR's GIS. Data for unstable hillslopes based on Shaw and Johnson (in press) slope morphology model)

	Length on HCP lands (miles)	Percent of each stream type in the stream network (based on length)	Density on HCP lands (miles per square mile)	Area on HCP lands (acres)	Percent of HCP lands
Streams					
Type 1	87.3	4	.21		
Type 2	44.7	2	.11		
Type 3	285.7	11	.68		
Type 4	261.5	10	.63		
Type 5[1]	1,852.6	73	4.44		
Open Water				500	
Land in rain-on-snow zone				50,375	
Roads			3.21		
Unstable Hillslopes				37,991	14

[1] Untyped streams are treated as Type 5 for the purpose of analysis.

Current Water Quality Status

The Washington Department of Ecology is authorized by the U.S. Environmental Protection Agency (EPA) to regulate water quality in the state; this includes enforcing compliance by landowners in minimizing nonpoint sources of water pollution (e.g., sediment from mass-wasting events) and avoiding exceedance of mean daily water temperatures. The Washington Department of Ecology compiles a list of water-quality-limited streams as required by Section 303(d) of the federal Clean Water Act, and the list is approved by EPA. Tables 4.8.10, 4.8.11, and 4.8.12 provide information on the water quality impairments for each of the planning units within the three major planning subareas. This information is derived from the GIS database for waters classified by the Washington Department of Ecology (1994) as water-quality-impaired.

Table 4.8.10: Water quality-limited streams within (5) West-Side Planning Units

(Source - Washington Department of Ecology, 1994. List of water quality limited streams in Washington State)

	North Puget	South Puget	Columbia	South Coast	Straits
Number of impaired stream segments	19	7	4	12	6
Total miles impaired	43.53	9.89	4.82	11.66	5.54
Miles of streams impaired for: Temperature	24.35	0	3.19	0	1.19
Sediment	1.66	0	0	0	
Fecal coliform	7.99	9.89	1.13	5.74	4.35
Dissolved oxygen	0	0	0	.74	0
Temperature and sediments	88.60	0	0	0	0
Combination of any 3 of 4: (temperature, sediment, fecal coliform, and dissolved oxygen)	.93	0	.50	5.18	0

Table 4.8.11: Water quality-limited streams within (3) East-Side Planning Units

(Source - Washington Department of Ecology, 1994. List of water quality limited streams in Washington State.)

	Klickitat	Yakima	Chelan
Number of impaired stream segments	6	8	1
Total miles of impaired streams	6.62	16.71	0.08
Miles of streams impaired for: Temperature	1.41	14.81	0
Sediment	0	0	0
Fecal coliform	1.65	1.65	0
Dissolved oxygen	0	0	0
Temperature and sediment	3.56	0.25	0.08
Combination of any 3 of 4: (temperature, sediment, fecal coliform, and dissolved oxygen)	0	0	0

Table 4.8.12: Water quality- limited streams within the Olympic Experimental State Forest

(Source - Washington Department of Ecology, 1994. List of water quality limited streams in Washington State.)

Number of impaired stream segments	26
Total miles of impaired streams	58.46
Miles of streams impaired for: Temperature	57.97
Sediment	0
Fecal Coliform	0
Dissolved oxygen	0
Temperature and sediment	0.49
Combination of any 3 of 4 (temperature, sediment, fecal coliform, and dissolved oxygen)	0

The Department of Ecology is directed, through the Clean Water Act, to establish total maximum daily loads (TMDL) for all waters on the list. The total maximum daily load is defined as the sum of all pollutant loads allocated to point and nonpoint sources within a watershed. The TMDL is set such that the loading capacity of an identified water segment is not exceeded.[1] Ecology prioritizes waters for TMDL development by assessing "vulnerability to degradation, extent of beneficial use impairment, availability to technical support, amenability to control the problem through TMDLs, and the degree of public interest" (Washington Department of Ecology 1994). Watersheds are managed on a 5-year cycle, during which time the intent is to meet water-quality standards through monitoring, inspections, TMDL development, permitting, and other pollution-control activities.

4.8.2 Evaluation of Alternatives

Water temperature and sedimentation are the two nonpoint sources of impairment most closely related to forest land management. Soil disturbance, road runoff, reduced shade, and other factors affect water quality. The designation of riparian zones and related management strategies within these zones mitigate adverse affects because riparian vegetation traps sediments, stabilizes banks, and provides shade. Water quantity, or stream flow, and overall hydrology within drainage basins can also be affected by forest land management. These water quality and quantity issues are discussed in the riparian habitat sections (Sections 4.2.3, 4.3.2, and 4. 4.2) of this draft EIS. Additional information related to the No Action alternative is available in the FEIS for DNR's Forest Resource Plan (1992a). In addition to wetlands, watershed analysis, roads, and riparian management zone policies, DNR adopted a landscape planning policy that incorporates this broader watershed perspective into forest land management.

[1] DNR and the Washington Department of Ecology currently are pursuing the possibility of satisfying TMDL requirements with the Washington Forest Practices Act watershed analysis methods (WFPB 1995b), in order to delist water-quality-limited streams (J. Schuett-Hames, Washington Department of Ecology, Southwest Regional Office, Olympia, personal commun., 1995; S. Bernath, DNR, Forest Practices Division, Olympia, pers. commun., 1995). This cooperative agreement is contingent on the inclusion of water quality and monitoring modules in the Forest Practices watershed analysis manual, as well as a more comprehensive treatment of Type 4 and Type 5 drainages as nonpoint sources for stream sediment loading and water temperature impacts. DNR's Forest Practices Division is taking the necessary steps toward accomplishing these tasks.

4-529 4.9 CULTURAL RESOURCES

4-529 4.9.1 AFFECTED ENVIRONMENT

4-531 4.9.2 ALTERNATIVES

4.9 Cultural Resources

4.9.1 Affected Environment

Many people in Washington State, including Native Americans, value the archeological and historical sites associated with their history and culture. Many Native Americans continue to use local traditional resources and highly value traditional cultural sites.

Native Americans have occupied the Washington landscape for more than 12,000 years. The original inhabitants were descendants of Asian peoples who entered North America via the land bridge that once connected Alaska to Kamchatka and Siberia (Washington Office of Archaeology and Historic Preservation 1989). Archaeological sites have been found from the Pacific coast to the Columbia plateau. Evidence of Washington's prehistory includes ancient tools, remnants of habitation sites, burial grounds, and petroglyphs that provide clues to the lives of these people.

Because of the barrier created by the Cascade mountains, the cultures of Native Americans west of the Cascades differed greatly from those on the east side of the mountains. The tribes west of the Cascades were grouped by anthropologists as "Coast Indians," whereas tribes east of the Cascades were referred to as "Plateau Indians" (Avery 1965). The life of the Coast Indians, including the Salish and Nootka cultural groups, was centered around water. Salmon was not only a major source of food, but also the focus of many ceremonies. The tribes celebrated their spiritual ties to the salmon and paid tribute to them as the foundation of their food supply. The coast peoples ate other kinds of fish, including herring, trout, cod, and shellfish, as well as roots, berries, and nuts. The region provided ample wood for constructing canoes and houses. Coastal tribes used cedar bark to weave clothing and made rain hats and baskets from spruce root and grass fibers.

The coast people fished and hunted along the coast in spring, summer, and fall, living in small temporary encampments. In the winter they gathered together in more permanent villages. The coastal environment, with its plentiful resources, allowed these Native Americans to accumulate a great wealth of clothing, baskets, and food. Often the wealthiest man in the village was chief. The chief usually inherited his wealth in the form of fishing rights at a particularly good spot in the river or the right to pick berries where they were most abundant. A unique feature of some Coast Indian cultures was the potlatch, a grand feast given by a wealthy family at which they gave away their possessions to guests. It took years for the hosts to collect enough food and gifts, such as blankets, jewelry, and baskets, for hundreds of guests.

The lives of the Plateau tribes were somewhat different than the coast people. Because food was less plentiful for the Plateau tribes, they spent much more time securing provisions than the coast tribes. Salmon were also a major food source for these tribes. However, because other kinds of fish were not as plentiful, Plateau tribes supplemented their diet with rabbit, deer, and elk, as well as roots, berries, and nuts. Wood was scarce around the Plateau villages, so shelters were built from poles and animals skins or woven

mats, or pithouses were dug below ground. Caves and natural rock-shelters also provided protection from the elements.

The Plateau tribes did not have the plentiful resources to build up stores of wealth that the coastal tribes did. Chiefs of the Plateau villages were chosen for their wisdom rather than wealth. Sweathouses played an important part in Plateau culture. Most were built from a framework of bent limbs covered with branches, skins, or mats. Sweating in these huts was part of a purification ritual.

Table 4.9.1 shows the nine HCP planning units and the major tribes associated with those lands.

Table 4.9.1: HCP planning units and major tribes associated with those lands

PLANNING UNIT	MAJOR TRIBES
OESF	Makah/Ozette, Quileute, Hoh, Quinalt, Lower Elwha S'Klallam, Jamestown S'Klallam, Port Gamble S'Klallam
Straits	Makah, Lower Elwha S'Klallam, Jamestown S'Klallam, Port Gamble S'Klallam, Skokomish
South Coast	Quinalt, Shoalwater Bay, Chehalis
North Puget	Nooksack, Lummi, Swinomish, Sauk-Suiattle, Stillaguamish, Tulalip, Muckleshoot
South Puget	Suquamish, Muckleshoot, Puyallup, Nisqually, Squaxin Island, Skokomish
Columbia	Yakama, Chinook
Chelan	Yakama
Yakima	Yakama
Klickitat	Yakama

Many archaeological and historic sites lie within the borders of DNR's nine habitat conservation planning units. Table 4.9.2 summarizes the types of sites in each planning unit that are located on or near DNR-managed lands.

Table 4.9.2: Types of archaeological and historic sites within the borders of DNR's nine HCP planning units

(Source - DNR TRAX system)

UNIT	NO. OF SITES	TYPES OF SITES
OESF	11	cemeteries, shipwrecks, homesteads
Straits	13	historic battle ground, lithic debris, mammoth bone[2]
South Coast	33	bridges, railroad and logging camps, ancient campsites and rock-shelters
North Puget	33	rock-shelters, petroglyphs, burial grounds, historic district[3]
South Puget	7	campsites, lithic matter, and railroad camps
Columbia	15	historic city district, ancient caves and petroglyphs
Chelan	3	campsite, burial ground, cairn
Yakima	11	ancient rock-shelters and lithic matter
Klickitat	20	homesteads, camp and village sites, and pictographs

4.9.2. Alternatives

Native American graves and archaeological sites are protected from disturbance under chapters 27.44 and 27.53 RCW. Federal and state laws also protect historic and archaeological sites. The state Office of Archaeology and Historic Preservation maintains a register of these sites. DNR uses a computer-based filing and recording system that allows the department to inventory and retrieve information about sites in a particular area. DNR land managers use the department's Total Resource Application Cross-Reference (TRAX) system in evaluating specific project impacts to ensure that department activities do not damage these sites. The department works closely with tribes and other agencies to keep these records current.

[2]The Manis Mastodon Site, near Sequim, is listed on the National Register of Historic Places.

[3]Part of the Stevens Pass Historic District, which is listed on the National Register, lies within the North Puget Sound Unit.

The department's current procedure is to survey areas and obtain as much information as possible from tribes and other interested parties before a timber sale is executed. The department intends to continue to work closely with tribes to identify historical and archaeological sites. The goal is to prevent timber harvesting and related activities from inadvertently damaging cultural resources.

The department's policy, stated in the Forest Resource Plan, is that the department will establish a program to identify and inventory historic and archaeological sites and protect them at a level which, at a minimum, meets regulatory requirements. This policy reduces the possibility that timber harvest or other department activities will destroy or damage historical or archaeological sites.

DNR's policy ensures that resources are identified within the project area and that the department will analyze the project's effect on the resources and take appropriate measures to ensure that no damage occurs. Mitigating measures may include the modification of practices, physical protection of the resource, data recovery, or similar measures. Where appropriate, additional professional assistance will be obtained. The proposed HCP for DNR's trust lands will not alter this policy or its implementation.

4-533 4.10 ECONOMIC ANALYSIS OF DNR'S HABITAT CONSERVATION PLAN

4-533 Economic Background

4-534 Methods

4-535 Results

4.10 Economic Analysis of DNR's Habitat Conservation Plan

This section provides an analysis of the economic impact of the proposed HCP alternatives on Washington's economy. This section focuses on changes in employment in the economy as a whole. When analyzing the impacts of changing policies in forest land management, some previous NEPA documents, such as the FSEIS for the President's Forest Plan (USDA and USDI 1994a), have examined the role of nontimber uses such as special forest products, tourism, and recreation. While these issues were raised during the scoping process and considered by DNR in developing the range or alternatives, DNR and the Services do not believe that activities involving use of these resources would differ in the presence or absence of an Incidental Take Permit. As a result, this section does not examine these issues.

Typically, changes in forest management affect many aspects of the regional and national economy. The proposed changes are small relative to the national timber harvest, so changes in prices for timber products and other adjustments in the national economy are not anticipated. Different regions throughout the state that rely on timber from state-managed lands may experience both positive and negative impacts from changes in management of the state's resources. This analysis focuses on timber-related employment and employment income as policy-relevant indicators of the HCP alternatives and their impacts on the region's economy.

Economic Background

Forest products are an important component of Washington's economy. The lumber, wood products, and paper industries provided more than 52,000 of the 336,000 manufacturing jobs in the state in 1993. In comparison, the aircraft manufacturing sector provided 95,000 jobs (Washington State Employment Security 1995). Although manufacturing accounted for only 12 percent of total employment in 1993 (U.S. Department of Commerce 1995), manufacturing activity generates work in other sectors of the economy as companies and workers demand supplies and services. As manufactured products are exported from the region they generate important new income for the state economy.

Some regions of the state are more dependent on forest industries than others. The economy of the Olympic Peninsula is heavily dependent on lumber and wood products. Lumber and paper products are a significant component of the economy of the region west of the Cascades. Regions near Seattle-Tacoma have denser populations and more diverse economies. The economies of regions east of the Cascades are more agriculturally oriented.

In 1990, the forest products industry supplied about half the logs it consumed from its own lands. State-managed lands supplied 16 percent of the logs used, 910 MMbf (DNR 1994c), but this decreased considerably after 1990. The small proportion from state-managed lands is misleading because some regions of the state rely on timber from state-managed lands for a much larger share of their supply. Clallam County sawmills, for example, obtained more than a fifth of their logs from state-managed lands (DNR 1994c).

In 1990, more than a quarter of the logs exported from the Olympic Peninsula were from state-managed lands (DNR 1994c). Mills east of the Cascades relied on state-supplied timber to a lesser extent. However, export of logs from state-managed lands is now prohibited.

The volume of timber sales from state-managed lands has not been very stable. Road building, policy shifts, litigation, and endangered species protection have affected the amount of timber cut. These changes lend perspective to changes anticipated under the HCP. The timber industry has absorbed much larger year-to-year changes in harvest amounts than are anticipated from the implementation of the HCP. The industry is now well adapted to changes in supply, particularly supply from state-managed lands. Implementation of the HCP eliminates a significant source of variation in harvests from state-managed lands.

The forest products industry is highly cyclical. Changes in the national demand for housing and paper products relate closely to the health of the national economy and interest rates. Additionally, timber supply from the Pacific Northwest is sensitive to international markets. Even before the recent controversies over endangered species, the Northwest forest industries were changing. Competition from southern forests and imports, technological changes, and exhaustion of old-growth forests confronted the industry with new challenges (Schamberger et al. 1992). In the past, log production for export provided some "slack" in the production system. Raw log exports would increase or decrease in response to relative price shifts brought on by changes in domestic demand. Timber harvest was somewhat insulated from domestic economic downturns because it had an alternative outlet for its product. Recent legal changes have curtailed exports. As a result, business-cycle effects are felt more quickly at the forest level. A stable but flexible supply of logs from state-managed lands may be able to mitigate these impacts.

Methods

The U.S. Forest Service has developed a series of multipliers based on the number of jobs created and income generated by the harvest of 1 million board feet of timber. Any increase in harvest volume has a direct effect in the timber industry. More people are employed to cut and process logs. The increase also has an indirect effect as mills buy more supplies from other industries and mill employees spend their income in the community. The U.S. Forest Service multipliers show both the direct impact of a change in harvest volume and the indirect change generated by the additional employment in the timber industry. Multiplying the change in harvest volume by the multiplier yields the expected change in employment. Any impacts are linearly related to the change in harvest volume.

Although they are simple to apply, the multipliers embody a number of assumptions about the timber industry and the regional economy. The multiplier must reflect the different uses of the logs to gauge the employment impact accurately. Logs harvested for export generate employment in the forest and shipping docks but not in sawmills or furniture factories. Less processing implies fewer new jobs will be added. In addition,

some regional economies can provide many services and supplies needed by timber mills and workers. In these integrated economies the increased wages may recirculate several times, generating additional income and employment. Contrast the impact of a dollar spent in a grocery store in a remote part of Alaska with one spent in a supermarket in Tacoma. Each probably goes largely to a food wholesaler in Seattle. The Alaskan dollar has left the regional economy after only one transaction. The Tacoma dollar will pay salaries to the wholesaler's employees who will then recirculate it in the regional economy. The Tacoma dollar will generate more income in the region because the economy is more complete. For these reasons, the U.S. Forest Service develops a unique multiplier for each timber harvest region reflecting the use of its timber and the regional economy. In this analysis, the multiplier for the nearest region was applied in each planning unit.

Any multiplier analysis also reflects the technology used during the period in which the multiplier is calculated. The technology in the timber industry has been changing rapidly in recent years. Improved productivity has significantly reduced the number of jobs per board foot produced (Mead et al. 1991, quoted in Schamberger et al. 1992). These changes are likely to continue for the near future. Adjusting the multiplier for technological change is conceptually possible but any adjustment would be speculative at best.

Multipliers are designed to evaluate the short-term changes in harvest volumes associated with 5- and 10-year forest plans. They do not encompass longer term adjustments such as the migration of people or industries. Nor can they capture the impact of new products and price structures. Within the planning horizon of the proposed plans it is easy to imagine the possibility of large shifts of capital and people. Substitution of recycled plastics for logs, and computer monitors for paper, is already changing the dynamics of the lumber and paper industries. When one considers that 200 years ago parchment and the quill pen were advanced communications technology, defending an assumption of no changes in technology or economic structure through the forecast period is difficult. Any economic forecast beyond 40 years should be viewed with the deepest skepticism.

Data provided by DNR are based on 10-year forecast periods. Sustainable harvest calculations suggest the volume of harvest by age class of trees. Annual harvest quantities are required for the multiplier analysis, so 10-year harvest totals were divided by 10. Actual annual harvests will vary because of weather, market conditions, and other events. Employment and income impacts are shown as a range of probable changes to demonstrate the degree of uncertainty about actual harvests.

Results

Tables 4.10.1 and 4.10.2 show the annual harvest levels and associated employment and unemployment income impacts for each alternative analyzed. Estimated harvest levels for the alternatives are divided into two categories: expected and low. The expected harvest levels represent average annual harvest levels based on the projection of DNR-managed land harvest levels for the first decade (see Appendix 5 for a discussion of the assumptions used for the harvest analysis projections). Low harvest levels represent the

possibility of annual negative fluctuations of up to 35 percent for the No Action alternative and 25 percent for Alternative B. It is recognized that future conditions and circumstances may result in higher harvest levels than specified in the expected or low harvest levels used here. However, given the uncertainty typically associated with making such projections, a more conservative approach to the harvest level estimates is probably warranted.

Table 4.10.1 shows that total regional expected annual harvest levels under Alternative B would be 7.1 percent greater than under the No Action alternative. Implementation of Alternative C would result in a decrease of 16.3 percent in annual harvest levels compared with the No Action alternative. Under low harvest levels, Alternative B would result in a 23.5 percent harvest increase over the No Action alternative. Alternative C would result in a decrease of 3.4 percent.

Table 4.10.1: Aggregate harvest levels and timber-related jobs, by alternative

Source: Washington Department of Natural Resources 1996.

	Timber Harvest[1]				
	Alts. A, 1	**Alts. B, 2**	**Percent Change in Harvest Levels[2]**	**Alts. C, 3**	**Percent Change in Harvest Levels[2]**
Expected	724.7	776.0	+ 7.1%	606.9	-16.3%
Low	471.0	582	+ 23.5%	455.2	-3.4%

[1] In millions of board feet

[2] HCP Alternatives compared with Alts. A, 1.

For expected harvest levels, the table shows that job impacts, based on percentage increases, would be concentrated in the east-side and OESF planning units. For the east-side planning units, timber-related employment and income would increase by over 32 percent Alternative B compared with the No Action alternative. For the OESF Planning Unit, employment and income under Alternative B would increase by 42.9 percent. For the west-side planning units, harvest levels and employment would be similar under both alternatives A and B.

Table 4.10.2: Timber-related Job and Income Impacts, by Planning Unit and Alternative

Source: Total timber-related jobs and income are based on response coefficients (jobs and income per million board feet of timber harvest) developed for National Forest timber harvest levels in Washington State. Contact Regional Economist, U.S. Forest Service, Strategic Planning, Region 6 Office, Portland Oregon.

	Total Timber-related jobs[1]					Total Timber-related job income[2]				
	No Action	HCP Option B		HCP Option C		No Action	HCP Option B		HCP Option C	
Unit	Jobs	Jobs	Percent change[3]	Jobs	Percent change[3]	,000 Dollars	,000 Dollars	Percent change[3]	,000 Dollars	Percent change[3]
West Side[4]:										
expected	13,671	13,693	+0.2%	10,777	-21.2%	378,683	377,945	-0.2%	294,805	-22.2%
low	8,886	10,270	+15.6%	8,082	-9.0%	246,144	283,459	+15.2%	221,104	-10.2%
East Side[5]:										
expected	313	415	+32.6%	286	-8.7%	7,084	9,380	+32.4%	6,468	-8.7%
low	204	311	+52.5%	215	+5.4%	4,605	7,035	+52.8%	4,851	+5.4%
OESF:										
expected	938	1,340	+42.9%	579	-38.3%	24,990	35,700	+42.9%	15,427	-38.3%
low	610	1,005	+64.8%	434	-28.8%	16,244	26,775	+64.8%	11,571	-28.8%
Total:										
expected	14,922	15,448	3.5%	11,642	-22.0%	410,757	423,025	3.0%	316,700	-22.9%
low	9,700	11,586	19.4%	8,731	-10.0%	266,993	317,269	18.8%	237,526	-11.0%

[1] Includes direct, indirect and induced employment from associated harvest levels.

[2] Includes direct, indirect, and induced employment income from associated harvest level.

[3] Specified Alternative compared with No Action alternative.

[4] Columbia, Straits, North Puget, South Puget and South Coast planning units.

[5] Chelan, Yakima, and Klickitat planning units.

For low harvest levels, the OESF Planning Unit would have the highest percentage increase for harvest and employment levels under Alternative 2 compared with the No Action alternative. The east-side planning units would have the next highest percentage increase, and the west-side planning units have the smallest increase.

Under the expected harvest projections, Alternative C would result in a decrease in timber-related employment and income for all three areas compared with the No Action Alternative. The west-side would experience a 21 percent decline in employment and income; the east-side about a 9 percent decline and the OESF a 38 percent decline. Under low harvest projections, the east-side would show a 5.4 increase in employment and income compared with the No Action Alternative; the west-side, a 9 to 10 percent decline in employment and income; and the OESF, about a 29 percent decline.

Overall, under expected harvest projections, Alternative B would result in a 3.4 and 3.0 percent increase in timber-related employment and associated income, respectively over the No Action alternative; Alternative C would result in a 22 percent decrease for both employment and income.

Under low harvest projections, Alternative B would result in an increase of 19 percent over the No Action alternative for both employment and income. Alternative C would decrease employment and income around 10 percent.

4-539 4.11 CUMULATIVE EFFECTS

4-539 4.11.1 Introduction

4-539 4.11.2 Assumptions

4-540 4.11.3 Alternative A and Alternative 1

4-541 4.11.4 Alternative B

- West-Side Planning Units

-East-Side Planning Units

4-542 4.11.5 Alternative C

4-542 4.11.6 Alternative 2

4-543 4.11.7 Alternative 3

4-543 4.11.8 Closing

4.11 Cumulative Effects

4.11.1 Introduction

The cumulative effects analysis addresses the effects of each alternative and their interactions with other reasonably foreseeable actions at the regional level. Cumulative impact is the impact on the environment that results from the incremental impact of the action when added to other past, present, and reasonable foreseeable future actions, regardless of the originator of those actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

Each resource assessment section in this DEIS includes at least some discussion of cumulative effects potential related to DNR's No Action and action alternatives as these apply to the five west-side, three east-side and OESF planning units in conjunction with expected actions on federal and private lands and regional recovery plans for threatened and endangered species. This is especially true for the action alternatives because the management strategies were developed with potential cumulative effects as one consideration in determining the potential effectiveness of the strategy for that resource. In addition, a habitat-based assessment is provided in Section 4.5.4. In many ways, that section provides a cumulative effects assessment in respect to overall forest and riparian habitat. Rather than repeat cumulative effects discussions contained in other parts of this document, Section 4.11 will give a brief overview of the cumulative effects contribution anticipated from DNR's No Action and action alternatives.

The discussion in this section, as well as earlier sections, does not address harvest of specific units, construction of specific roads, or other specific management activities that would be undertaken by DNR during normal forest practices. Specific actions like these that are not directly addressed under an alternative would be consistent with DNR's Forest Resource Plan (DNR 1992b), the Washington Forest Practices Act, and other state and federal laws.

4.11.2 Assumptions

DNR's planning area for the proposed HCP coincides with the range of the northern spotted owl. The total area of trust lands covered by the proposed HCP is approximately 1.6 million acres. Actions proposed by DNR would be applied only to DNR-managed lands. However, many other individuals and entities own and manage forest land within this same area, including the federal government (8,826,000 acres), state government (non-DNR) (151,000 acres), city and county government (101,000 acres), tribes (1,015,000 acres), and private individuals and organizations (9,488,000 acres). Potential actions by these other landowners, which would affect the overall quantity, quality, and pattern of forest land and forest habitat within western Washington, are many and highly variable. It is impossible to predict what that aggregate set of actions will be during the next 100 years. Therefore, in an effort to provide a meaningful summary of potential cumulative effects for DNR's actions, one must make some assumptions. These assumptions, based on potential trends rather than specific actions by specific landowners or government entitites, are listed below:

(1) Washington State's population will continue to grow, increasing the already abundant demands for forest lands in this state to do all and be all: providing timber and forest products, jobs, forest refuges for spiritual quests, suitable development land for expansion of society's infrastructure, habitat for all animal, plant and fish species native to Washington, unique settings for a broad range of recreation and outdoor sports, and more.

(2) In light of these demands and the changing winds of law and legislation, landowners and land managers will continue to seek creative ways to increase regulatory certainty.

(3) Large forest landowners and managers, in search of ways to resolve conflict among the many growing demands, will look increasingly toward processes that define a niche for their lands and will create specific, objectives-based plans to achieve them.

(4) Although minor adjustments may be made over time, the President's Forest Plan will provide the general level of long-term protection envisioned at the time of its adoption. As a result, national forests and parks will provide the backbone of forest habitat conservation in Washington State. Other landowners who develop specific conservation strategies will seek to define their niche in relationship to the federal lands in their area, providing themselves the greatest flexibility while also making an effective contribution to overall conservation within the state.

(5) The current shift toward habitat-based conservation, rather than species-by-species conservation, will continue as a result of composite efforts to achieve both regulatory and conservation certainty into the future.

(6) While they will be potentially more dynamic through time than the President's Forest Plan, the cumulative set of habitat conservation plans initiated by private, tribal, municipal, and state landowners and managers will create an increasingly effective, reliable, and integrated network of forest habitat in Washington.

(7) DNR will continue to manage the majority of its forest trust lands as commercial forest, being guided in that management by its responsibilities to each of the trusts. Although some forest land may become designated as transition lands during the Asset Stewardship planning process recently initiated, no significant changes in overall emphasis are expected.

4.11.3 Alternative A and Alternative 1

Conservation under the No Action alternatives (A and 1) is currently achieved on DNR-managed lands on a site-by-site, species-by-species basis under the guidance of the Forest Resource Plan (DNR 1992b) and the Washington Forest Practices Act. Coordination with adjacent landowners' efforts is also site-by-site, rather than at the landscape level. However, policies adopted by the Board of Natural Resources in the Forest Resource Plan (DNR 1992b) are shifting DNR toward a broader approach to forest management through landscape planning, watershed analysis, and other policies. Implementation of these policies is currently in progress.

While this shift will increase the amount of attention given to how DNR-managed lands fit into a landscape context and to potential cumulative effects of individual activities, there is no inherent strategy for achieving clearly defined conservation goals at this broader scale. More specifically, without a defined strategy for managing the nature and pattern of forest and riparian vegetation at a broad regional scale, it is difficult to ensure that positive cumulative outcomes can be accomplished for habitat within the context of commercial forest production and other forest demands. This becomes clear as the various resource assessments contained in Chapter 4 are read. Repeatedly, the No Action alternatives are described as having the potential to provide for various conservation needs, but that this can not be counted upon because: (1) no specific provisions are defined for certain needs; and/or, (2) the quantity, quality, and distribution of resulting habitats are unplanned (e.g., unpredictable movement of owls circles under today's owl circle approach rather than controlled location of habitat based on potential effectiveness and contribution need.)

If habitat were abundant, the cumulative effects might be of less concern. But when some habitats are dwindling and specific characteristics of certain habitat needs are still unknown, the inability to predict whether the cumulative effect will be positive or negative on a landscape level causes concern. There is relatively low certainty as to whether the No Action alternatives will provide positive cumulative effects on the quantity, quality, and distribution of forest habitat in Washington over the next 100 years. The individual resource evaluations suggest, at the least, there will be some gaps in availability of some habitats for some life cycle needs of some species.

4.11.4 Alternative B

West-Side Planning Units

Alternative B provides a landscape-level, habitat-based strategy for providing conservation in western Washington for a broad range of species and habitat types. The primary emphasis is on spotted owls, marbled murrelets, and riparian habitat; however, it is expected that the resulting quantity, quality, and patterns of upland and riparian forests will be effective habitat for many other native species.

The owl strategy, in particular, builds on anticipated federal forest patterns. By identifying the type of effective support DNR-managed lands can contribute, Alternative B has the potential to gain high conservation benefits while maintaining the greatest operational flexibility. It also makes no demands on other nonfederal landowners, since their actions are not essential to ensuring the DNR contribution, but they have the opportunity to identify a niche for themselves in relation to this and the federal strategy that enhances everyone's contribution, thus gaining the same certainty with high flexibility. This should provide greater likelihood of positive cumulative effects for northern spotted owl conservation. This is particularly true if the trend toward habitat-based conservation plans continues as assumed.

The riparian strategy seeks to ensure overall riparian ecosystem function from headwaters to the mouth of all rivers to the extent feasible for a single land manager among many

others within each watershed. This should provide greater certainty of positive cumulative effects for the high number of species that rely on riparian, wetland, and aquatic areas than the No Action alternatives. Although the long-term contribution of marbled murrelet habitat is uncertain, there will be at least some added assurance of older forests across a larger percentage of DNR-managed lands. In addition, due to the multiple-species perspective, Alternative B provides greater certainty that the range of forest successional stages on DNR-managed lands will include older forests, with important unique features and habitats maintained, and be located where they are more strategically effective from a biological perspective.

East-side Planning Units

Because there are so many differences between west-side and east-side ecology, DNR decided to leave most habitat issues in the east-side planning units for future planning efforts. Only the northern spotted owl strategy and other listed species potentially utilizing the east-side planning units' habitat are applied to the east-side planning units. Potential cumulative effects on eastside units related to the spotted owl strategy are described at the end of Section 4.3.1.

4.11.5 Alternative C

Alternative C is similar to Alternative B. Like B, it takes a strategic approach to locating certain habitats and protecting certain unique features and habitat elements. However, it provides greater certainty than either A or B that there will be adequate amounts of older forest, more certain range of desired habitats, and higher protection of riparian forests on DNR-managed lands. At the same time, it also reduces management flexibility. The potential long-term implications of this reduced flexibility in DNR's ability to respond to actions taken by other landowners within the planning area are unclear related to cumulative effects on habitat conservation.

4.11.6 Alternative 2

Like Alternative B for the other planning units, Alternative 2 provides a landscape-level, habitat-based strategy in the OESF for contributing to conservation in western Washington for a broad range of species. The primary emphasis is on spotted owl, marbled murrelet, and riparian ecosystems; however, it is expected that the resulting quantity, quality, and patterns of upland and riparian forests will be effective habitat for many other native species.

While Alternative 1 emphasizes protecting existing habitat for individual species, Alternative 2 is an experimental approach for enhancing the natural growth potential of today's commercial forest and for building habitat into the future. It begins with a habitat-recovery phase, then stabilizes around a habitat-maintenance approach. The nature of riparian, murrelet, and owl habitat targets should ensure a broad distribution of quality, quantity, and types of habitat landscape-by-landscape. While Alternative 2 is less closely tied to support of federal owl sites through fixed zones than Alternative 3, it also allows the greatest flexibility to locate habitat in the most strategic location through time, adjusting more easily to an unpredictable, changing environment.

Alternative 2 includes a research program that will emphasize cooperative efforts with other landowners and land managers. This has the potential to make two strong contributions toward ensuring positive long-term cumulative effects: (1) valuable new knowledge that can be used to improve the effectiveness of the conservation strategies; and, (2) the common ground gained in forest management through partnerships and shared knowledge, rather than independent actions taken without attention to adjacent lands and approaches. At the same time, because Alternative 2 is an experimental approach to achieving habitat-based conservation in a commercial forest, there is greater potential risk. This makes the cumulative outcome less certain than Alternative 3, but still more certain than Alternative 1.

4.11.7 Alternative 3

On the broad scale, Alternative 3 in the OESF is similar to Alternatives B and C for the west-side planning units in that it provides a landscape-level, habitat-based strategy for providing conservation on the Olympic Peninsula and is based on a more traditional zoned approach. It builds on habitat zones designed to provide specific functions for spotted owls in relation to federal lands. The primary emphasis on spotted owl, marbled murrelet, and riparian ecosystems is expected to result in forest and riparian vegetation patterns that provide effective habitat for many other species beyond just these three. Likewise, due to the multiple species emphasis and the careful placement of owl zones, this alternative provides greater certainty that the range of forest successional stages on DNR-managed lands will include older forests and be located where they are most strategically effective. There is greater certainty of positive cumulative effects under Alternative 3 than under Alternative 1.

Unlike Alternative 1, however, Alternative 3 incorporates an aggressive approach to research and gaining new knowledge and to coordinate efforts with other landowners, closer to like Alternative 2. This has the potential to make two strong contributions toward ensuring positive long-term cumulative effects: (1) valuable new knowledge that can be used to improve the effectiveness of the conservation strategies, and (2) the common ground gained in forest management through partnerships and shared knowledge, rather than independent actions taken without attention to adjacent lands and approaches. This also means there is greater potential risk than with Alternative 1 regarding the actual cumulative effects outcome; this risk is lower than with Alternative 2 because Alternative 3 is somewhat less experimental in the approach to achieving habitat through time.

4.11.8 Closing

In 100 years, as a traveler exploring western Washington, would a person be able to tell which alternative had been implemented? It might be difficult to tell the difference at the stand level. What isn't seen may be more significant than what is seen. For example, not seeing overly narrow riparian management areas would be significant. In general, under all the alternatives, the full range of silvicultural activities will still be applied. Under all the alternatives, all the assortment of forest stands seen today will be out there on the landscape. There will be no way to tell whether the stand you're walking through or

looking down upon is the result of any particular alternative. The difference will be pronounced at the landscape level, showing a mosaic of stand treatments that are interwoven, providing lang-term economic and ecological viability. The point is that the differences will be subtle. In fact, the effectiveness of each alternative lies precisely in the cumulative effects of the many small actions that make up that alternative. Alternatives B, C, 2, and 3 offer specific strategies to guide the cumulative effects toward positive outcomes; Alternatives A and 1, because they continue stand-level management in an atmosphere of regulatory uncertainty, permit effects to fall where they may. Alternative C is more conservative than Alternative B in providing for greater certainty of conservation benefits. Alternative 3 is more conservative than Alternative 2 in applying an experimental approach to achieving a habitat-based strategy for integrating production and conservation.

5. List of Preparers

5. List of Preparers

Members of the Interdisciplinary Team (IDT)

Name	Contribution	Degree(s)
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Craig Hansen, USFWS	USFWS IDT Co-Lead	B.A., M.S., Wildlife Management
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Matt Longenbaugh, NMFS	Fishery Biologist	B.S., Marine Science
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George Wilhere, DNR	Wildlife Biologist	M.S., Biomedical Engineering; M.S., Neurobiology; M.E.M., Conservation Biology
Jeff Cederholm, DNR	Natural Resource Scientist	B.S., M.S., Fisheries Biology

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The following individuals contributed to the development of the Environmental Impact Statement for the Habitat Conservation Plan. Team leaders are indicated by an asterisk.

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Grant Munro, *industrial forestry*
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Charles Peterson, *Western Council of Industrial Workers*
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Jim Closner, Field Foresters
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6. Distribution List

6. Distribution List

Federal

Environmental Protection Agency[1]
National Marine Fisheries Service
National Park Service, Pacific Northwest Region
US Fish and Wildlife Service
US Forest Service, Portland
Olympic National Park

U.S. Senate

The Honorable Slade Gorton
The Honorable Patty Murray

U. S. House of Representatives

The Honorable Norm Dicks
The Honorable Richard Hasting
The Honorable Jack Metcalf
The Honorable Linda Smith
The Honorable Rick White
The Honorable Jennifer Dunn
The Honorable Jim McDermott
The Honorable George Nethercutt
The Honorable Randy Tate

State

California Department of Forestry
Central Washington University Board of Trustees
Eastern Washington University Board of Trustees
The Evergreen State College Board of Trustees
Governor's Timber Team (Washington)
Maryland Forest Service
Oregon Department of Forestry
University of Washington Board of Regents
Washington State Board of Education
Washington State Department of Ecology
Washington State Department of Fish and Wildlife
Washington State Office of Archaeology and Historic Preservation
Washington State Parks and Recreation Commission
Washington State University Board of Regents
Western Washington University Board of Trustees

[1] Names shown in bold and italics will receive a complete set of the HCP and EIS. All others will receive Executive Summaries.

State Legislators

Senator Ann Anderson, Natural Resources Committee
Senator Kathleen Drew, Natural Resources Committee
Senator Jim Hargrove, Natural Resources Committee
Senator Mary Margaret Haugen, Natural Resources Committee
Senator Valoria Loveland, Democratic Caucus Chair
Senator Dan McDonald, Republican Caucus Leader
Senator Bob Morton, Natural Resources Committee
Senator Irv Newhouse, Republican Caucus Floor Leader
Senator George Sellar, Republican Caucus Chair
Senator Sid Snyder, Democratic Caucus Leader
Senator Harriet Spanel, Natural Resources Committee
Vic Moon, Research Analyst, Senate Natural Resources Committee
Cathy Baker, Fiscal Analyst, Senate Natural Resources Committee
Representative Marlin Appelwick, Minority Leader
Representative Clyde Ballard, Speaker of the House
Representative Bob Basich, Natural Resources Committee
Representative Barney Beeksma, Natural Resources Committee
Representative Jim Buck, Natural Resources Committee
Representative Ian Elliot, Natural Resources Committee
Representative Dale Foreman, Majority Leader
Representative Steve Fuhrman, Natural Resources Committee
Representative Bill Grant, Minority Caucus Chair
Representative Brian Hatfield, Natural Resources Committee
Representative Ken Jacobsen, Natural Resources Committee
Representative Lynn Kessler, Minority Whip
Representative Barbara Lisk, Majority Caucus Chair
Representative John Pennington, Natural Resources Committee
Representative Debbie Regala, Natural Resources Committee
Representative Tim Sheldon, Natural Resources Committee
Representative Val Stevens, Natural Resources Committee
Representative Brian Thomas, Natural Resources Committee
Representative Les Thomas, Natural Resources Committee
Representative Bill Thompson, Natural Resources Committee
Karl Herzog, Fiscal Analyst, House Capital Budget Committee
Linda Byers, Research Analyst, House Natural Resources Committee
Nancy Stevenson, Fiscal Analyst, House Appropriations Committee
Bob Longman, Coordinator, House Finance Committee

County

Adams County Commissioners
Adams County Planning Department
Asotin County Commissioners
Asotin County Planning Department
Benton County Commissioners
Benton County Planning Department
Chelan County Commissioners
Chelan County Planning Department
Clallam County Commissioners
Clallam County Conservation District
Clallam County Planning Department
Clark County Commissioners
Clark County Planning Department
Columbia County Commissioners
Columbia County Planning Department
Cowlitz County Commissioners
Cowlitz County Planning Department
Douglas County Commissioners
Douglas County Planning Department
Ferry County Commissioners

County (cont.)

Ferry County Planning Department
Franklin County Commissioners
Franklin County Planning Department
Garfield County Commissioners
Garfield County Planning Department
Grant County Commissioners
Grant County Planning Department
Grays Harbor County Commissioners
Grays Harbor County Planning Department
Island County Commissioners
Island County Planning Department
Jefferson County Commissioners
Jefferson County Planning Department
King County Council
King County Council, Surface Water Mgmt. Division
King County Planning Department
Kitsap County Commissioners
Kitsap County Planning Department
Kittitas County Commissioners
Kittitas County Planning Department
Klickitat County Commissioners
Klickitat County Planning Department
Lewis County Commissioners
Lewis County Planning Department
Lincoln County Commissioners
Lincoln County Planning Department
Mason County Commissioners
Mason County Planning Department
Okanogan County Commissioners
Okanogan County Planning Department
Pacific County Commissioners
Pacific County Planning Department
Pend Oreille County Commissioners
Pend Oreille County Planning Department
Pierce County Council
Pierce County Planning Department
San Juan County Commissioners
San Juan County Planning Department
Skagit County Commissioners
Skagit County Planning Department
Skamania County Commissioners
Skamania County Planning Department
Snohomish County Commissioners
Snohomish County Planning Dept
Spokane County Commissioners
Spokane County Planning Department
Stevens County Commissioners
Stevens County Planning Department
Thurston County Commissioners
Thurston County Planning Department
Wahkiakum County Commissioners
Wahkiakum County Planning Dept
Walla Walla County Commissioners
Walla Walla County Planning Department
Whatcom County Council
Whatcom County Planning Department
Whitman County Commissioners
Whitman County Planning Department
Yakima County Commissioners
Yakima County Planning Department

Local

Seattle Water Department
City of Aberdeen, Department of Planning and Economic Development
City of Everett, Public Works Department
City of Forks, Economic Development Steering Committee
Port of Port Angeles

Tribal

Chehalis Tribe
Chinook Tribe
Cowlitz Tribe
Hoh Tribe
Jamestown S'Klallam Tribe
Lower Elwha S'Klallam Tribe

Tribal (cont.)

Lummi Nation
Makah Tribal Council
Marietta Band of Nooksack Indians
Muckleshoot Tribal Council
Nisqually Tribe
Nooksack Tribe
Northwest Indian Fisheries Commission
Point No Point Treaty Council
Port Gamble S'Klallam Tribe
Puyallup Tribe
Quileute Tribe
Quinault Nation
Samish Tribe
Sauk-Suiattle Tribe
Shoalwater Bay Tribal Council
Skagit Tribe
Skokomish Tribe
Snohomish Tribe
Stillaguamish Tribe
Swinomish Tribe
Suquamish Tribe
Squaxin Island Tribe
Tulalip Tribe
Upper Skagit Tribe
Yakama Tribe

Libraries

Aberdeen Timberland Library
Antioch University of Seattle Library
Battelle Seattle Research Center Library
Bellevue Community College Library
Bellingham Public Library
Brewster Public Library
Burlington Public Library
Camas Public Library
Cathlamet City Library
Central Washington University Library
Central Washington University, Horticulture/Forestry Library
Centralia Timberland Library
Chehalis Timberland Library
Chehalis Tribe Library
Chelan Public Library
Cheney Public Library
Chewelah Public Library
City University, Bellevue Library
Clark College Library
Clark County Law Library
Cle Elum Public Library
Columbia Basin College Library
Colville Confederated Tribes Library
Colville Public Library
Davenport Public Library
Dayton Public Library
Eastern Washington University Library
Edmonds Community College Library
Ellensburg Public Library
Elwha S'Klallam Tribe Library
Enumclaw Public Library
Ephrata Public Library
Everett Community College Library
Everett Public Library
Evergreen State College Library
Fairwood Library
Forks Memorial Library
Fort Vancouver Regional Library
Fort Vancouver Regional Library, White Salmon Branch
Fort Vancouver Regional Library, Battle Ground Branch
Fort Vancouver Regional Library, Stevenson Branch
Foster Wheeler Environmental Library
Gonzaga University, Crosby Library
Georgia Pacific, Bellingham Division Library
Goldendale Public Library
Government Research Assistance Library
Grand Coulee Public Library
Grandview Community Library
Grays Harbor College, John Spellman Library
Green River Community College, Holman Library
Harrington Public Library
Heritage College Library
Highline Community College Library
Hoh Tribe Library
Hoquiam Timberland Library
Issaquah Library
ITT Rayonier Research Center Library
James River Corporation, Camas Technical Center Library
Jamestown S'Klallam Tribal Library

Libraries (cont.)

Jefferson County Rural Library
John A. Brown Library
Kalispel Tribe Library
Kelso Public Library
Kettle Falls Public Library
King County Library
King County Library, North Bend Branch
Kitsap Regional Library
Kittitas Public Library
Lacey Timberland Library
Longview Public Library
Lower Columbia College,
Alan Thompson Library
Lummi Reservation Library
Makah Tribe Library
Mid Columbia Library
Mid Columbia Library,
West Richland Branch
Mt. Vernon Public Library
Muckleshoot Library
Montesano Timberland Library
Natural Resources Building Library
Neill Public Library
Nisqually Tribe Library
North Central Regional Library
North Central Regional Library,
Republic Branch
North Central Regional Library,
Waterville Branch
Nooksack Tribe Library
North Seattle Community College Library
Northwest Indian Fisheries Commission
North Olympic Library, Forks Branch
North Olympic Library, Port Angeles Branch
Okanogan Public Library
Olympia Timberland Library
Olympic College Library
Omak Public Library
Othello Public Library
Pasco Public Library
Pend Oreille County Library
Peninsula College, John D. Glenn Library
Pierce College, Fort Steilacoom Library
Pierce County Library
Pomeroy Library
Port Gamble S'Klallam Tribe Library
Port Townsend Public Library
Prosser Public Library
Pullman Public Library
Puyallup Public Library
Puyallup Tribe Library
Raymond Timberland Library
Quileute Tribe Library
Quinault Indian Nation Library
Reardan Memorial Library
Renton Public Library
Richland Public Library
Ritzville Public Library
Roslyn Public Library
St. Martins College Library
San Juan Island Library
Sauk-Suiattle Tribe Library
Seattle Central College Library
Seattle Community College Library
Seattle Pacific University Library
Seattle Public Library
Seattle University Library
Sedro Woolley Public Library
Shoalwater Bay Community Library
Shoreline Community College,
Ray W. Howard Library
Skagit Valley College Library
Skokomish Tribe Library
Sno Isle Regional Library
Sno Isle Regional Library, Coupeville
Branch
Sno Isle Regional Library, Langley Branch
Sno Isle Regional Library, Stanwood
Branch
South Bend Timberland Library
South Puget Sound Community College
Library
South Seattle Community College Library
Spokane Community College Library
Spokane County Library
Spokane Falls Community College Library
Spokane Public Library
Spokane Tribe Library
Sprague Public Library
Squaxin Island Tribal Library
Stillaguamish Tribe Library
Suquamish Tribe Library
Swinomish Tribe Library
Tacoma Community College Library
Tacoma Public Library
Tri Cities University Library
Tulalip Tribe Library

Libraries (cont.)

Tumwater Timberland Library
University of Puget Sound, Collins Memorial Library
University of Washington, Allen Library
University of Washington, College of Forest Resources Library
University of Washington Library, Government Publications
University of Washington, School of Fisheries Library
Upper Skagit Tribe Library
U.S. Environmental Protection Agency, Region 10 Library
Waitsburg Weller Public Library
Walla Walla Community College Library
Walla Walla County Library
Washington State Library
Washington State University, Environmental Science Library
Washington State University, Department of Forestry Library
Washington State University, Government Documents
Wenatchee Public Library
Wenatchee Valley College Library
Western Washington University, Huxley College Library
Western Washington University, Mabel Zoe Wilson Library
Weyerhaeuser Corporate Library
Weyerhaeuser Forestry Library
Weyerhaeuser Technical Center Library
Whatcom Community College Library
Whatcom County Library
Whitman College, Penrose Library
Whitman County Library
Whitworth College Library
Wilbur Public Library
William G. Reed Timberland Library
Winthrop Public Library
Yakama Indian Nation Cultural Center Library
Yakima Valley Community College Library
Yakima Valley Regional Library

Organizations

Audubon Society (state)
American Rivers
Beak Consultants
Black Hills Audubon Society
Boise Cascade
Bullitt Foundation
Buse Timber and Sales
Champion International
Columbia Gorge Audubon
Council of Presidents
Forest Land Management Commission
Foster Wheeler Environmental
Greater Ecosystem Alliance
Island Foresters
ITT Rayonier
Longview Fibre
Mantech Environmental
The Mountaineers
Murray Pacific
The Nature Conservancy
Northwest Forestry Association
Olympic Peninsula Foundation
Parametrix, Inc.
Pacific Lumber and Shipping
People for Puget Sound
Plum Creek
Pope & Talbot
Puget Sound Society for Conservation Biology
Resources Northwest, Inc.
Save Our Wild Salmon
Seattle Audubon
Sierra Club
Simpson Timber
Trout Unlimited
Washington Association of School Administrators
Washington Commercial Forest Action Committee
Washington Environmental Council
Washington Forest Protection Association
Washington Hardwoods Commission
Washington State Association of Counties

Organizations (cont.)

Washington State School Directors' Association
Washington Trout
Washington Wildlife Federation
Washington Wilderness Coalition
Western Ancient Forest Campaign
Western Forest Industries Association
Wild Salmon Center
The Wilderness Society
World Wildlife Fund
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Alice Blandin
Cedar Blomberg
Jody Brower
Elsa Bruton
Lanny Carpenter
Tina Chan
Ellen Chu
John Clevenger, Jr.
Clifton Collins
Michael Collins
Lisa Dabek
Helen Daly
Jack Davis
Carolyn Dobbs
Harm Dotinga
Gene Dziedzic
Ronald Figlar Barnes
Jerry Franklin
Julie Garrison
Margaret Gaspari
Marcy Golde
Warren Groves
Tom Hamer
Janet Hardin
Kathleen Hedtke
Becky Herbig
Clayton Hobart
Richard Holthausen
James Karr
Jim Klinck
Joel Kuperberg
Kirk Lakey
Jeff Langlow
Darrell Linton
Mike Mackelwich
Jill Mackie
Larry Maechler
Joe Mennish
Charley Moyer
Grant Munro
Nancy Naslund
Dan Norkowski
Bill Null
Randall Payne
Bert Paul
Olemara Peters
Karen Peters Waldron
Charles Peterson
Alicia Pool
Martin Raphael
Ivan Redmund
Melanie Rowland
Robert Sager
Jim Schafer
Randy Scott
Jean Stam
Dave Stokes
Dan Stroh
Steve Tharinger
Ed Thiele
Sonjia Thompson
Linda Thomson
Neil and Milicent Turnberg
Brian Urbain
Aaron Viles
Paul Wagner
Roy Wagner
Jim Walton
Jeff White
Larry Williams
Shawna Wittman
Vim Wright
E Zahn
F R Zimmerman