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Department of
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Environmental Assessment

Canyon Timber Sale

Gifford Pinchot National Forest
Mount St. Helens National Volcanic Monument
Skamania County, Washington

T. 4 N., R. 5 E., and T. 5 N, R. 5 E., Willamette Meridian

For Information Contact: Mitch Wainwright, Canyon Interdisciplinary Team Leader
42218 NE Yale Bridge Rd, Amboy, WA 98601
(360) 449-7857
mwainwright@fs.fed.us

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SUMMARY

The Gifford Pinchot National Forest proposes to commercially thin approximately 479 acres of timber stands out of a total of 553 acres within twelve harvest units on the Mount St. Helens National Volcanic Monument (outside of the legislated Monument) in Washington State. The project area is located in T. 4 N., R. 5 E., and in T. 5 N., R. 5 E., within the Merwin Reservoir and Yale Reservoir fifth-field watersheds. The purpose of this action is to restore and improve/accelerate timber growth and yield of even-aged, stagnated stands that were artificially regenerated following clear-cut timber harvest in the 1960s and 1970s. It is also to restore late-successional ecosystems in stands in Late-Successional Reserves and in Riparian Reserves, and to manage the stands within the lands designated as Matrix in the Northwest Forest Plan for the continued production and utilization of forest resources, principally timber, water, dispersed recreation, and wildlife.

There is a need to restore late-successional components within Riparian Reserves. The proposed action would accelerate the growth of the young trees by thinning 41 acres of currently overstocked dense conifer stands and by increasing overall species diversity by under planting with a mix of shade-tolerant species. The proposed action would yield approximately 7.6 million board feet of commercial timber for sale.

Following internal and public scoping, the Forest Service identified no potentially significant issues that would lead to the development of an alternative other than the proposed action (Alternative A).

Alternative B is the No Action alternative and is the baseline for consideration of effects from other alternatives.

Based upon the effects of the alternatives, the responsible official would decide which alternative best meets the overall purpose of and need for action or whether there would be any significant effects to the human environment, which would call for the preparation of an Environmental Impact Statement.

CHAPTER 1. PURPOSE AND NEED FOR ACTION

Background

The proposed action is a commercial thinning of overstocked stands located in T. 4 N., R. 5 E., and in T. 5 N., R. 5 E.,W.M., within the Merwin Reservoir and Yale Reservoir fifth-field watersheds, Skamania County, Washington. The planning area occupies the Upper and Lower Canyon Creek, and Upper Siouxon Creek sixth-field watersheds.

Intensive timber harvesting in this watershed began in the early 1950s and continued throughout the next four decades. All of the timber stands in the proposed action originated from artificial plantations as a result of clear-cut timber harvests in the 1960s and 1970s. These young stands are dense, even-aged stands that are comprised of mostly Douglas-fir, with a component of western hemlock. These stands are also currently experiencing individual tree mortality from inter-tree competition, reduced diameter growth and reduced tree canopies from high tree densities.

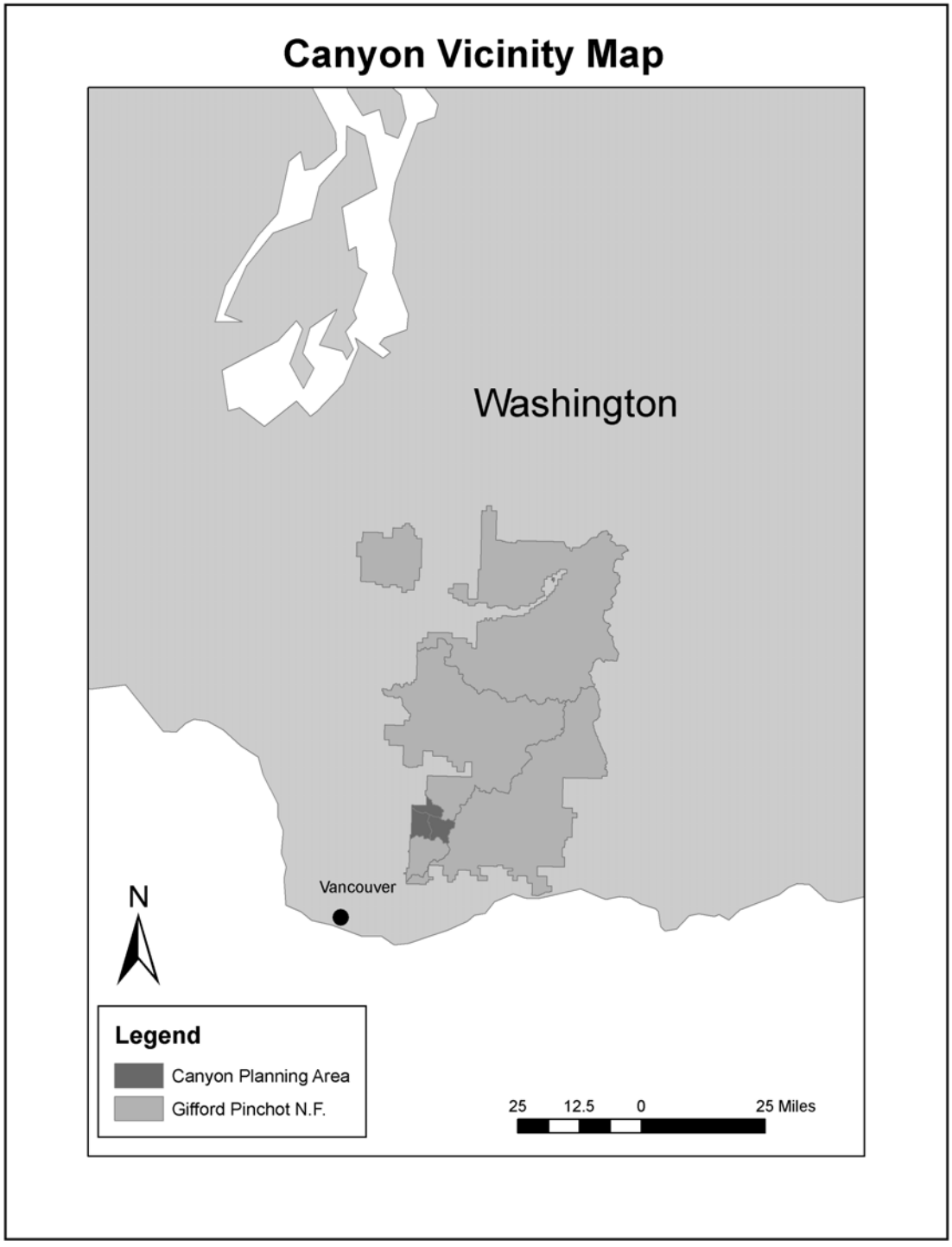

Figure 1-1. Canyon Timber Sale planning area vicinity map

Purpose of and Need for Action

Purpose and Need Statement: There is a need to restore and accelerate timber growth and yield in even-aged, dense stands in the Canyon Creek watershed that were artificially regenerated following timber harvest in the 1960s through early 1970s. There is also a need to restore late-successional ecosystems in stands in Late-Successional Reserves and in Riparian Reserves, and for the continued production and utilization of forest resources within the Matrix allocation.

Desired Condition: The proposed treatment units are located within Matrix and Late-Successional Reserve allocations, and some contain Riparian Reserves. The desired condition for the General Forest management area within Matrix is that the lands are managed for the continued production and utilization of forest resources, principally timber, water, dispersed recreation, and wildlife. The desired future condition for Deer and Elk Winter Range within Matrix is that tree species and sizes are varied and well distributed, and that at least 44 percent of the biological winter range is in optimal thermal cover. The desired condition for Riparian Reserves is that these lands support late-successional forest stands that provide connectivity of late-successional forest habitat across the Forest, as well as benefiting fish and riparian-dependent non-fish species.

Late-Successional Reserves are to provide habitat for late-successional and old-growth related species. The Forest's Late-Successional Reserve Assessment (1997) recognized a need for commercial thinning in stands less than 80 years old with the objectives of accelerating growth, increasing plant species diversity, increasing structural diversity, and to provide a mechanism to create snags and down wood where needed.

Existing Condition: Overall tree growth in the proposed treatment units is slowing due to overcrowded conditions. Stand health is declining due to stand age, overcrowded conditions, and competition for water, light, and nutrients. In addition, some stands are showing evidence of poor health due to mistletoe infestation within the western hemlock component. Thinning can provide faster attainment of large-diameter individual trees than what would be possible in young, fully stocked stands. In addition, structural and species diversity can be enhanced by thinning in areas that are relatively uniform in stocking, species composition, and tree size by applying variable thinning prescriptions.

Stands that are never thinned generally reach maximum density by age 25. At maximum density, the lower branches are shaded and die, reducing the live crown percent of each tree. When live crowns are reduced, all of the benefits derived from thinning are lost or delayed for a long time.

Management Direction

This action responds to the goals and objectives outlined in the *Gifford Pinchot National Forest Land and Resource Management Plan* (LRMP, 1990), as amended by the *Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl* (Northwest Forest Plan, 1994, amended 2004). The LRMP and the Northwest Forest Plan were combined into a convenient reference, referred to in this document as Amendment 11. This action helps move the project area towards desired conditions described in the LRMP.

The 32,300-acre planning area for Canyon Timber Sale consists of the Upper Canyon Creek, Lower Canyon Creek and Lower Siouxon Creek sixth-field watersheds.

The Siouxon Creek watershed has been designated a Tier 2 Key Watershed under the Northwest Forest Plan. Tier 2 Key watersheds were selected as sources of high quality water and may not contain at-risk fish stocks.

The Canyon Timber Sale project incorporates recommendations for vegetation management from the *Lower Lewis River Watershed Analysis* (1996). The Watershed Analysis includes a recommendation for thinning on lands managed for timber growth and yield (pages VI-5 – VI-6). The Watershed Analysis also recommends overstory release or thinning in Riparian Reserves to accelerate growth of conifers and interplanting to enhance species diversity (page VI-7).

Recommendations from the Watershed Analysis include high prioritization for road decommissioning and weatherization.

Eleven of the twelve proposed Canyon Timber Sale units are located within lands designated as matrix in the Northwest Forest Plan and General Forest (TS) in the LRMP. Some of these Matrix units encompass Deer and Elk Winter Range as described by the LRMP (Figure 1-2). Each of these management areas allows for scheduled timber harvest though standards and guidelines and other management practices have been designed to achieve multiple use goals and objectives. The other proposed unit is located within Late-Successional Reserve where timber harvest is allowed if designed to enhance structural diversity and accelerate the development of late-successional characteristics.

Thinning and planting of shade tolerant species (western redcedar and western hemlock) are proposed in some locations within the Riparian Reserve. Riparian Reserves are portions of watersheds where riparian-dependent resources receive primary emphasis and where special standards and guidelines apply. The objective for treating the Riparian Reserve portions of these stands is to encourage the growth of larger conifers, including increased tree diameter and wide vigorous crowns, increase species diversity, and augment future sources of coarse wood for the riparian forest floor and in streams.

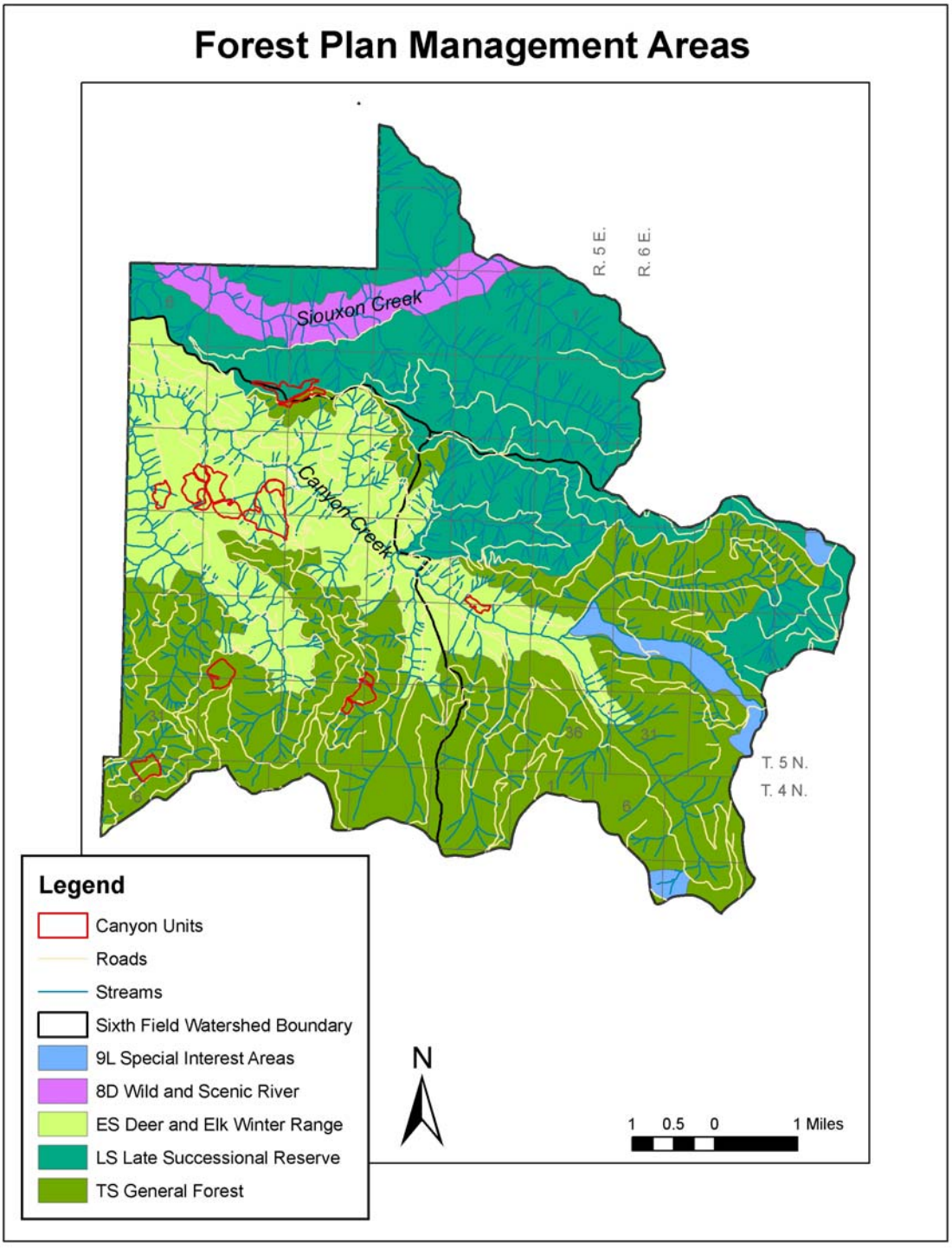

Figure 1-2. Gifford Pinchot National Forest LRMP management areas within the Canyon Timber Sale planning area

The objective for matrix lands is to restore and accelerate the timber growth and yield of even-aged, stagnated stands and to manage the lands within the general forest management area for the continued production and utilization of forest resources, principally timber, water, fish, dispersed recreation, and wildlife (LRMP, Amendment 11, page 6-25). Objectives for matrix include provisions to:

- Provide coarse woody debris well distributed across the landscape in a manner which meets the needs of species and provides for ecological functions.
- Retain (or recruit when deficient) snags within the harvest unit at levels sufficient to support species of cavity-nesting birds at 40 percent of potential population levels.
- Plan prescribed fires to minimize the consumption of litter and coarse woody debris and heavy equipment operations limited to avoid soil compaction.
- Manage fifth-field watersheds comprised of 15 percent or less of late-successional forest to retain late-successional patches.

Approximately 42 percent (13,670 acres) within the planning area is designated General Forest (TS) management area. The desired future condition for General Forest management area is achieved when: "Evidence of land managed for timber production and other commodities is apparent. All tree sizes and mixtures of native species from seedlings to mature sawtimber are well distributed." The Visual Quality Objective (VQO) for General Forest is Modification where: "Harvest units may dominate the natural form, line, color, and texture, but must blend with the natural character of the land." The Recreational Opportunity Spectrum (ROS) is Roaded Modified (LRMP, Amendment 11, page 6-26).

The Deer and Elk Winter Range (ES) management area occupies about 22 percent (7,250 acres) of the planning area. The desired future condition for this management area includes: "Management activities, including timber harvest, are locally apparent. Tree species and sizes are varied and well distributed. Optimal cover may be present, particularly if required to ensure that at least 44 percent of the biological winter range in the fifth-field watershed is in optimal cover." The VQO for the ES management area is Modification and the ROS is Roaded Natural (LRMP, Amendment 11, page 6-21).

The General Late-Successional Reserve (LS prescription) management area occupies about 29 percent (9,510 acres) of the planning area. These lands are not suitable for timber management or habitat manipulation to benefit early-successional related species. The desired future condition for this management area is that late-successional and old-growth forest ecosystems would develop over time, and destructive fires seldom occur.

A Wild River (8D prescription) corridor along Siouxon Creek runs through the northern part of the planning area and occupies approximately 4 percent (1,280 acres) of the area. Within the Wild River management area, vegetation varies from natural openings through stands of old-growth timber, and is predominately the product of natural succession. The VQO for this prescription is Preservation and the ROS is Semi-primitive Non-motorized (LRMP, Amendment 11, page 5-32).

The Special Interest (9L prescription) management area occupies about 2 percent (586 acres) of the planning area. Special Interest lands are unique because they include features deserving of special management. They include a wide range of features, such as waterfalls, scenic spots, caves, and botanical, historical, and geological sites. Visual evidence of management is subordinate to the special features. Plant communities are usually the product of natural succession. Vegetation may range from natural openings through stands of mature and old-growth timber.

Proposed Action

To meet the purpose and need, the Forest Service proposes to commercially thin approximately 438 upland acres and approximately 41 riparian acres within the Canyon Timber Sale planning area. The proposed action would yield approximately 7.6 million board feet of commercial timber for sale from both upland and riparian harvest. Harvested trees would be logged using skyline, or tractor yarding systems. The following connected actions would be needed: construct approximately 1.75 miles of temporary roads, and reconstruct approximately 0.34 mile of existing roads. Other actions that are proposed following harvest include machine piling of slash at the designated landing locations, within 50 feet of Forest Roads (FR) 5300 and 5700, and in isolated areas of heavy slash accumulation; and under planting approximately 41 acres of thinned riparian area. Finally, the temporary roads would be closed, decompacted, and re-seeded.

A complete description of the proposed action is found in Chapter 2 of this document.

Decision Framework

The responsible official (Mount St. Helens Monument Manager) will review the proposed action and the other alternative to determine which of them best meets the purpose of and need for action. When making the decision, the responsible official will also take into consideration the specific objective of developing an economically feasible timber sale as well as the issues that have been raised by the interdisciplinary team and from comments received from the public, other agencies, and tribes in response to this analysis.

The final decision would be to either:

- select the action alternative for implementation, or
- defer action at this time, or
- conclude that significant impacts would result from the proposed action which would warrant the preparation of an environmental impact statement.

Public Involvement

The proposal was listed in the Schedule of Proposed Actions beginning in October 2006. A description of the proposal was sent to a mailing list of 49 individuals, organizations, agencies, and tribes for comment during scoping which was initiated on November 15, 2006.

During the initial scoping period, the Forest Service received three comment letters in response to the proposed action. Using these comments the interdisciplinary team developed the final proposed action and a list of issues that would be addressed in this analysis.

A legal notice announcing the availability of the Canyon Timber Sale EA for review and comment was published in the *Columbian* newspaper (newspaper of record) on October 8, 2007. A letter notifying interested individuals, Tribal governments, and agencies of the comment period was also sent out. The 30-day comment period ended on November 7, 2007. Three individuals and organizations submitted written comments. Copies of these letters are in the Canyon Timber Sale analysis file. Substantive comments received are summarized along with Forest Service responses in Appendix C of the EA.

Issues

The issues were developed through public as well as internal scoping. Each of the issues raised was either used to refine the proposed action through the incorporation of specific design features, or addressed through application of Standards and Guidelines or best management practices. None of the issues raised during scoping was considered to be a significant issue, thus the issues raised did not drive development of another action alternative.

The following issues were identified by the Interdisciplinary Team or the public, and were used to develop the proposed action (Alternative A).

Issue 1: Connectivity within the riparian reserves of Canyon Creek.
Previous timber harvest activity in riparian areas in the analysis area has fragmented habitat within Riparian Reserves. Late-seral characteristics development within Riparian Reserves of Canyon Creek would allow for spatial connectivity within and between watersheds critical for riparian and aquatic dependent species. Riparian connections include floodplains, wetlands, upslope areas, headwater tributaries, and intact refugia. Currently, Riparian Reserves are predominately in early to mid-seral stage consequently fragmenting the late-seral connectivity needed for healthy riparian and aquatic habitats. This condition is due to past harvest management including fires resulting from escaped slash burns.

An opportunity exists to restore late-seral components such as large, multi-species trees, multi-canopies, and future coarse wood by thinning overstory trees, inter-planting with shade tolerant species, and creating or maintaining down logs and snags. This opportunity is particularly helpful in Units 8, 9, 10, and 12 where about a mile and a half of Riparian Reserves connect the Canyon Creek with Lower Big Rock Creek.

This issue is addressed by enhancing late-seral components of riparian areas through the thinning prescription, while protecting the sediment filtering and shade providing function of non-disturbed stream adjacent riparian areas by setting stream adjacent no-cut buffers. One site potential tree height no-cut buffer (210 feet) immediately adjacent to Fly Creek would preserve all shade to the perennial stream. A one site potential tree height no-cut buffer immediately adjacent to the one wetland in Unit 10 would avoid any changes to the water table supporting the wetland. A 100-foot no-cut buffer for the stream that drains the wetland in Unit 10 would protect the stream and the remnant old-growth trees in this area. All other no-cut buffers are 60 feet which avoid disruption to the well vegetated stream adjacent slopes capturing any sediment movement created by thinning of trees within the Riparian Reserve and minimize changes to air temperatures and humidity levels in the stream adjacent areas.

Issue 2: Roads delivering sediment and increasing the stream network.
Road construction and use deliver sediment to streams and can negatively affect aquatic habitat. Currently, the sub-basins in Canyon Creek have high road densities. Most of the temporary road construction proposed for this project involves flat, ridge oriented roads with little risk of soil displacement, reduction of soil infiltration, sediment delivery to streams or concentration of water. Construction of one temporary spur road in Unit 12 would deliver sediment to a perennial stream. Project design requirements and Best Management Practices including decommissioning this temporary road after use would minimize the quantity of sediment reaching the perennial stream and eliminate the concentration of water from the road.

One road that would be used as a haul route from Unit 17 is a chronic erosion source, introducing sediment to Fly Creek and increasing the stream network. Forest Road (FR) 4205522 is immediately adjacent to Fly Creek and constricts the channel resulting in steep eroding stream banks. Decommissioning this road would decrease the ongoing chronic road sediment delivery to Fly Creek and

would stabilize Fly Creek stream banks in a configuration that would allow vegetation to reestablish thereby reducing chronic bank sloughing and erosion.

The extension of Forest Road 5300607, which accesses Unit 12, is not a system road and has been treated as a temporary road even though it has been referred to as a system road along with the name "Burma Road". It lacks adequate drainage on steep sections and one stream crossing structure resulting in chronic erosion of the road surface, sediment delivery to an intermittent stream and contribution of increased stream network from concentrated surface flow in ditches. Decommissioning this road would decrease the ongoing chronic road sediment delivery to nearby streams that are tributaries to Canyon Creek.

Issue 3: Optimal thermal cover in deer and elk winter range, and elk and deer forage production. The biological winter range in the Merwin Reservoir and Yale fifth-field watersheds contains only 16 percent optimal thermal cover while the Forest Plan calls for maintaining 44 percent. There is an opportunity to accelerate the development of optimal thermal cover in units in winter range (units 6, 8, 9, 10, 11, 12, and 20) with heavier thinning prescriptions or by creating gaps, and under planting to promote a multi-story overstory canopy.

In addition, forage for elk and deer is declining in winter range as well as the rest of the analysis area due to timber growth in old harvest openings. Heavy thinning could be used to open areas enough to significantly increase forage production.

This issue is addressed through the variable density thinning prescription, and heavy thinning which would accelerate growth on the retained trees while promoting development of a second canopy layer and increased forage production.

Other Issues

There were no issues raised that the interdisciplinary team felt would lead to the development of a second action alternative. A list of the issues that would be addressed by the required standards and guidelines of the Forest Plan, project design features or mitigation measures is shown in Appendix B.

CHAPTER 2. ALTERNATIVES, INCLUDING THE PROPOSED ACTION

This chapter describes and compares the alternatives considered for the Canyon Timber Sale project. It includes a description and map of the action alternative considered. None of the issues raised during scoping was considered to be a significant issue, thus the issues raised did not drive development of action alternative other than the Proposed Action.

Alternatives

Alternative A—The Proposed Action

The Proposed Action reflects comments received during scoping that encouraged the use of variable density thinning. While wood production is a primary goal of Matrix lands, other values such as water, fish, dispersed recreation, and wildlife (LRMP, amendment 11, page 6-25) are also important. Variable density thinning can be used to increase tree vigor and long term volume growth, as well as maintaining and improving habitat values by increasing stand heterogeneity.

The Proposed Action would commercially thin 479 acres out of a total of 553 acres in twelve timber sale units.

General Forest – The proposed action would thin the trees, to accelerate conifer growth, within timber stands within the General Forest/Matrix allocation totaling approximately 393 acres. A variable density reduction thinning prescription (VDT) would be used to space the trees and accelerate the conifer growth rate. Specifically:

- Stands 2, 6, 11, 12, 14, 16, 17, and 20: Five percent of the upland acreages within these stands would be cut for "gaps". Gaps would be created openings (1/3 – 1/2 acre each) and well distributed. Temporary road prisms and log landings would count toward this goal. Five percent of the unit acreages would be retained for no-cut, leave areas. Riparian Reserve no-cut buffers and sensitive species buffers would count toward this goal. The exception being unit 12 which would retain approximately 30 acres (riparian and alder patch). The remaining acres would be thinned to an approximate Curtis RD34-47 (125-140 trees per acre).

- Stands 8, 9, and 10: Within Deer and Elk Winter Range, thirty to forty percent of the upland acreage within these stands would be thinned heavily to between an approximate Curtis RD25-34 (85 trees per acre) to provide a future mix of forage and cover that, over time, would maintain a level of deer and elk commensurate with other resource management goal and objectives. The heavy thinned areas would be located away from FR 5300, and distributed in the upland forested areas. Approximately 10 percent of the unit acreage would be retained for no-cut, leave areas. Riparian Reserve no-cut buffers and sensitive species buffers would count toward this goal. The remaining acres would be thinned to between an approximate Curtis RD31-43 (120-125 trees per acre). The primary goal of this entry is to reduce stocking levels to significantly increase growth rates of dominant and co-dominant trees and provide forage.

A component of down logs (120 linear feet/acre) would be created or maintained in all units, and snags (2.6 snags/acre) would be created in Units 2 and 12.

Riparian Reserves - The proposed action would commercially thin approximately 41 acres of timber stands within the riparian reserves. A density reduction thinning prescription would be used to space the trees and accelerate the conifer growth rate. Specifically:

Stands 3, 6, 8, 10, 12, 14, 16, 17, and 20: The thinning treatment (VDT) would reduce stand density to an approximate Curtis RD34-47 (125-140 trees per acre) on the treated acres within the Riparian Reserves. A 60-foot no-cut buffer would be required from all waterways, with the following exceptions: unit 17 (Fly Creek) which would receive a 210-foot (1 site potential tree height) no-cut buffer; Unit 10 where the wetland would also receive a 210-foot no-cut buffer, and the creek draining the wetland in the southwest part of the unit would receive a 100-foot no-cut buffer. Two (largest diameter) trees per acre would be "daylighted" within the Riparian Reserve treatment areas. All Douglas-fir trees within an 18-foot radius of the leave tree would be removed. The primary goal of this entry is to reduce stocking levels to significantly increase growth rates of dominant and co-dominant trees and interplant shade tolerant species. A component of down logs and snags would also be created or maintained on these acres. Shade tolerant conifers (western red cedar and western hemlock) would be planted on all treated riparian acres (38 acres). Vexar tubing, with 2 sticks, would be placed on the western red cedar seedlings (within one week after planting) to deter animal browsing.

Riparian reserve widths are expressed as the height of a site-potential tree which is the average maximum height of the tallest dominate tree at age 200 years for a given site class. The riparian reserve widths for the Canyon planning area are as follows:

- Fish bearing streams – two site potential trees or 420 feet.
- Perennial non-fish bearing – one site potential tree or 210 feet.
- Intermittent streams – one site potential tree or 210 feet.

Late Successional Reserve - The proposed action would commercially thin approximately 45 acres of timber stands within the Late-Successional Reserve. A variable density reduction thinning prescription (VDT) would be used to increase tree vigor and add stand level complexity (patchy understory development, large trees, and decadence) and protect key habitat and legacies features. Specifically:

Stand 3: Ten percent of the upland acreages within this stand would be cut for "gaps". Gaps would be created openings (1/3 – ½ acre each) and well distributed. Temporary road prisms would count toward this goal. Approximately 10 percent of the unit acreage would be retained for no-cut, leave areas. Riparian Reserve no-cut buffers would count toward this goal. The remaining acres would be thinned to an approximate Curtis RD47 (131 trees/acre). The entire unit, except the untreated retention islands, would be under planted, with shade tolerant conifer species.

A component of down logs (120 linear feet/acre) would be created or maintained, and snags (2.6 snags/acre) would be created

Slash Treatment – Tops, branches, and other slash generated by the activity would be left in the units and would not be piled, except for machine piling at the designated landing locations, within 50 feet of FR 5300 and 5700, and in isolated areas of heavy slash accumulation. The slash piles would be burned during a time of the year when damage to the soil would be minimized.

Road Decommissioning - Following timber harvest activities Forest Roads 4205522 and 5300607 would be decommissioned. Decommissioning would include removing culverts, pulling back the fill at stream crossings and stream-adjacent road sections to a stable slope, and decompacting the road bed.

Table 2-1. Summary of Proposed Action

Unit	Acres	Yarding Method	Normal Thinning (acres)	Heavy Thinning Deer/Elk (acres)	Gaps (acres)	Retention Islands outside RR (acres)	RR Thinning Treatment (acres)	RR no-cut Buffer (acres)
2	17	Ground	15	0	1	1	0	0
3	50	Ground	39	0	5	4	1	1
6	24	Sky/ Ground	16	0	1	0	3	4
8	36	Sky/ Ground	19	13	0	2	1	1
9	42	Ground	21	17	0	4	0	0
10	62	Ground	23	25	0	0	3	11
11	14	Ground	13	0	0	1	0	0
12	143	Sky Ground	79	0	7	2	27	28
14	52	Sky/ Ground	43	0	3	0	2	4
16	49	Sky/ Ground	43	0	2	1	1	2
17	48	Skyline	38	0	2	0	2	6
20	16	Skyline	12	0	1	1	1	1
Total	553		361	55	22	16	41	58

Table 2-2. Temporary road construction by unit.

Unit #	Action Alternative Temporary Road Length (ft)
3	3,168
6	800
9	300
10	800
12	4,224
16	1,056
Total	9,348

Prior to Timber harvest, culverts would be cleaned, replaced or added at 7 locations:
FR 4205522 at mile post 0.2 – replace 18" culvert with a 24" culvert
FR 4205522 at mile post 0.42 – clean existing culvert

FR 5300 at mile post 6.45 – place rip rap at culvert outlet
FR 5300 at mile post 5.95 – replace 18" culvert with a 36" culvert
FR 5700 at mile post 2.15 – replace rusted 18" culvert with a new 18" culvert
Place two 18" culverts on the temporary road in Unit 12. These would be removed when the temporary road is obliterated.

The following are design features of the proposed action. A complete list of project design criteria and mitigation measures can be found in Appendix A.

- A density reduction thinning prescription for the uplands would be used to space the trees and accelerate the conifer growth rate. The thinning treatment would reduce stand density to an average of 85 to 140 trees per acre.
- A riparian management zone, 420 feet on each side of perennial fish bearing streams and 210 feet on each side of non-fish-bearing perennial and intermittent streams, would be designated. Density reduction activities would be permitted within portions of the management zone. Cut trees would be directionally felled away from the streams. A 60-foot no-cut buffer would be implemented adjacent to all streams in the units except for the stream in the southwest part of Unit 10 which would receive a 100-foot no-cut buffer, Fly Creek at the base of Unit 17 which would receive a 210-foot no-cut buffer, and the wetland in Unit 10 which would also receive a 210-foot no-cut buffer.
- Remnant legacy features (snags and large down logs) would be preserved whenever possible. In identified areas devoid of these features, snags and coarse woody debris would be created.
- Hardwoods that exist within the units would not be cut, except if there are cases where hardwoods need to be removed in order to reuse an old landing or temporary road.
- Western hemlock, and/or western redcedar would be planted within the thinned riparian areas. Vexar tubing would be installed on the western redcedar to deter animal browsing.
- The location of the temporary road crossing with the perennial stream, associated clearing limits, location of temporary stream diversion point and location of downstream sediment trap in Unit 12 will be flagged on the ground prior to construction.
- All temporary road construction activities associated with the new 420 foot section of this temporary road, logging operations requiring the use of the new section and decommission activities of this same section in Unit 12 will occur between July 1 and September 30 of the same dry season.
- Place rock on road approaching temporary road crossing location in Unit 12 and construct temporary stream diversion, diverting all surface flow entering the construction area prior to installing the culvert.
- A downstream sediment trap will be constructed and made functional once the stream has been diverted out of the construction area and prior to culvert placement.
- Seed and mulch all disturbed areas with the exception of the road surface immediately after temporary road construction activities and prior to use by logging equipment in Unit 12.
- Temporary roads, including 5300607 would have all culverts removed, and temporary roads and log landings would be sub-soiled and grass seeded as needed following logging operations.
- An invasive weed prevention and treatment plan would be completed for the project.
- Skyline logging would require a slack pulling carriage for lateral yarding.
- All off-road heavy equipment used in the removal of logs would be cleaned to remove soil, seeds, vegetation matter or other debris that could contain noxious weeds.

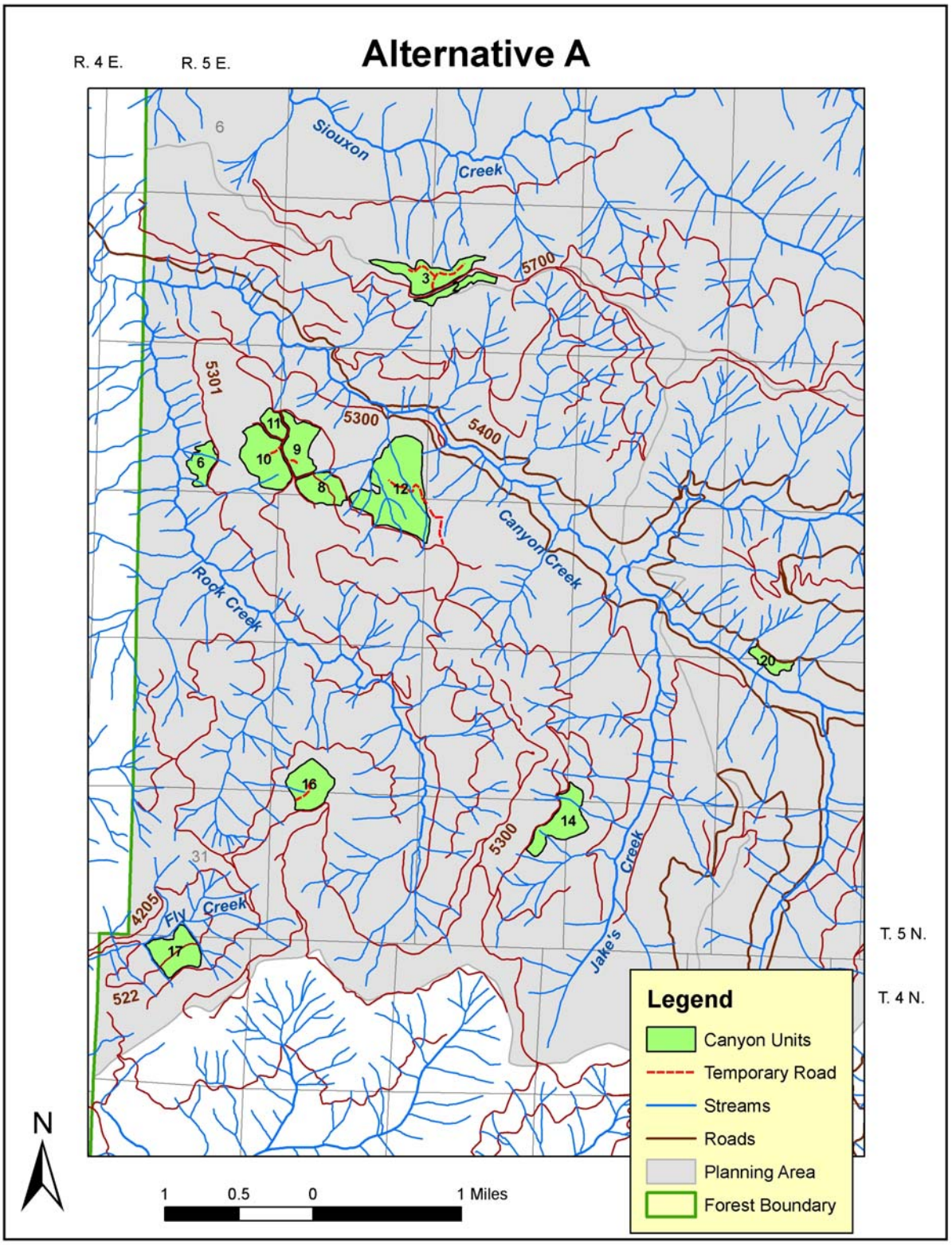

Figure 2-1. Alternative A – Proposed Action.

Alternative B—No Action

Alternative B is the No Action alternative. This alternative is included in accordance with the National Environmental Policy Act, (CFR 1502.14 (d)) and provides a baseline to evaluate the action alternatives. This alternative assumes that none of the proposed activities would occur, including: thinning treatments, riparian planting, construction of temporary roads, slash treatments, or road decommissioning activities.

The opportunity to restore and accelerate timber growth and yield in even-aged, dense stands, and to restore late-successional ecosystems in stands in Late-Successional Reserves and in Riparian Reserves, and for the continued production and utilization of forest resources within the Matrix allocation would be forgone at this time.

The opportunity to decommission FR 4205522 to reconnect aquatic habitat and reduce sedimentation in Fly Creek would be forgone at this time.

Alternatives Considered but Eliminated from Detailed Study

An alternative was proposed through scoping that would require the stands be thinned without construction or reconstruction of any temporary roads. After considering the proposed placement of temporary roads, and the Project Design Criteria and Best Management Practices that would be part of the Proposed Action, the interdisciplinary team concluded that the potential effects of a second action alternative that eliminated temporary roads would be nearly indistinguishable from the Proposed Action. In addition, if temporary roads were not built, alternative yarding systems, such as helicopter yarding would be required that would be economically infeasible. The proposed units that require temporary roads would have been dropped from the Alternative, thus not meeting the Purpose and Need to thin these stands.

There were no other issues raised through scoping that were sufficiently significant to drive the development of another action alternative.

CHAPTER 3. ENVIRONMENTAL CONSEQUENCES

This chapter describes the current environment in the project area. It also displays potential effects (direct/indirect, beneficial/adverse, and cumulative) on resources that could occur if either of the two alternatives described in Chapter 2 were implemented. By comparing current conditions of each issue to future conditions as altered by management activities, the decision-maker and interested persons can assess the benefits of the alternatives, evaluate trade-offs posed by the environmental consequences, and determine if the relevant issues and concerns have been adequately addressed.

This evaluation is based on data gathered by members of the interdisciplinary team between 2005 and 2006, data from silvicultural examinations and the Lower Lewis Watershed Analysis, as well as information provided by resource specialists and the public.

The application of all design features from Appendix A as well as standards and guidelines, and Best Management Practices is integral to the assessment of impacts.

Soils

The extent of detrimental soil conditions within units of the action alternative was analyzed within the project area. Quantitative analysis and professional judgment were used to evaluate *soil quality* in terms of the percent area in a detrimental condition. The term "*project area*" refers to the larger scale boundary surrounding all the units in the proposed action, also referred to as the "*planning area*." The terms "*activity area*" or simply "*units*" refer to the smaller, stand scale, individual units in the action alternatives, whether individually or collectively. Delineation of soils mapping is termed "*soil mapping units*" sometimes referred to as "*SMU.*"

Soil productivity affects growth rates of species through the physical, chemical, and biological components of the soil environment. These growth rates are more noticeable in a timber stand several years following changes in these components. Thus effects to *soil productivity* are more measurable in the long term. *Soil quality* is a better measure of short-term effects.

Soil quality is maintained when soil compaction, displacement, puddling, burning, erosion, loss of organic matter and altered soil moisture regimes are maintained within defined standards and guidelines. Under the action alternatives these standards and guidelines would be achieved in all activity areas.

Management Direction

The Gifford Pinchot National Forest Land and Resource Management Plan, Amendment 11 (Forest Plan), p. 2-58 to 2-62, requires losses in *soil productivity* be limited to 20 percent or less of the activity area. Site treatment practices and harvest methods, particularly the use of fire and pesticides, are to be modified to minimize soil and litter disturbance. "Soil Management Guidelines," as amended, would apply "unless on-the-ground assessment indicates a change in the guidelines is necessary." The Soil Management Guidelines cited are now the Gifford Pinchot National Forest Soil Resource Inventory (Wade, et. al., 1992).

Regional direction and clarification of terms is given in the Forest Service Manual, Chapter 2520, R-6 Supplement No. 2500.98-1. In the standard, "*activity area*" is the total area for which ground-disturbing

activity is planned and includes the transportation system, in and directly adjacent to, the activity area. The Northwest Forest Plan requires designating unstable and potentially unstable lands as Riparian Reserves.

Physiographic Setting

Landtype Association mapping stratifies the units into two distinct bands of soil temperature conditions. The following units of the Canyon Timber Sale are in a cold (cryic) soil temperature regime: Unit 16 and upslope parts of Units 2, 3 and 14 (Figure 3-1). The remaining units are in the relatively warmer, yet still cool (frigid) temperature regime. All of the *project area* is in a relatively moist/wet (udic) moisture regime.

LandType Association characterized the *project area* as colluvial soils derived from [Tertiary] "marine volcanics" on "steep, moderately [or slightly] dissected mountain slopes," and undergoing "soil creep, stream incision and dissection."

Current soils information for this project area was collected on a site-specific basis. Soils of the project area were mapped as part of the Soil Resource Inventory (Wade, et. al., 1992). This information is available at the Gifford Pinchot National Forest Headquarters.

Soils in the activity areas are suitable for timber harvest in alignment with timberland suitability classification (FSM 2415.2). Selected Soil Mapping Interpretations in Table 3-1 show the acres of the potentially unstable *soil mapping unit* 87 contained by timber sale unit 12. Note that tractor logging is not permitted by the Forest Plan (per the Soil Resource Inventory) on slopes greater than 30 percent except on a case-by-case basis when a soil scientist could determine that a given piece of machinery could operate on steeper slopes without damage to the soils.

Most of the soils in the activity areas (approximately 313 acres) are less than 3 feet deep, with a thin, gravelly, sandy loam layer over a thin layer of gravelly loam. These soils are found on gentle slopes (less than 30 percent), namely ridgetops and benches. Coarse rock fragment percentages affect soil characteristics such as water holding capacity, productivity, fertility and stability. Elevations range from 1,320 feet (Canyon Units 6 and 12) to 3,360 feet in Canyon Unit 16.

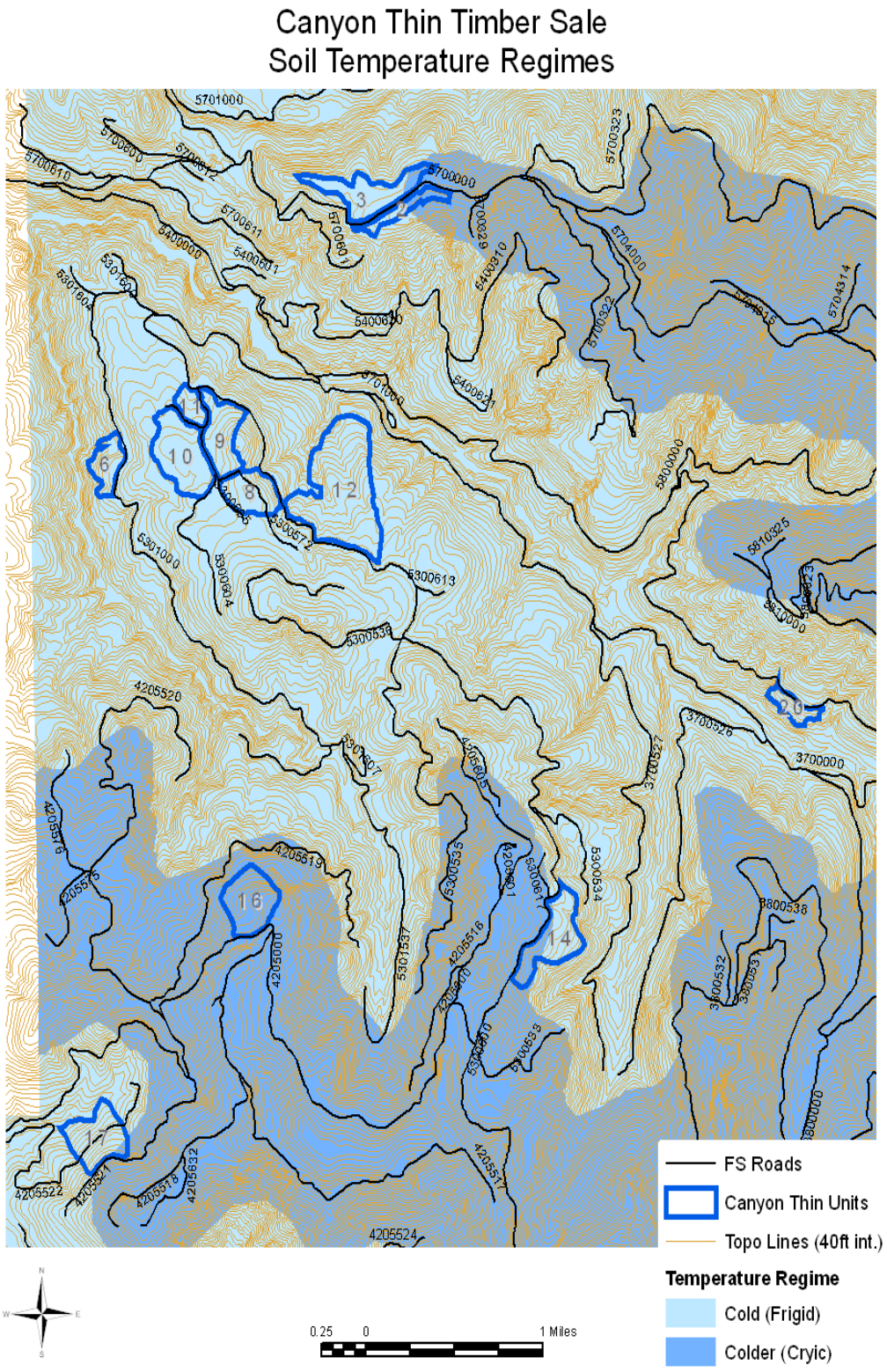

Figure 3-1. Soil temperature conditions of the Canyon Timber Sale planning area

Table 3-1. Selected soil mapping interpretations

				Slope Stability						
Soil Map Unit	**Acres**	**Landform**	**Fertility**	**Natural Stability**	**Expect to increase landslides**	**Surface Erosion**	**Displacement**	**Compaction**	**Regeneration**	**Tractor Logging**
3	1.6	Wet Meadows	Moderate	Very Stable	Unchanged	Slight	Low	**High**	Noncommercial Lands	N/A
21	12.1	Valley Bottoms, Toe-slopes	Moderate	Stable	Unchanged	Slight	Moderate	Moderate	Moderate	Permitted
81	62.2	Steep Side slopes	Low	Stable	Unchanged	Moderate	N/A	N/A	Low to Moderate	Not Permitted
82	8.4	Steep Dissected Side slopes	Low	Stable	Increased	Moderate	N/A	N/A	Low to Moderate	Not Permitted
83	42.8	Steep Side slopes	Moderate	Stable to Less Stable	Increased	Moderate	N/A	N/A	Moderate	Not Permitted
85	312.8	Ridge tops, Benches	Moderate	Very Stable to Stable	Unchanged	Moderate	Moderate	Moderate	Moderate	Permitted
87	18.5	Steep Dissected Side slopes	Moderate	**Unstable**	**Greatly Increased**	Moderate	N/A	N/A	Moderate to **High**	Not Permitted
88	5.8	Benches, Toe-slopes	Moderate	Stable	Unchanged	Moderate	Moderate	Moderate to **High**	Moderate	Permitted
8322	89.1	Steep Side-slopes	Moderate	Stable	Unchanged	Moderate	N/A	N/A	Moderate	Not Permitted

Existing Condition

After unit by unit analysis of terrain and topography, soil mapping units were changed to increase their accuracy at the project scale. Soils mapping is updated to reflect field observations and GIS analysis.

A concern for potential erosion exists if proposed actions do not allow for sufficient ground cover to remain on all the *soil mapping units*, except SMU 3 and 21, due to the Moderate rating for Surface Soil Erosion Potential (Table 3-1). The rating for Surface Soil Erosion Potential is based on the important assumption that all vegetative cover, including litter, is removed. Evaluations of climate, slope gradient, slope length, soil characteristics, hydrologic characteristics of the soil, and bedrock materials are considered in this rating.

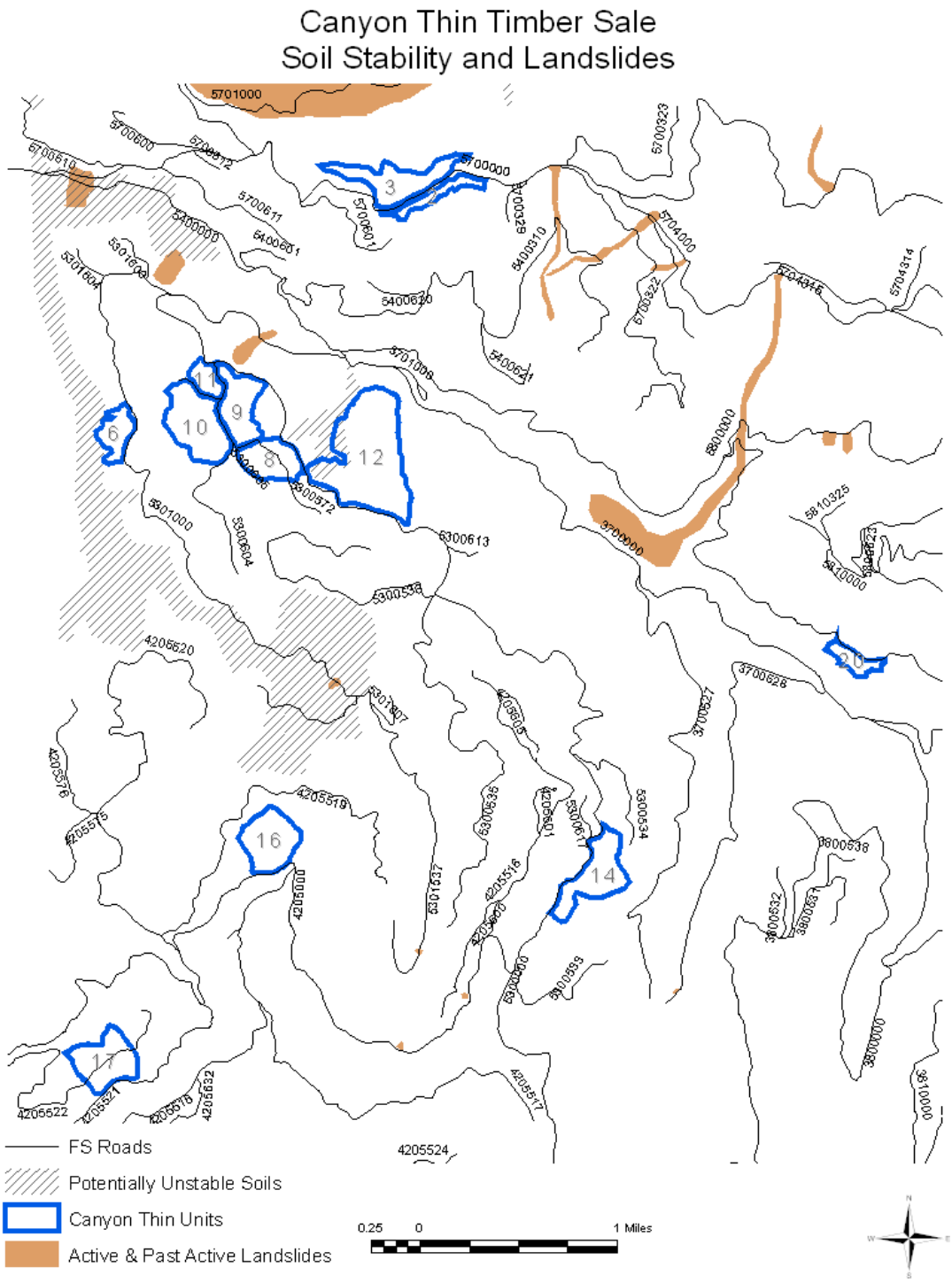

Figure 3-2. Landslides and soil stability of the Canyon Timber Sale planning area

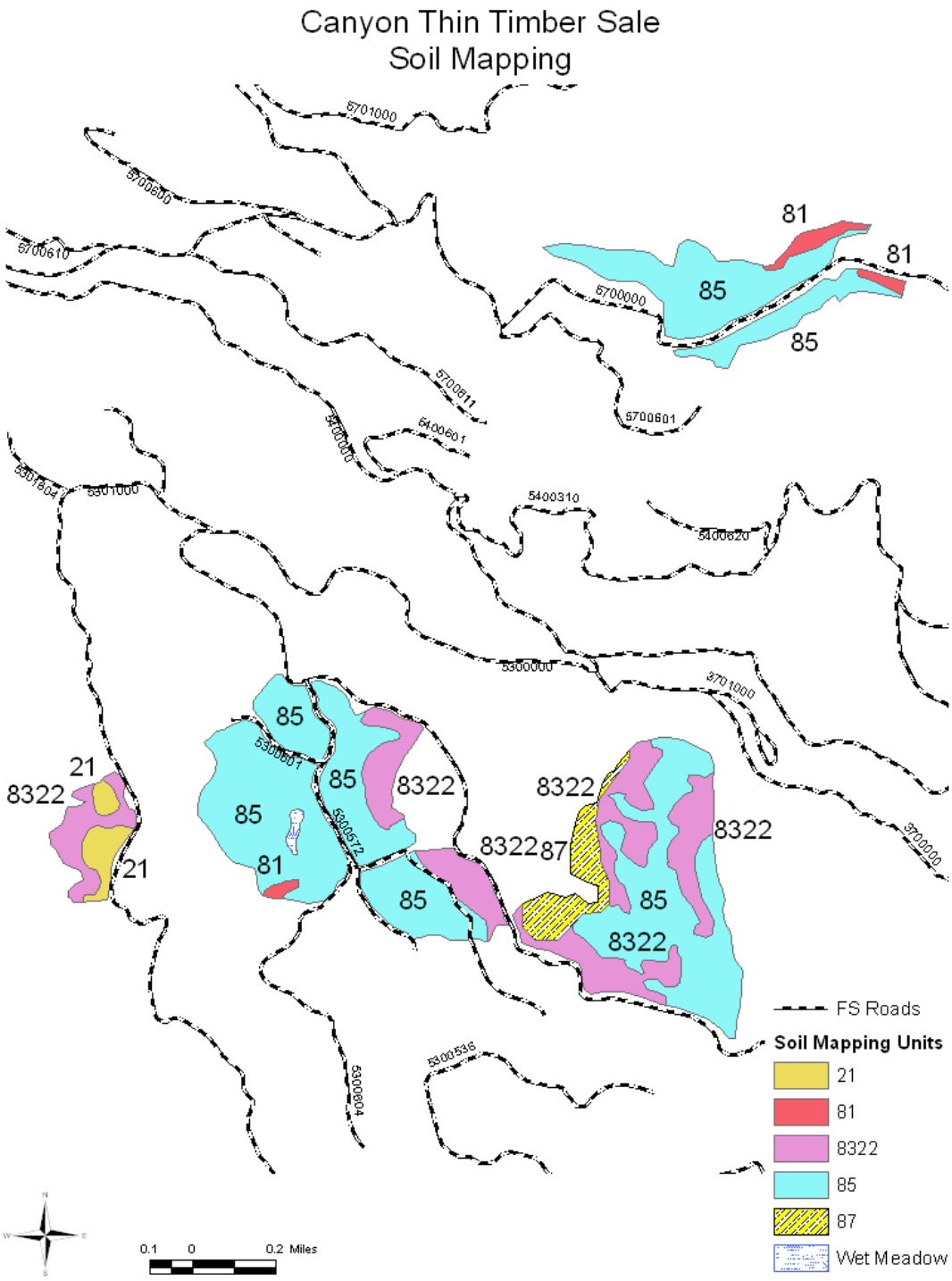

Figure 3-3. Soil mapping of Canyon Timber Sale Units 2, 3, 6, 8, 9, 10, 11, and 12

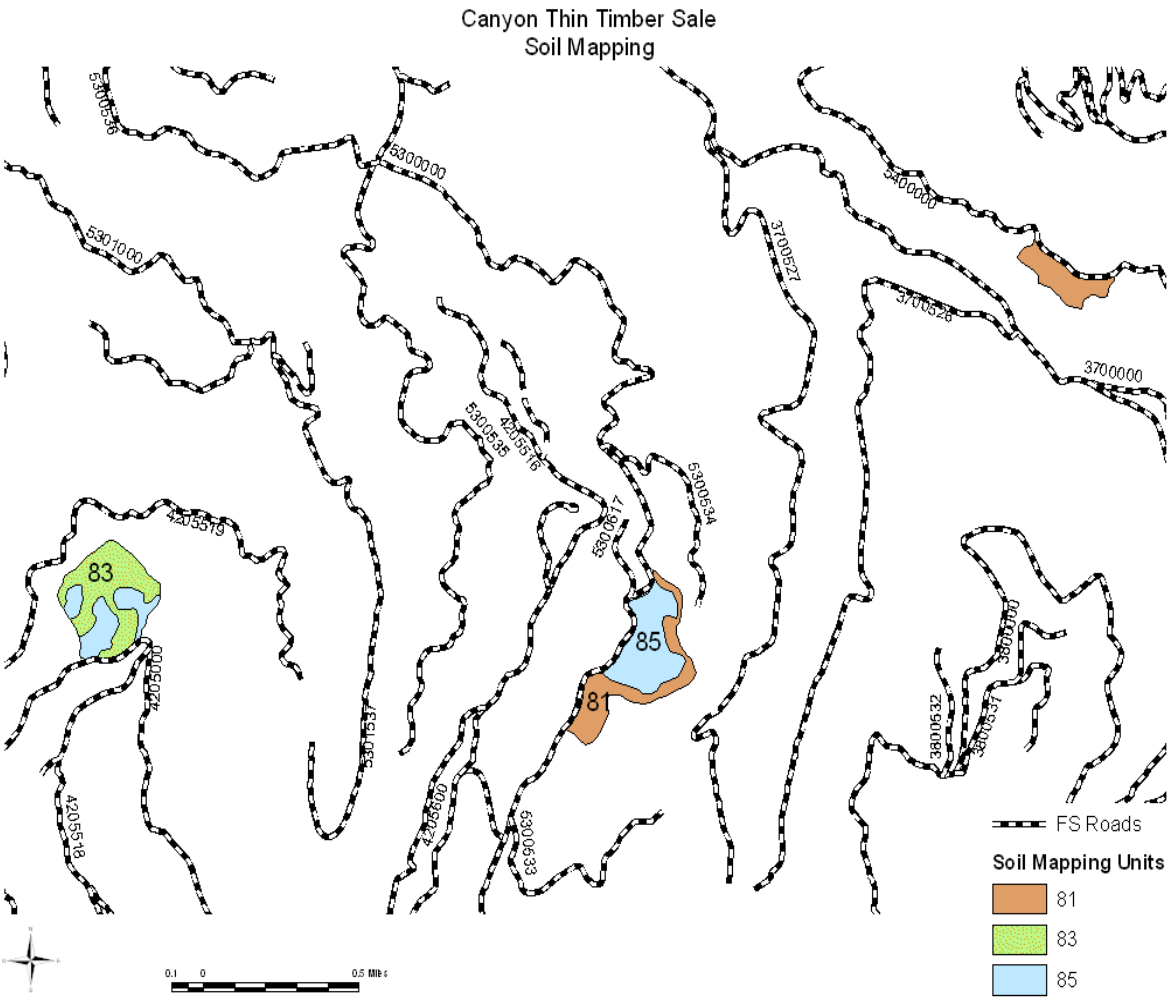

Figure 3-4. Soil mapping of Canyon Timber Sale Units 14, 16, and 20

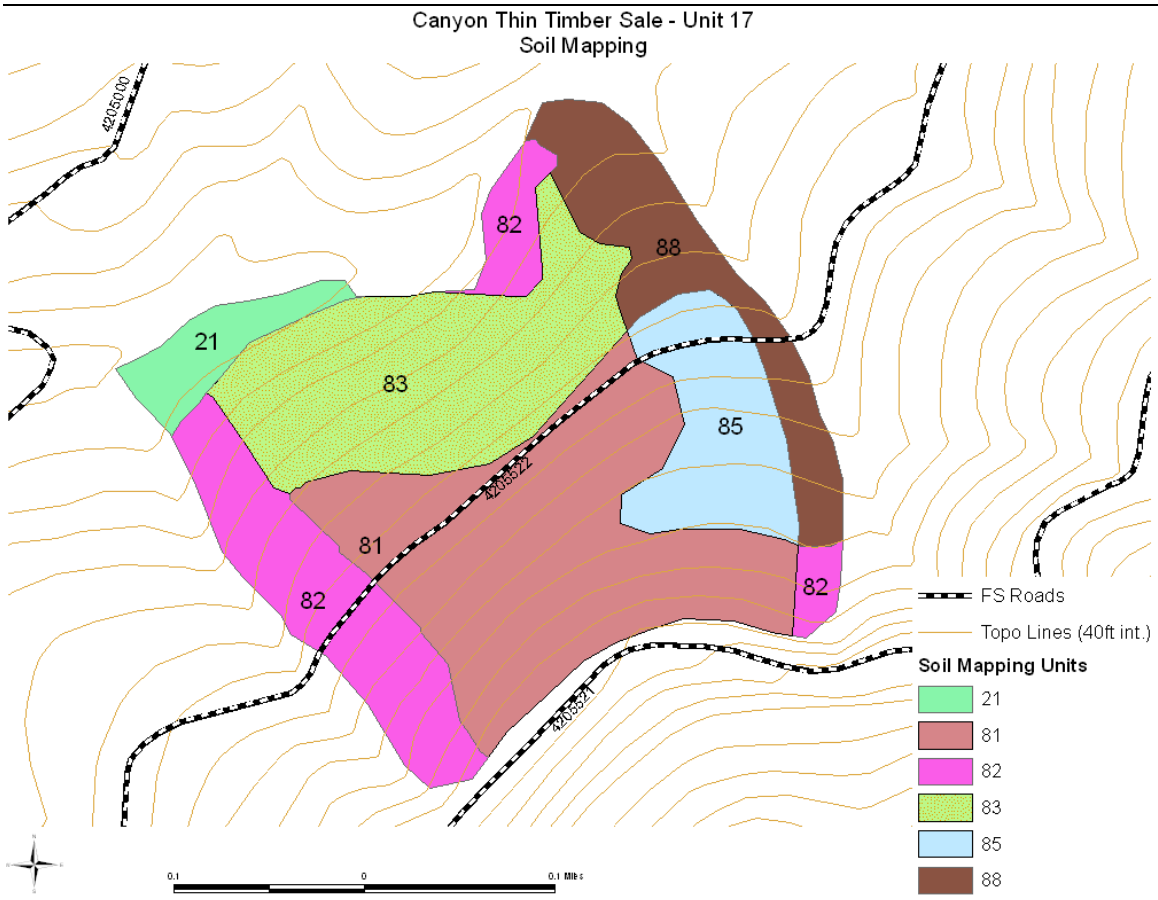

Figure 3-5. Soil mapping of Canyon Timber Sale Unit 17

Although the soil mapping of Canyon Unit 17 is complex, it can be partially explained by the different landforms it occupies (Table 3-1), and the differences in soil depth between the map units. Soil Map Units 21, 83, 87, 88, and 8322 are soils greater than 3 feet deep. Soil Map Units 81, 82, and 85 are less than 3 feet deep.

Soil Productivity

Timber Harvest

Evidence of ground-based timber harvest activities exists within the unit boundaries. Thus, soils in the project area have been converted to an essentially non-productive condition in the long term (greater than fifty years), where detrimental soil conditions exist. A detrimental soil condition occurs when site productivity and hydrologic function are adversely affected by any of the following disturbance activities: soil displacement, compaction, soil puddling, severe burning and accelerated erosion.

Soil displacement is the lateral movement of topsoil by mechanical forces such as equipment blades, vehicle traffic, or logs being yarded. Mixing of surface soil layers by disking, chopping, or bedding operation, are not considered displacement.

Landings and old non-system roads occupy between 0 and approximately 3.9 percent of the *activity areas* (Table 3-2). All of the proposed harvest units have less than 12 percent detrimental soil conditions. Representative samples of each proposed unit were visited on the ground to evaluate compacted skid

trails and landings. To be consistent, landings were calculated at a quarter acre, and roads at 30 feet wide, unless more accurate data was available.

Roads
System roads convert productive soils to an essentially non-productive condition in the long term (greater than fifty years). Most of the precipitation that falls on the compacted surfaces becomes surface runoff. National Forest system roads currently occupy between approximately 1.6 and 8.2 percent of the activity areas (Table 3-2). System roads were estimated using GIS analysis and include roads within and adjacent to each unit boundary.

Table 3-2. Approximate extent of detrimental soil conditions currently in Canyon Timber Sale units - existing condition

Canyon Unit	System roads, (%)[1],	Non-system Roads and trails (%)	Landings (%)[2]	Total detrimental soil conditions (%)
2	7.1%	3.5%	1.5%	12.0%
3	2.5%			2.5%
6	4.2%	1.5	1.0%	6.8%
8	8.2%	0.9%	0.7%	9.8%
9	5.5%	0.8%	1.2%	7.5%
10	2.4%	0.6%		3.0%
11	7.7%			7.7%
12	1.8%	2.7%	0.2%	4.7%
14	4.4%	3.9%		8.3%
16	1.6%		0.5%	2.2%
17	4.2%			4.2%
20	6.8%			6.8%

Fire Disturbance
Wildfires may have caused a loss in *soil productivity* in some of the activity areas. The Gifford Pinchot NF GIS layer "gpburn" shows Units 2 and 3 of the proposed actions within a historically large burn area (Siouxon Burn). Unit 17 is in close proximity to one of the polygons delineated out of the East Fork Lewis River, which means there's a possible impact from the Yacolt Burn and associated fires there. Another possible impact could be from Civilian Conservation Corps-era snag felling and related activities to reduce fire hazards.

There is no evidence that soil fertility (Table 3-1) is outside the norm for the *soil mapping units* as they are currently delineated.

Soil Organisms/Biology
Soil biological processes are important to nutrient cycling and maintenance of soil structure. Organic matter and topsoil removal has a potential for reducing soil nitrogen and mycorrhizae. Knowledge of specific fungal, bacterial, and arthropod populations is not available for analysis in this project.

[1] Assuming a 30 foot (9.1m) road width. Where two units a alongside system road, the acreage was divided between them.
[2] Assuming landings are a quarter acre (18m radius), unless a better measure is available.

Biological Soil Crusts

Biological soil crusts are living communities of cyanobacteria, algae, mosses, liverworts and/or lichens growing on the soil surface and binding it together. They may be important in carbon and nitrogen fixation and in determining water infiltration rates. Commonly found in arid or semi-arid environments (USDA 1997) they are not known to exist in the activity areas.

Slope Stability

Soil mapping identifies potentially unstable slopes on Canyon Harvest Unit 12, which is mapped with soil mapping unit 87 in the Soil Resource Inventory (Figure 3-2, Wade, et. al., 1992). Field investigations found no actively moving landslides in the unit. However, it would be classified as a High Risk in the Soil Resource Inventory mapping for mass movement potential. The document titled NEPA Assistance for the Soil Resource (Wade and High 1992) recommends no roads should be built in these areas. If roads are built however, the process would involve Geotech analysis and careful road design.

Unit 6

The western boundary of Canyon Unit 6 is upslope and adjacent to soils mapped as potentially unstable (SMU 8387). Although the proposed action would not occur on unstable soils, their downslope position means there is a slight potential for off-site change in groundwater conditions that affect soil stability.

Unit 12

Hydrologist input and field visits suggest the steep stream banks on the western parts of Canyon Unit 12 (mapped as SMU 87) were formed from past mass movement activity. The features in that part of the unit suggesting mass movement has occurred are steep (bare in some places) scarps and small slumps in the riparian areas.

Summary of Existing Condition

Ground-based timber harvest has altered soil properties and decreased *soil productivity* in the planning area. Much of the soil disturbance between skid trails and away from landings has decreased over time, but *soil quality* was reduced where ground-based skidding operations displaced organic surface layers or caused deep compaction.

Detrimental conditions are limited to less than 20 percent of the activity area, and so are within Forest Plan standards for soils.

Environmental Consequences

Issue: Soil Productivity

The degree or intensity of *soil productivity* losses is variable depending on the nature of the impacting mechanism. Losses to *soil productivity* associated with permanent features of the transportation system, including system roads, are essentially permanent. Restoration by subsoiling, fertilization, and revegetation would initiate recovery of productivity, but is unlikely to return the soil to its original condition and productivity.

Under the action alternative, the standards and guidelines for soils would be achieved in all activity areas.

Alternative A

The proposed action would thin the trees within timber stands totaling 393 acres within the General Forest/Matrix allocation and approximately 45 acres within the Late-Successional Reserve.

Direct and Indirect Effects– Locally Concentrated Losses

Changes in *soil productivity* are a function of the type, timing, and location of disturbances. These changes vary depending on soil properties in the disturbed areas. Direct effects due to soil disturbing activity occur on site and affect only the area where they occur. Off-site effects, such as sedimentation to streams, occur some time after or some distance away from the disturbance.

Potential effects of the proposed activities on *soil productivity* are due to compaction, puddling, displacement, erosion, severe burning and loss of soil organic matter. Irretrievable losses in *soil productivity* due to soil disturbing activities are limited to permanent features of the transportation system including National Forest system roads, and non-system roads, that are not subsoiled because they are not part of the proposed action.

Detrimental soil conditions would remain less than 20 percent of the project units, including existing skid trails, as required by the Forests Plan. Locally concentrated losses in *soil quality* would occur due to additional compaction and displacement. The extent of soil disturbance to areas previously undisturbed is expected to be less than 2.3 percent of any activity area with the prescribed logging system design (Table 3-3).

Fuels Treatment
Severe burning is not analyzed as an effect on soils on landings because of the overriding impact of the landing construction and associated use, especially since the large burn piles would occur on landings. Therefore consideration or calculations of soil disturbance due to burning do not include piling or burning slash on landings.

Slash burning is not a real concern because the extent of burning in the activity areas would be relatively small. Estimates of pile sizes for machine piles are less than 0.2 percent of each activity area (Harm 2003). The distribution of these piles would be spread out across the units, which further reduces the threat of a negative impact. Effects of slash burning on soils would likely be insignificant.

Soil Compaction
The moderate risk of compaction rated by the *soil mapping unit*s would be mitigated by the prescribed Constraints and Mitigation Measures (Appendix A), which would restore all temporary roads and landings in the proposed action alternatives. Existing landings and skid trails that are not restored would likely remain in a detrimental condition for the long term. Temporary road and landings can be restored to accelerate their recovery and reduce losses in *soil productivity*.

Road decommissioning
Road decommissioning is taken into account because of the restoration of compacted soil conditions on the road surface, i.e. subsoiling and seeding. Only the road decommissioning that would affect the compaction of soils within or adjacent to the units of the proposed actions is considered in this report.

Table 3-3. Prediction of remaining detrimental conditions of proposed road and landing construction (See Canyon Timber Sale Soils Report, Appendix B: Calculations and Assumptions in the Analysis File.)

	Alternative A (%)	No Action, Alternative B (%)
New construction, roads & landings (range of %, each unit)	0 to 2.3 %	0%
Cumulative Disturbance without mitigation measures	3 to 12 %, 31.6 acres total	2.2 to 12 %, 29.8 acres total
Predicted compaction post-mitigation measures	Net decrease of 2.2 acres of compacted soils after road decommissions, 29.4 acres total	Same as existing condition, 29.8 acres total

Up to approximately 2.3 percent of the activity areas would involve disturbance of fresh soils for Alternative A and 0 percent for Alternative B. As stated in the Forest Plan, all permanent roads adjacent to the unit boundaries count toward the detrimental acreage and the amount of area left in a detrimental condition.

The percent area to be affected was calculated based on the proposed action. Mitigation measures would rehabilitate compaction due to construction and use of temporary roads in all proposed activities. Therefore, no net loss in *soil productivity* is predicted in any of the units. The detrimental conditions listed include both the new and existing roads and landings.

In general, the short term losses in *soil quality* would be relatively low to moderate in intensity, and the losses would lessen with time (Table 3-4). This could translate to similar effects on *soil productivity*; however the prescribed Constraints and Mitigation Measures would ameliorate the damage and allow a relatively rapid recovery in the long term.

Table 3-4. Magnitude, Duration and Intensity of Losses to Soil Quality or Soil Productivity

Duration	Intensity of Soil Productivity Loss	Magnitude (Extent)
Short term	Low to Moderate; Canyon Units 3, 6, 10, 12 and 16	Relatively small, less than 2.3 percent of unit area
Short term	None; Canyon Units 2, 8, 11, 14, 17 and 20	N/A
Long term, more than 50 years	Insignificant (not measurable) to Low	Relatively small

Long Term Effects - more than 50 years
Conditions in disturbed areas would have improved where restored by subsoiling, fertilization and revegetation. Logging slash is an important source of organic matter that supplies sites with nutrients and reduces the potential for surface erosion. Harvesting only the bole of trees does not greatly deplete nutrients, and losses tend to be associated with whole tree harvest and short rotations. Neither whole tree harvest nor short rotations would be employed in this sale. The intensity of losses was based on the interpretations made by the Soil Resource Inventory and professional judgment.

Canyon Harvest Units 2, 6, 8, 11, 14, 17 and 20
Ground-based equipment would work on previously disturbed roads and landings, therefore no risk for further detrimental soil conditions is expected.

Soil Organisms
Logging and site preparation can affect the numbers of species and abundance of soil organisms. Soil dwelling organisms are not specifically addressed by standards and guidelines at Forest or Regional levels, but the magnitude, duration and intensity of effects to soil dwelling organisms are likely to be similar to that of soil quality effects for Soil Productivity. Mitigation measures which protect soil productivity would also protect or benefit soil organisms and their habitat.

Soil compaction, lack of vegetation, or lack of plant litter covering the soil surface tends to reduce the number of soil arthropods (Soil Quality Institute, 2002). The proposed activities may change soil habitats and the food web, and alter *soil quality*, or the capacity of soil to perform its functions (Tugel, A.J., 2001, Chapter 2).

Some of these organisms, called mycorrhizae, have been shown to profoundly affect forest growth and productivity. Mycorrhizal fungi assist trees in absorbing water, nutrients and provide protection from pathogen attack. Soil compaction, loss of soil organic matter, and changes in vegetation can affect soil organisms and result in productivity loss.

Limiting the degree and extent of the effects listed above provides protection for the majority of the populations of soil organisms within the activity areas. These effects are assumed to be temporary and recover naturally, after restoration efforts like subsoiling and seeding/planting. Magnitude, duration and intensity of effects to soil dwelling organisms are likely to be similar to that of *soil quality* effects listed above in Table 3-4.

Long Term Effects- more than 50 years
Populations of soil dwelling organisms would have essentially recovered in the long term. Restoration by subsoiling, fertilization and revegetation, which was intended to accelerate recovery of *soil productivity*, would improve conditions in disturbed areas. The organisms then can re-colonize the disturbed areas when conditions become favorable.

Issue: Slope Stability – Mass Wasting
Figure 3-2 shows where potentially unstable slopes are delineated in the Soil Resource Inventory (Wade, et. al., 1992) in Canyon Units 6 and 12. Mass wasting, slope failure and landslide are terms used interchangeably, and all denote the same type of event that describes a mass of soil that has loosened from the hillslope and falls downhill. In general, the major factors that increase a risk of landslides are increased soil moisture and a lack of soil-binding roots. Timber harvest across a hillside has been shown to increase the loss of root strength approximately 3 to 9 years after the trees are harvested.

Alternative A
The proposed action would thin trees from an average of 283 trees per acre in Canyon Units 6 and 12 to an average of 125-140 trees per acre. The prescription would include 1/3 to 1/2 acre gaps in the upland treatments distributed throughout the stands. There would also be thinning in Riparian Reserves to an average of 145 trees per acre.

Temporary road construction in Unit 12 is designed to avoid potentially unstable slopes. Harvest of Unit 6 would require reusing about 800 feet of temporary road that was built when the unit was harvested originally. The temporary road is on relatively flat ground at the top of the unit, and it does not cross any streams. It is not completely revegetated and appears to be compacted as a result of the previous use.

Direct and Indirect Effects
The risk of increasing landslide frequency or magnitude in Units 6 and 12 is relatively low due to the nature of the prescription and the proposed activities. Thinning a stand rather than completely clearing

the trees (clear-cut) poses a relatively decreased risk from what the research on effects of timber harvest has shown. The magnitude of the period of low stability is lessened because the loss of root strength is lowered.

There would be no significant change in the rate, size, or number of mass failure events due to the proposed actions.

Unit 6:
Unit 6 is delineated alongside and upslope of a mapped potentially unstable soil type. The proposed activities would not occur on the unstable soil type, only upslope of it. A potential exists for an indirect effect of changing the amount of surface and groundwater reaching the potentially unstable soils from upslope ground disturbance changing groundwater movement or intercepting subsurface or groundwater as surface water. An increase in soil moisture could in turn increase the potential for landslides or debris flows during high precipitation events.

Several factors provide protection against high flows into the potentially unstable soils. The silvicultural prescription calls for a tree spacing that would leave enough live trees to continue providing cover and vegetation to the soil, and protect soil organic matter, which helps retain soil moisture. These factors would mitigate the concerns for unstable soils in the units due to tree removal.

The potential for an increase in the number of landslides or slope failure following harvest still exists, but is unlikely. There are currently no landslides known to have occurred in the unit or adjacent to its boundary.

Unit 12
Unit 12 is partly delineated in an area with signs of soil mapping unit 87, which is a potentially unstable soil type. A qualified, experienced Forest Service earth scientist identified unstable and potentially unstable land during field surveys. Features such as hummocky topography, leaning and twisted trees, bare scarps, sag ponds, pressure ridges and tension cracks are evidence of potential slope instability. Usually, slopes with two or more of these features are considered potentially unstable, although other factors such as the presence or absence of landslides in adjacent harvested areas are considered.

Effects of Alternative B
There would be no change in the rate, size, or number of mass wasting (slope failure) events in Alternative B.

Cumulative Effects
Cumulative effects on the soil resource include all past, present, and reasonably foreseeable actions that cause soil disturbance within the project area.

Table 3-5. Actions considered in soils cumulative effects analysis

Action	Description	Date
Past		
Salvage timber harvest on National Forest System Land	Extent of salvage harvest is unknown in the watershed.	1930s– 1990s
Reforestation efforts following catastrophic fires	Snag felling and salvage logging	1902 – 1955

Action	Description	Date
Present and/or Ongoing		
National Forest System roads	Construction and use of system roads on lands within the listed Sub-Basins.	Ongoing
Timber Sales	Temporary road and landing construction for the Crayon Timber Sale	Ongoing
Forest Trails	Management of forest trails including erosion work, route signing, and maintenance.	Ongoing
Future		
Other Silvicultural Treatments	Stand treatments adjacent to private lands that minimize the potential for fire to reach adjacent private lands.	None planned, only recommended (USDA 1996)
Road decommissioning	Removing roads from the transportation system and returning to stable configuration.	Decomm Road 4205.519 concurrent with Crayon Timber Sale

Past, Present, and Proposed Actions
The proposed activities (with incorporated design features), in combination with past or reasonably foreseeable future actions on nearby federal land and adjacent private land, are not likely to increase the amount of detrimental soil conditions that already exist. Soil disturbance from natural events and past management activity were described above. Roads represent the greatest amount of detrimental permanent soil damage.

None of the Crayon Timber Sale units, which is a recent timber sale in the analysis area, coincide with units of the proposed action. Areas of previous harvest that do coincide with Canyon harvest units are expected to decrease detrimental soil conditions by restoring re-used skid trails and landings according to Mitigation Measures which would result in improved soil productivity.

Relative to Alternative B (no action) in the Canyon Timber Sale, Alternative A would cumulatively improve soil productivity at the watershed scale, mostly due to the restoration activity that reduces soil compaction by temporary road restoration and road decommissioning. The combined effects of current disturbances and the proposed activities are addressed above. The amount of trees harvested and their distribution can reasonably be assumed to have a minimal change in the root strength across the potentially unstable soils in the stands. That is, the thinning is light enough that it would not significantly affect soil stability.

Foreseeable Activities
The action alternatives combined with all past, present, and reasonably foreseeable management activities would affect soil productivity and populations of soil dwelling organisms in the project area. Foreseeable activities in the project area include timber harvest, restoration activity, National Forest System road management and maintenance, and Forest trails management and maintenance. The combined effects of most future activities would cumulatively improve productivity of the soil, mostly because due to the restoration activity that reduces soil compaction by road decommissioning. Other activities would neither increase nor significantly decrease soil productivity or populations of soil dwelling organisms.

At the scale of the project area, the contribution of cumulative impacts by the Canyon Timber Sale would not be significant on soil productivity or the soil resource. Forest Service activities would meet standards and guidelines for maintaining soil productivity through proper implementation of management requirements and the prescribed mitigation measures.

Hydrology

Hydrologic background

The Canyon Timber Sale Analysis area includes three sixth-field hydrologic units (subwatersheds); Upper Canyon Creek, Lower Canyon Creek and Lower Siouxon Creek. The analysis area covers approximately 25,925 acres and generally ranges in elevation from 1,000 to 3,000 feet. Canyon Creek is presently designated as two subwatersheds, Upper Canyon Creek and Lower Canyon Creek based on the current version of the "Federal Standards for Delineation of Hydrologic Unit Boundaries" (version October 2004).

The Lower Lewis River Watershed Analysis (1996) divided drainage areas and called them sub-basins. The watershed analysis information would be used in this analysis and consequently, the terminology of sub-basin would be carried through into this specialist report even though the terminology and associated hydrologic unit size is inconsistent with the "Federal Standards for Delineation of Hydrologic Unit Boundaries" (version October 2004). For this analysis, the Canyon Creek Area would refer to all the area that drains into Canyon Creek above River Mile 8 plus the headwaters of Fly Creek (10 square miles).

Most of the activities of this timber sale analysis area are within Canyon Creek. Canyon Creek is considered a Class I fish bearing stream. Big Rock Creek and Jakes Creek are major tributaries to Canyon Creek in the Canyon Analysis area and also considered Class I fish bearing streams. Canyon Creek leaves the National Forest 8 miles upstream from where it drops into Merwin Lake. The lowest 1,000 feet of Canyon Creek has numerous waterfalls one of which is 18-20 feet high. This series of waterfalls is presumed to be the barrier to anadromous fish access.

Canyon Creek geology is predominately stable with limited unstable or potentially unstable areas. Mass wasting was not a predominant landscape disturbance in the Canyon Creek area. A few unstable and potentially unstable areas (57 Acres and 874 acres respectively) exist in Canyon Creek Area within Big Rock Creek and Canyon Creek drainage.

Parts of two units are located at the watershed break between Siouxon Creek and Canyon Creek. Siouxon Creek is considered a Class I fish bearing stream and is about 1 mile downslope from the units.

Disturbances shaping the landscape

Forest conditions change over time in response to disturbance processes. Historically, these processes included fire, flooding, mass wasting or insects and disease. Fire was one predominant disturbance process that affected the forest conditions in terms of the seral stage of a stand. The proportion of forest in various seral stages was approximated in the Regional Ecosystem Assessment Process Report (REAP) which estimated 45-68 percent in late-seral stage and 10-18 percent in early-seral stage within the Lewis River Sub-basin (USFS 1993).

Stand replacement fires historically occurred within Canyon Creek Area, although the Canyon Creek Area was not affected by the two extremely large most recent stand replacement burns that occurred in the early 1900s, the Yacolt burn (238,900 acres) to the east and south, and the Siouxon burn (24,320 acres) to the north and east. This Canyon Creek Area had two relatively smaller fires, the 1979 Ruth Fire (3.200 acres) and the 1985 West Point Fire (285 acres) both occurring along the north side of Canyon Creek.

The predominant disturbance for the past seventy years in the Canyon Creek area has been vegetation management. For this analysis it is estimated that over 50 percent of the entire area draining into Canyon

Creek has been harvested in the past 70 years. The Lower Lewis Watershed Analysis estimated a range of 53-64 percent harvested of the 4 sub-basins without nonfederal lands in Canyon Creek and suggested a much higher percentage in the sub-basins with nonfederal lands. The managed stands within federal lands in this analysis area were fully stocked after harvest.

Vegetation management has created a mosaic of small even-age patches of varying age with little structural diversity within them. Vegetation management pattern of small even-age patches is different than what would be expected from natural disturbances as large even aged areas would be expected from natural disturbances such as stand replacement fires.

Small patches of large tree multi-canopied stands are scattered throughout Canyon Creek and comprise only 9-24 percent of the area within the 4 sub-basins without non federal lands (USFS 1996). This pattern is presumed to be similar in the other sub-basins with non federal lands and is lower than historical levels estimated to be at least 45 pecent.

The small ridgetop area that drains into Siouxon Creek was affected by the Siouxon Burn, a large stand replacement burn and was managed about 50 years ago. This management is part of the 2 percent area federally managed in Lower Siouxon Creek Sub-basin. Much of the remainder of Siouxon Creek is comprised of closed pole/small tree seral stage (86%) resulting from the 1902 Siouxon Burn.

Peak flows influenced by past vegetation management

Past vegetation management and disturbances in Canyon Creek may have influenced basin hydrology in the past by increasing peak flows during fall and winter storms and decreasing summer low flows.

Peak flows for Canyon Creek sub-basins were modeled in the Lower Lewis River Watershed Analysis to determine where changes in vegetation were contributing to increased peak flows. Only one sub-basin flowing into Canyon Creek within forest lands, Sorehead Creek, indicated increased peak flows from vegetation management at greater than 10 percent and subsequently was considered to have a possibility of detrimental effects to Sorehead Creek. Increases in peak flow estimates are assumed to have declined since the analysis was conducted (analysis based on 1994 data), based on the fact that no regeneration harvest has occurred and existing stands have 10 years of growth, consequently increasing the hydrologic maturity of the stands within Sorehead Creek sub-basin.

Sorehead Creek is an erosion type channel, with steep gradients, and active downcutting. A debris torrent initiated by a road failure occurred along Sorehead Creek during the 1996 Flood. The detrimental effects of increased peak flows carrying additional sediment through Sorehead Creek into Canyon Creek mainstem has not resulted in unstable reaches within Canyon Creek as Canyon Creek is inherently stable, with most of the stream in a steeply confined bedrock/large boulder controlled canyon. Stream surveys in 1990 and 2005 described the stream as extremely stable with little evidence of scour or excessive deposition.

No sub-basins flowing into Siouxon Creek within forested lands indicated increased peak flows greater than 10 percent.

Peak Flows influenced by Road Drainage Network

Roads impede surface water infiltration, intercept subsurface flows, and provide a direct surface linkage for delivering water to stream channels. The road network can substantially increase the natural drainage density of a watershed as a result of these processes. Roads can also be significant sources of fine sediment in streams draining heavily roaded watersheds.

Canyon Creek area has high road densities within National Forest lands, ranging from 3.64 -5.23 miles/square mile of the sub-basins analyzed in the Lower Lewis Watershed Analysis. Road densities on private forest lands are often higher than those found on the National Forest, so it is possible that the road densities in the sub-basins with private lands are higher. Roads throughout the analysis area occupy a range of positions from following ridgelines to paralleling streams along valley bottoms, and crossing mid-slopes. All the sub-basins flowing into Canyon Creek except for Lower Big Rock Creek, road densities increased the length of stream miles by 40 percent or more.

The Lower Siouxon Creek Sub-basin has low road densities (2.56 miles/square mile) and consequently is not considered to have an increased stream network.

Roads can increase the total volume of water available for rapid transport to stream channels in two ways. Roads intercept precipitation, which results in overland flow over compacted surfaces – reducing infiltration rates. Secondly, shallow subsurface flow may be intercepted at road cut-banks and converted to rapid surface runoff. This process effectively increases drainage density in a watershed, which can result in increased peak flows (Wemple, et al. 1996).

Response reaches would be most sensitive to where any detrimental effects exist from past increased peak flow resulting from management activities and previous disturbances. Response reaches have low gradients and tend to be less confined. The mainstem of Canyon Creek is largely made up of transport reaches with moderate gradients that move water, wood and sediment relatively quickly. Canyon Creek transport reaches are generally stable resulting from the stable geology of the drainage and associated bedrock controlled stream configurations.

The 2005 Canyon Creek stream survey (after the major flood of 1996) characterized all the reaches with extremely stable configurations despite low levels of large wood. The stream survey did not document any conditions such as down cutting or excessive sediment accumulations that would indicate detrimental effects from past occurrences of increased peak flows. The 2000 Big Rock Creek stream survey characterized all reaches with stable banks and adequate large wood, an indication that past increases in peak flows from increased road network did not result in persistent channel instability.

Riparian Habitat influenced by past vegetation management

Similar to forest stands across the landscape, the natural disturbances that affect riparian stands are fire, flooding, mass wasting or insects and disease. The REAP report (1993) also estimated the proportion of riparian forests in late-seral condition historically ranged from 50-75 percent and 4-12 percent of the riparian forests were historically in early-seral conditions (REAP 1993). Under those conditions, riparian connectivity for plants and animals was largely intact because the riparian areas burned less frequently than drier upland forests (USFS 2002).

Connectivity

The predominant disturbance for the past seventy years in the Canyon Creek basin has been vegetation management. Currently, only about 12-32 percent of the riparian reserves in the sub-basins of the analysis area are in multi-layered large tree (late seral) stage, much lower than historical levels.

Currently 21-46 percent of the stream riparian areas are in early-successional stages (open or closed sapling/pole/small tree) as estimated from 1994 data. Twelve years of growth of these stands and limited thinning activity may have decreased these percentages since they were calculated, although not to the level that would have been expected due to a natural disturbance regime (less than 12% of an area). The fragmentation of riparian habitat has probably influenced the capacity of these riparian reserves to provide effective habitat and dispersal corridors between large habitat blocks, although the stream adjacent riparian habitat along the mainstem of Canyon Creek and Lower Big Rock Creek has been less affected.

The 2005 stream survey noted that no recent harvest units lay in the riparian area along Canyon Creek and that the riparian forest between the stream and road were large trees, multiple canopies with cedar as the dominant species. The lowest four miles of Big Rock Creek documented large or mature trees in the 2000 stream survey.

The predominant disturbance in Siouxon Creek was the 1902 Siouxon Burn and consequently, the riparian reserves lack multi-layered large tree stands.

Large wood

Only moderate levels of large wood exist along the mainstem of Canyon Creek and is attributed to low levels of recruitment potential into tributaries and large wood transport down through Canyon Creek during high flow events such as the 1995/1996 floods. Large wood was removed from tributary channels and adjacent riparian areas within Canyon Creek area during past logging operations. Some large wood was also removed from the mainstem during the early 1980s when all debris jams were mistakenly interpreted as fish migration barriers, although poor access to Canyon Creek probably limited this activity.

Big Rock Creek stream survey noted adequate levels of wood (62 pieces per mile) including large wood complexes.

The current recruitment potential of large wood from the riparian areas into the stream system is considered low due to past logging practices where large stands were converted to young stands, and due to the existing road system where roads block the movement of large wood through transport reaches into lower gradient reaches. All the sub-basins with the exception of Lower Big Rock Creek have low large wood recruitment potential due to the past streamside riparian harvest of 30 percent or greater. The current and future lack of large wood recruitment results in insufficient large wood to sustain physical complexity and stability and in particular to Canyon Creek limits the amount of smaller sediments such as spawning gravels to be retained or accumulate.

Lack of large wood recruitment due to the 1902 Siouxon Burn exists in all drainages of Siouxon Creek.

Stream Temperature

Water quality is generally good in Canyon Creek. Water temperatures during summer months represent the critical water quality parameter. Canyon Creek summer temperatures remain below the Washington State Department of Ecology temperature standard (16 degrees Celsius) as measured at two locations during 2001-2006 (Figure 3-6). Siouxon Creek water temperatures do not meet the state standard every year, which is attributed to the slow watershed wide recovery from the 1902 Siouxon Burn. The Regional Ecosystems Assessment Process Report estimated that historic maximum stream temperatures for the entire Lewis River watershed ranged between 14 and 19 degrees Celsius (USDA, 1993).

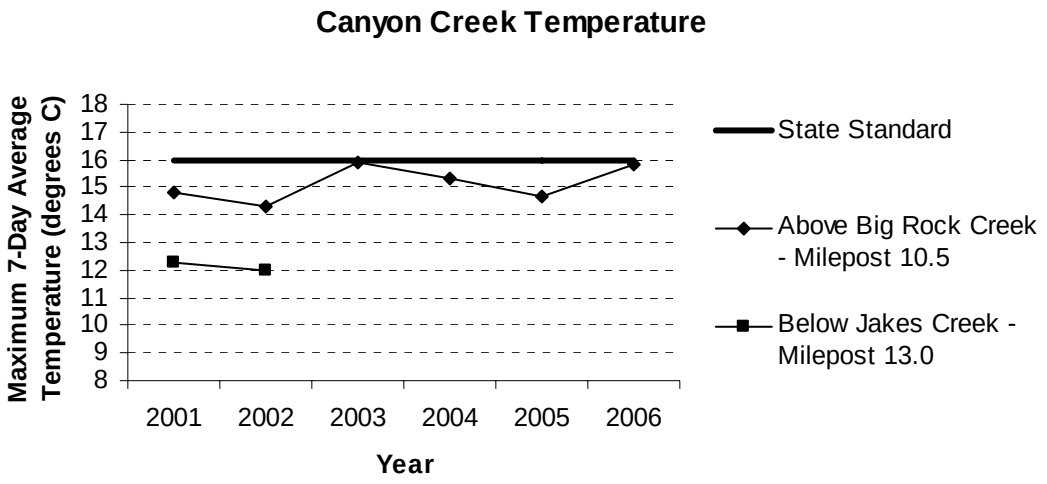

Figure 3-6. Water temperature of Canyon Creek from 2001 to 2006

Channel substrate and stability influenced from past road construction and logging

Erosion rates from roads contribute the most sediment to streams in a watershed. Principal mechanisms for sediment delivery to stream from roads in Canyon Creek are erosion from road surfaces and culvert failures resulting from blockages. The Lower Siouxon Creek sub-basin has few roads and consequently sediment delivery from roads is low.

Smaller sediments including sands and silts are believed to dominate the largest fraction of sediment delivered via road surfaces to steam channels. These smaller sized sediments are mobilized from road surfaces to streams during storms. Road traffic, particularly heavy truck traffic, increases the quantity of smaller sized sediments mobilized during wet conditions. Road drainage is delivered to streams through roadside ditches and culvert outlets.

Generally, most surface erosion from roads is transported to streams in the first two or three years after road construction. After this time, vegetation reestablishment on cut and fill slopes help alleviate surface erosion. Road use especially during the wet season continues to contribute sediment into future years although in lesser amounts than the first two or three years. Sediment from roads with little traffic that have been in place for more than five years generally contribute sediment to streams during flood events when fill slope failures directly or indirectly move large quantities of sediment into streams and culvert blockages and subsequent failures directly deliver sediment to streams.

Many road failures occurred within Canyon Creek during the 1996 Flood. Sediment from these road failures were delivered to Canyon Creek. The 2005 stream survey did not document excessive sediment accumulations due to the fact that the mainstem Canyon Creek has predominately transport reaches which would transport sediments downstream. Road failures were not identified within the Siouxon Creek Sub-basin after the 1996 flood. Sediment delivery from roads into Siouxon Creek was considered minimal as few roads exist within Siouxon Creek on National Forest Lands.

Soil disturbance occurs from logging activity. The past soil disturbance and erosion from historic logging operations have become revegetated and are not considered to be currently delivering sediment to

streams. More recent thinning activities have minimal soil disturbance with the implementation of specific project design and best management practices including designated untreated buffers and road rocking requirements.

Increased levels of sediment can adversely affect fish habitat and riparian ecosystems. Spawning gravels can be filled in by fine sediment, reducing survival of eggs and developing fish, food availability can be reduced and important habitat such as pools may be filled in by excess sediment.

Environmental Consequences

Erosion and Sediment Delivery

From Roads

Alternative A

No new permanent road construction would occur in Alternative A. Six units would have temporary roads constructed (Table 3-6). The temporary road in Unit 3 is considered a flat, ridge top roads, and does not cross intermittent streams or well-defined channels. The temporary road in unit 10 is located along a remnant road prism and crosses one ephemeral channel. Temporary road drainage can be accomplished by mimicking the terrain for both these roads. The temporary road in Unit 6 is located along a remnant road prism and does not cross any defined channels. Drainage can be accomplished by outlsloping this road. These temporary roads are not considered to contribute sediment to any stream. course.

Table 3-6. Temporary road length for each unit in the action alternative.

Unit #	Action Alternative Temporary Road Length (ft)
3	3,168
6	800
9	300
10	800
12	4,224
16	1,056
Total	9,348

The temporary road into Unit 9 would have a grade and cut into the hillside for a short distance. This temporary road would not cross any defined channels. It is considered to contribute a minor amount of sediment to the road drainage features of Forest Road 5300572. The temporary road in Unit 16 is located along a remnant road prism and crosses the headwaters of a defined ephemeral draw. Drainage can be accomplished by outsloping the road at this location. This road is considered to contribute a minor amount of sediment to the ephemeral draw. Sediment transport from the temporary roads in Unit 9 and 16 to a perennial stream may occur through time but not in a measurable amount.

The temporary road for Unit 12 is 0.8 mile long and would be located along the remnant road prism that was built when the unit was previously harvested in the early 1960s with one exception. One of the stream crossings would be moved 50 feet further up the creek to avoid reopening a road section that runs directly adjacent to the creek for 50 feet. This new crossing location and new road section would be located to join into the other section of existing road bed at a gentle grade necessitating a new road prism across the unit for 420 feet.

Sediment would be generated from the new road sections and use of the abandoned roadbed. Project design criteria and best management practices implemented in the construction and decommissioning of this temporary road would minimize the amount of erosion that occurs and therefore minimize the sediment delivered to the small perennial stream.

The amount of sediment in transport from road construction depends on many variables which make it difficult to quantify the amount of sediment eroding from any portion of the road.

New road construction generates 100 percent sediment delivery from any area that directly drains into a perennial stream. In the case of the new road and stream crossing, this length is considered to be 75 feet on both sides of the creek. Outside of the stream-adjacent 75 foot section, a 0 percent sediment delivery rate is assumed as the road drains directly onto well vegetated forest floor.

Decommissioning the road would reduce the sediment delivery from this section by routing sediment laden water away from the perennial stream onto the vegetated hillslope. Protecting exposed soils from the direct impact from rain with mulch would avoid transporting sediment.

Road decommissioning after vegetation has been established has the immediate benefit of reducing erosion and sediment delivery from roads and remediating increased peak flows caused by increased stream network from roads.

For a worse case analysis, it is assumed that for 75 feet of each side of the perennial stream, disturbed soils from the temporary road construction and decommission would be delivered directly to the stream. The quantity of sediment is estimated as shown below.

150 ft length * 15 feet wide = 2250 square feet * conversion factor to acres = 0.05 acres

Basic erosion rate of 20 tons per acre was selected from Washington Department of Natural Resources Basic Erosion Rate Table and assumed parent material of new road section was basalt and relatively unweathered rocks (WDNR, 1995). This erosion rate assumes a lack of project design criteria and best management practices which would minimize sediment delivery to streams. This rate represents erosion from bare road prism surfaces and assumes exposure of soil to rainfall.

0.05 acres * 20 tons/acre ~1.02 tons.

Design criteria for this new section of road would include:

- Locate road crossing at a 90 degree angle to the perennial stream
- Diverting all surface flow around stream crossing during installation of culvert
- Rock road surface on 75 feet of each side of culvert crossing
- Capture surface flow on the road section approaching the new road crossing from the east and route it away from this new road crossing by installing an 18” ditch relief culvert.

- The location of the temporary road crossing with the perennial stream, associated clearing limits, location of temporary stream diversion point and location of downstream sediment trap in Unit 12 will be flagged on the ground prior to construction.
- All temporary road construction activities associated with the new section of this temporary road, logging operations requiring the use of this new section and decommission activities of this same section in Unit 12 will occur between July 1 and September 30 of the same dry season.
- Place rock on road approaching temporary road crossing location and construct a temporary stream diversion to divert all surface flow entering the construction area in Unit 12 prior to the construction of the other stream crossing construction activities (culvert installation).
- A downstream sediment trap will be constructed after the stream has been diverted and made functional prior to the culvert installation.
- Culvert fill will be clean angular rock.
- Seed and mulch all disturbed areas with the exception of the road surface immediately after temporary road construction activities and prior to use by logging equipment in Unit 12.

These project design criteria and best management practices would substantially reduce the estimated erosion from rainfall on a bare road prism surface.

This new road section along with the entire length of this remnant road used in harvest activities would be decommissioned immediately following the completion of harvest activities and prior to the wet season to further reduce the amount of sediment delivery to the perennial stream. The decommissioning would include:

- Removing all culverts, and all culvert fill material placed during construction, recontouring the stream bank, mulching and revegetating with an erosion control mix.
- Installing cross drains to drain the road surface onto the forest floor.
- Removing all rock surfacing within 75 feet of all streams and pile rock within the nearest landing.

Effective implementation of project design, best management practices and the decommissioning would meet all the requirements within the Memorandum of Understanding with the Washington Department of Fish and Wildlife and eliminate at least 90 percent of the potential for sediment delivery from the areas where this is accomplished (professional opinion).

1.02 tons of sediment * 10% delivered = 0.10 tons * conversion factor to pounds = 200lbs.

Sediment delivered from the new section of road is approximately 200 pounds. This is a gross-modeled approximation of the measureable quantity of sediment delivered from construction of the new 420 foot road section to a perennial stream that would occur in the Lower Canyon Creek sub-basin.

The sediment delivered would move down in pulses through the perennial tributary through time and eventually be delivered into Canyon Creek in smaller quantities spread out through time. The smaller pulses of sediment delivered to Canyon Creek would be quickly transported through Canyon Creek into lower reaches off National Forest lands in quantities that could not be discernible from background sediment movement quantities.

Two roads would be decommissioned in the proposed action, FR 5300607 (0.2 miles) and FR 4205522 (1.9 miles). Forest Road 4205522 parallels Fly Creek for about a half mile constricting the stream configuration with resulting steep unstable stream banks. One of the two culvert crossings of Fly Creek are blocked with sediment. Both road decommissions would remove all culverts, recontour streambanks

to a stable configuration and revegetate all disturbed ground. Chronic sediment delivery from the surface and cut and fill slopes of the road, grossly estimated as 1.6 tons/year, (Canyon Timber Sale, Hydrology Report) along with the sediment from the half mile length of unstable and failing stream banks would be decreased as soon as the vegetation is established.

Alternative B
No temporary roads would be constructed and therefore no increased sediment delivery would occur. Forest Road 4205522 would not be decommissioned so sediment delivery from the stream adjacent road would continue. Forest Road 5300607 would be decommissioned as it is a Crayon Timber Sale Planned Activity.

From Logging
Alternative A
Harvest activities can disturb the soil when trees are felled, and moved through the stand to landings, and when landings are constructed.

Soil disturbance from one end suspension cable yarding occurs. Delivery of disturbed soil to streams is dependent upon proximity of the soil disturbance or erosion to the stream, slope angle, soil texture and whether overland flow occurs. The untreated buffers act to disrupt the movement of any soil disturbance by avoiding the creation of gullies from harvest techniques on or near stream adjacent slopes and providing a vegetated buffer to catch sediment particles.

Untreated buffers designed as one site potential tree height along Fly Creek and the wetlands (210 feet) and 60 feet along other streams would assure that sediment is not delivered to streams from harvest activity soil disturbance. The larger untreated buffer width assures any sediment movement is captured on the ground prior to reaching fish bearing streams, and in addition protects shade and microclimate conditions such as ground moisture, air temperature and humidity. Sediment delivery to streams from designed logging activities are not considered measurable.

Alternative B
No harvest activities or landing construction would occur and therefore no sediment delivery risk from these activities exists.

From Haul Routes
Alternative A
Sediment would be delivered from hauling activity during the dry season. In general, roads lacking surface rock, with steep grades and sideslopes and with stream crossings or in proximity to streams are the greatest sediment contributors from surface erosion. Timing of haul limited to dry months and to only dry periods of the early fall would reduce rates of sediment delivery to streams.

With this project, there is a high probability that sediment from the road surface would enter Canyon Creek, and the East Fork Lewis River and tributaries from haul traffic. The operating season for road reconstruction and maintenance work and for hauling logs has been limited to include only the months of June through September, with possible extensions into October and November if conditions remain dry. This is done to reduce the amount and duration of erosion that occurs from the road-related activities. Disturbance of the road surface both by construction-related activities and by hauling would generate sediment and dust, and some of this material would be transported to the aquatic system either during the time of disturbance or during subsequent periods of runoff.

Haul activities and road work occuring during the dry months with no unseasonable precipitation events, result in relatively low amount of material actually transported to streams during the period of haul and

maintenance or reconstruction. Replacement of stream culverts would require excavation of fill material over and around the existing pipe, removal of the pipe, and replacement with a new pipe and fill material.

Some direct excavation within the channel would need to occur to provide an adequate size and condition of the bed prior to laying new pipe.

Road reconstruction for this project involves two stream culvert replacements, both of which would likely be dry at the time of work. Culvert replacements have the potential for mobilizing and entraining some of this material in subsequent periods of increased runoff, particularly in the fall. These effects would be relatively short term pulses of sediment movement in affected streams.

Summer blading of the road surface, ditch cleaning, maintenance and reconstruction work and timber hauling would similarly create conditions that would allow increased erosion and sediment delivery to streams. Some sediment introduction would be expected during summer months from dust created by these activities and by subsequent vehicle traffic on newly treated roads. Most sediment delivery from road work and hauling during the dry months would occur later in the fall when precipitation and runoff levels increase. During the first significant runoff event of the fall, substantial flushing of sediments from road surfaces and roadside ditches into tributaries and surface channels that are connected to the stream would occur. Based on research conducted elsewhere in Washington State, turbidity and suspended sediment levels would climb rapidly as ditchflow begins to occur during the first fall freshet, but would then rapidly decline as roads and ditches are essentially cleaned by precipitation and runoff (Reid and Dunne 1984). Subsequent periods of traffic on the roads would cause additional sediment delivery.

Accurate sediment production and delivery estimates would require extensive information on road surfacing, drainage frequency, and distance between road drains and streams. Sediment production models described in the Washington Forest Practices Board Manual: Standard Methodology for Conducting Watershed Analysis (1995) provides a framework for estimating sediment production rates from roads and was used for estimating sediment production from hauling activities in the Canyon Timber Sale (Canyon Timber Sale Hydrology report, Appendix A). These estimates are considered coarse due to the limited data on specific conditions of the various roads. The results are primarily provided to allow comparisons of relative sediment production rates between alternatives. The sediment production model assumptions were: 1) roads have basaltic parent material, 2) cut and fillslopes are 50 percent vegetated for the haul roads in the East Fork and greater than 80 percent for the haul roads in Canyon Creek, 3) annual precipitation is 47 inches or more, and 4) log haul occurred over a six month period of which only light traffic was on the roads for the balance of the year.

About two-thirds of the sediment production from haul activities occurs within the Lower Canyon Sub-basin due to the fact that all but two of the units' haul routes include at least 7 miles of FR 5400 and seven of the eleven units' haul routes included use of FR 5300 and 3700 (Table 3-7.) No increase in sediment production rates from haul activities were estimated for Jakes Creek, Upper Big Rock Creek, and Middle Canyon sub-basins as haul activities were minimal and included predominately paved roads. Sediment production rates were not estimated for the Lower Big Rock Creek or the Lower Siouxon due to only one or no stream crossings for delivery mechanisms.

Table 3-7. Sediment production from haul activities.

Sub-basin	Sediment Production No Action Alternative (tons/year)	Sediment Production Action Alternative (tons/year)	Increase in Sediment Production from Haul Activities (tons/year)
Jakes Creek	0.3	0.3	No increase
Upper Big Rock	0.3	0.3	No increase
Lower Big Rock	0	0	NA
Middle Canyon	1.3	1.3	No increase
Lower Canyon	21.3	25.4	4.1
Fly Creek	4.4	6.0	1.6
Lower Siouxon	0	0	NA
Upper East Fork	5.7	6.6	0.9

This sediment production from haul routes leads to increases in turbidity and suspended sediment in receiving surface waters. Since most of the roads in the planning area have active inboard ditches, these channels form the avenue for routing this sediment to streams. Ditches are drained at some spacing along roads by either ditch relief culverts or live streams. Some portion of the ditch relief culverts do not deliver sediment to the stream system because they discharge to unchanneled slopes where water can infiltrate the ground surface and/or sediment can be filtered and dropped out of suspension. No measure of the number of culverts in this planning area that deliver to streams or that discharge to forested slopes exists, but it is likely that the proportion would change based on the intensity and duration of the runoff event (fewer culverts delivering sediment to streams during low intensity and short duration runoff).

Minimizing sediment delivery to streams from haul routes requires restriction of haul to occur predominately during the dry season (July 1-September 30), the period during which runoff is usually of low intensity and short duration. Haul during any extended period of dry weather into October and November would be limited to units with landings adjacent to system roads (Units 2, 6 and 20) and be contingent upon functioning haul route road drainage features and paved or rocked road surfaces withstanding rutting from haul use during October and November.

Suspended sediment concentrations in ditchflow have been measured at 500 to 7,000 mg/l and as high as 20,000 mg/l during active hauling in a study completed in the western Cascades of Washington State (Bilby 1985). Once ditchflow begins to occur, suspended sediment concentrations in receiving streams can increase by over an order of magnitude as a result of the introduction of turbid ditchflow water to the stream. Because this material is relatively fine grained, it can be held in suspension within the stream and transported relatively long distances in the steep channels within the analysis area. Because of the steep slopes and high gradient of streams in the analysis area, it is estimated that fines delivered to surface channels would remain in suspension and be delivered downstream to fish bearing reaches. As this material travels downstream, the concentrations are likely to decline at some unknown rate due to dilution from other contributing streams that are not impacted by the road runoff. In valley bottom streams that support a majority of the fish, turbidity and suspended sediment levels are likely to be lower due to the greater opportunity for significant dilution in those areas.

Increased levels of sediment can adversely affect fish habitat and aquatic ecosystems. Spawning gravels can be filled in by fine sediment, reducing survival of eggs and developing fish, food availability can be reduced and important habitat such as pools may be filled in by excess sediment. Any sediment delivered to Canyon Creek from its tributaries would be transported downstream and would not affect the spawning gravels or fill in pools as the reaches in Canyon Creek are predominately transport reaches. Wide,

downstream reaches with low gradients would temporarily retain find sediments although few accumulations of fine sediments exist due to the transport capacity of Canyon Creek down to the confluence with Merwin Lake. Similarly, and sediment delivered to the East Fork from its tributaries would be transported to response reaches downstream (off Forest). This sediment would be well distributed in smaller quantities among the response reaches of the lower East Fork Lewis River. The magnitude of this sediment delivery would be indistinguishable from natural sediment movement processes and other anthropogenic sources of sediment.

Alternative B
No hauling would occur from the no action Alternative B – No action and therefore no additional sediment production would be delivered to streams from hauling.

Cumulative Effects
Similar timber sale activities on National Forest lands that are occurring or have recently occurred or are presumed to occur within the same general timeframe as this timber sale proposal are in the Crayon Timber Sale, Divot Timber Sale and Tee Timber Sale.

Crayon Timber Sale includes 10 units with thinning prescriptions and 0.3 miles of temporary road construction all within the Canyon Creek Area. Three units had short (0.1 mile) flat, ridge top temporary roads constructed none of which were near or entered the riparian reserves and consequently cannot deliver sediment to streams. Best management practices such as directional felling. ground based machinery limited to slopes less than or equal to 30 percent, skid trail spacing, 10 foot limit on rutting from logging operations, and one end suspension in skyline yarding operations would limit the amount of soil disturbance from logging operations within units. Similar to this Canyon Timber Sale proposed action alternative, a 60 foot minimum stream adjacent buffers within the riparian reserve would not have log removal or equipment activity and consequently assures any sediment movement is captured on the ground prior to reaching any stream.

Weyerhaeuser managed a large tract of land immediately adjacent to Canyon Creek further downstream (to the west) of this analysis area. The regeneration unit reconstructed or constructed roads which are delivering sediment to Canyon Creek. This sediment would be quickly transported through Canyon Creek downstream into the uppermost part of Merwin Reservoir.

Any sediment delivered to the sub-basins contributing to Canyon Creek from the Canyon Timber Sale along with the Crayon, and private commercial harvest units are presumed to move through in small pulses through time and be in quantities that are too small to be discernible from background levels. The quantities, timing and transport rate are considered to be similar to the sediment regime under which aquatic ecosystems evolved.

The Crayon Timber Sale haul routes include routes through both Canyon Creek and the East Fork Lewis River. Road reconstruction for the Divot and Tee Timber Sale improved or would improve drainage features and road surfacing of the main haul route through the Upper East Fork Subwatershed. This would subsequently reduced the amount of fine sediment that would delivered from the road surface and ditches during haul of the Canyon Timber Sale, since the haul routes use the same roads as these previous sales. Nonetheless, some fine sediment was and would be generated in the East Fork Lewis Subwatershed from use of forest roads during haul activities of all three Timber Sales (Divot, Tee and Crayon) in addition to that generated from haul in Alternative A of Canyon Timber Sale. Sediment production from haul activities for the Canyon Timber Sale action alternative was estimated as an increase in 0.9 tons/year for the Upper East Fork Subwatershed.

Increased Peak Flows

From Stream Network Extension by Roads

Alternative A

Roads can substantially increase the natural drainage density of a watershed as a result of impeding surface infiltration, intercepting subsurface flows and providing a direct surface linkage for delivering water to stream channels. Increases in the natural drainage density in a watershed from roads are modeled by accounting for the extension of streams from roads and associated ditches.

Stream channel network extension estimates were based on a modification of methods described by Wemple et al. (1996). Drainage density is widely accepted as an index of drainage efficiency, and is defined as the sum of stream length ($\mathbf{L}_S$) over the drainage area (A):

$$D_d = (\sum \mathbf{L}_S) \div A$$

Wemple et al. proposed that roads modify drainage density by extending the total length of effective surface flow; in other words, extending the stream channel network. This stream channel network extension can be estimated by adding the length of road segments discharging runoff directly to stream channels, and by adding the length of newly eroded gullies located on hillslopes where channels did not previously exist. Unfortunately gully information was not available for this analysis, so a modified formula was used to represent the stream channel network extension in Canyon Creek, where $\mathbf{L}_{RC}$ represents the length of road segments discharging runoff directly to stream channels:

$$D'_d = [\sum (\mathbf{L}_S + \mathbf{L}_{RC})] \div A$$

An estimate of relief culvert frequency of 660 feet was applied based on professional judgment of existing average conditions. Fewer relief culverts have been observed on level 1 and 2 roads in Canyon Creek, which indicates that the estimated distance between relief culverts is less on roads that receive lower maintenance levels than higher maintenance roads.

Stream networks in Canyon Creek Area have been extended by the construction of road systems throughout past decades that capture and route water through surface channels into natural streams for each sub-basin in Canyon Creek (Table 3-8). The resulting "post-road" drainage density is a direct reflection of relationships among stream channel length, number of stream crossings, average distance between culverts and drainage area and account only for National Forest System Roads. Drainage network increases are considered minor in the Lower Siouxon Sub-basin due to low road densities. Road stream crossings were highest in the Lower Canyon Creek Sub-basin.

Table 3-8. Estimated drainage network increases within Canyon Creek Basin on National Forest lands only.

Sub-basin	Area (mi^2)	Drainage network length, miles		Drainage density, mi/mi^2		Percent increase
		Streams (L_S)	Road-related extension (L_{RC})	Streams (D_d)	Total (D'_d)	
Jakes Creek	3.8	16.2	22.2	4.2	5.8	37.0
Upper Big Rock Creek	4.5	26.5	36.8	5.9	8.2	38.7

Lower Big Rock Creek	4.0	22.0	25.5	5.5	6.4	15.9
Middle Canyon Creek	5.0	30.0	43.5	6.0	8.7	45.0
Lower Canyon Creek	7.1	43.6	59.1	6.1	8.3	35.6
Fly Creek	10.0	50.5	58.8	5.1	5.9	16.3
Lower Siouxon Creek	6.2	30.9	32.9	5.0	5.3	6.5
Total	40.6	219.7	278.7	5.4 (average)	6.8 (average)	25.8 (average)
Fly Creek with decommission	10.0	50.5	56.3	5.1	5.6	11.4

No permanent roads would be constructed in Alternative A so the drainage networks would not be increased or negatively affected in the long term.

Forest Road 4205522 (1.9 miles) and Forest Road 5300607(0.2 miles) would be decommissioned after harvest activities are completed in the proposed action. The elimination of 2.1 miles of road would reduce or eliminate any drainage network extension that is currently caused by these two roads. The decommissioning of Forest Road 4205522 would reduce stream network extension in Fly Creek sub-basin thereby lowering the drainage density from 16.3 to 11.4 percent increase to the stream network. The decrease of the stream network extension is a favorable effect to the aquatic ecosystem due to the lessening of increased peak flows resulting from roads and ditchlines.

Forest Road 5300607 would be decommissioned by the proposed action in the Crayon Timber Sale if the Canyon Timber Sale No Action Alternative is selected and therefore is not considered a benefit of Alternative A.

Approximately 1.75 miles of temporary road would be constructed in Alternative A. Some of the temporary roads are on ridges and would have little accumulation of upslope drainage. The probability of temporary roads increasing the drainage network density in the sub-basin is so low as to be discountable.

Temporary roads constructed for logging this sale that are not decommissioned prior to the wet season would be weatherproofed by construction of waterbars, crossdrains and grade breaks. This would ensure that surface waters do not concentrate on the road surface and contribute directly to increases in drainage network density during the period of use.

Alternative B
No temporary road construction of decommission would occur with Alternative B and therefore there would be no change to the existing condition.

From Thinning Units
Vegetation manipulation can affect hydrologic processes at the stand scale, including changes in 1) interception of precipitation, 2) evapotranspiration, 3) snow accumulation, and 4) rates and timing of snowmelt. These hydrologic changes can affect the amount and timing of water that is available for runoff from a site. The degree to which these stand scale changes are manifested as a change in water available for runoff is dependent upon a number of factors related to both the extent and intensity of the vegetation manipulation, and characteristics of the site and sub-basin.

Complete forest cover removal from an area can 1) increase rates of snow accumulation by eliminating the interception of snow by canopy cover, 2) increase rates of snow melt from exposure to wind and sun, and 3) reduce or eliminate the evapotranspiration process by which trees absorb water from the soil through their root systems and transpire the water through the tree leaves back into the atmosphere. At the stand scale, evapotranspiration has the effect of removing water from the site and allowing it to return to the atmosphere without ever appearing as runoff or streamflow. As forest cover is removed, the amount of water pumped from the soil and transpired is reduced, and increased levels of water can build up in the soil. The increased soil water levels can provide increased water to streams, which are particularly important during the summer months and at the onset of the fall and winter storm season. This stand-scale effect manifests as increased streamflow levels within a drainage during the growing season, and increased peak flows during early season runoff events.

The level of forest canopy removal that begins to affect runoff levels by changing rates of evapotranspiration or by changing the snow accumulation and snowmelt processes are not well known at this time. This is in part due to a lack of research in this area, but also because of the degree of variability in all of the relevant meteorologic, hydrologic and geologic/soils factors at the microscale. It is reasonable to consider that removal of a few trees from a fully mature forest stand would have little if any effect on snow accumulation at the stand scale, or on the factors that cause snowmelt. However, removal of most of the trees from a stand would clearly reduce the effectiveness of the forest canopy in intercepting falling snow, and on modifying the microclimate beneath the forest canopy. As increasing portions of the forest canopy are removed, transpiration rates would decline at some rate. The position of the stand within a watershed relative to prevailing wind patterns and storm tracks, as well as the elevation of the stand, and the relative density of its canopy in its current condition also influence the function of the forest canopy, and the potential effects of its removal. Any changes in hydrology at the site scale need to be translated to the stream before any detectable change in flow can occur, bringing in a host of additional variables in terms of water routing through the soil.

In the absence of research findings quantifying levels of change in snow accumulation, snowmelt, or evapotranspiration in thinned forests as compared to untreated forests, hydrologists on the Gifford Pinchot National Forest have used 40 percent as a breakpoint between stand conditions that are more reflective of a mature forest, and stand conditions that are more representative of open conditions. It is recognized that the actual change in snow accumulation and in snowmelt doesn't occur at a point, but occurs as a continuum of incremental changes in a number of parameters, but for purposes of evaluating proposed projects, the collective professional judgment of the hydrologists was used to establish a common reference point.

Canopy cover has not been determined for all units included in the Canyon proposed action, but visual observations suggest that the stands being treated often have higher canopy cover than the 60 percent watershed average and may be closer to an average of 70-80 percent (author's personal observation). Thinning prescriptions under the proposed action call for leaving 40-50 percent canopy closure on all treated stands, except for three units where where about 40 percent of each unit would be thinned to 30 percent closure to increase growth rates of dominant and co-dominant trees and provide forage for deer and elk (Table 2-1). These areas would predominately be located within the gentle sloping or flat areas in the Lower Big Rock Creek Sub-basin.

Thinning the forest to a canopy closure of 30 percent may have some effects on the amount of water available for runoff from these areas, but that potential runoff changes at the site scale would be moderated by 1) the fact that the areas are on gentle slopes draining into flat ground or on flat ground where relative slow rates of runoff and high rates of infiltration occur, 2) canopy cover characteristics of the other areas within the stand would remain above 40 percent maintaining the quantity and rate of

runoff, and 3) moderating influence of the wetland to increased flows in the creek at the outlet of the wetland. For these reasons, runoff rates are believed to not likely get translated into measureable changes in stream flows.

The proposed action includes a thinning treatment of 479 acres within the analysis area. This represents approximately 2 percent of the entire Canyon Creek Timber Sale Area. The range of percent area thinned was less than 1 to 5 percent in the Canyon Creek sub-basins (Table 3-9).

Table 3-9. Acres of treatment by sub-basin and percent sub-basin treated.

	Sub-basin acres	Thinning acres	% of Sub-basin
Jakes Creek	2459	49	2
Middle Canyon Creek	3175	15	< 1
Upper Big Rock Creek	2851	47	2
Lower Big Rock Creek	2555	72	3
Fly Creek	6378	42	1
Lower Canyon Creek	4562	220	5
Lower Siouxon Creek	3945	45	1

The proposed variable density prescriptions for all proposed units avoid decreasing stand canopy closure to the extent that would decrease the hydrologic maturity of the stand with the exception of Units 8,9 and 10 as mentioned above. The proposed treatments of the units are not considered to have a negative effect to the hydrologic maturity of the stand and the small proportion of the sub-basins treated suggest that no measurable change to base or peak flows from the thinning would occur.

In a sensitivity analysis conducted on subwatersheds in the Wind River watershed, approximately 5 percent of the vegetation in a drainage was modeled as being converted from mature forest stands to immature stands. This led to predicted increases in peak streamflows of approximately 1.5 percent (Mt Adams Hydrology Files). For each 5 percent of the drainage converted from full forest cover to open conditions, the predicted peak flows would increase by 1.5 percent. This analysis was done for stands at approximately the same elevations as are found in the Canyon analysis area, so results are presumed to be applicable to this analysis.

However, because the Canyon Timber Sale does not convert stands to an open condition, but leaves 40 percent canopy in most units and 30 percent on 55 acres, it is reasonable to assume that potential peak flow increases here would be less than those estimated in the Wind River, where stands were presumed to be clear-cut. Based on the fact that the maximum percentage of treated areas within a sub-basin is 5 percent and the treatment is thinning versus conversion from full forest cover to open conditions, the magnitude of any changes in peak flows resulting from the proposed thinning is estimated to be low and undetectable in the normal variation of streamflow levels found in these streams.

Alternative B
No change to the hydrologic maturity of any stands result in no change to the existing condition for peak flows.

Cumulative Effects
Vegetation manipulation can affect hydrologic processes at the stand scale, including changes in 1) interception of precipitation, 2) evapotranspiration, 3) snow accumulation, and 4) rates and timing of snowmelt. These hydrologic changes can affect the amount and timing of water that is available for

runoff from a site, and thus can cumulatively affect the magnitude and timing of streamflows. The degree to which these stand scale changes are manifested as a change in streamflow within a drainage is dependent upon a number of factors related to both the extent and intensity of the forest manipulation, and characteristics of the site and drainage.

Microclimatic characteristics at different locations and elevations of the watershed are fundamental to the types of precipitation and water input responses likely to be experienced. In addition, physical traits inherent to the watershed largely control the mechanics of water movement from hillslopes to the stream channels, and ultimately to the watershed outlet. Although these inherent characteristics of the watershed are of overriding importance to watershed processes and functioning, they can be influenced by land management activities including both vegetation management and road management.

Nearly the entire Canyon planning area is in the elevation band that commonly experiences a mix of rain and snow through the course of the winter. This band of elevations has been described as the Rain-on-Snow precipitation zone (Washington Forest Practices Board 1997). Openings in the forest canopy in these elevations can cause increased snow accumulation in the forest openings, and increased rates of snowmelt during rain-on-snow in those areas. As increased portions of a watershed are put into an open condition and as snow accumulations and rates of snowmelt increase in those openings, peak streamflows that are heavily influenced by rain-on-snow runoff can be increased (Harr 1981, Christner and Harr 1986, Jones and Grant 1996).

Removal of forest cover from an area can also influence the hydrology of the site by reducing or eliminating the evapotranspiration process by which trees absorb water from the soil through their root systems and transpire the water through the tree leaves back into the atmosphere. As forest cover is removed, the amount of water pumped from the soil and transpired is reduced. The increased soil water levels can provide increased water to streams, which are particularly important during the summer months and at the onset of the fall and winter storm season. At the drainage scale, this stand-scale effect manifests in increased streamflow levels within a drainage during the growing season, and increased peak flows during early season runoff events.

No new permanent roads would be constructed and all temporary roads would be decommissioned after use. Only one of the temporary roads is considered to contribute to increased stream network due to contribution of ditch flow and this road would decommissioned before the wet season. Implementation of this best management practice would prevent any increase stream network. Similarly, the Crayon Timber Sale temporary short ridge top roads were not considered to be able to increase the stream network.

Alternative A is not considered to change runoff rates to the extent that changes to stream flow could be measured. Cumulative effects from the timber sales on National Forest Lands are not likely measureably changing peak or base flows in Canyon Creek or its tributaries based on the degree of modification of the treated stands and the proportion of these subwatersheds in which canopies have been modified. Cumulative effects from timber sales on NF lands are considered to be maintaining timing, magnitude, duration and spatial distribution of peak, high and low flows.

A large regeneration harvest unit has altered the hydrologic maturity of its stand off National Forest lands in the lower Canyon Creek area, west of the Canyon Creek analysis area. The regeneration unit is large enough to have affected peak flows from the small tributaries affected (drainage areas less than 1 square mile). The magnitude of change in the small tributaries peak flows and the cumulative effect in the mainstem Canyon Creek is unknown although probably since the units are so low in the Canyon Creek area where Canyon Creek contributing watershed is about 42 square miles, the increased peak flows to Canyon Creek from the affected tributaries are dampened. The Canyon Creek project does not negatively

affect peak flows and therefore, no additional cumulative effects are generated from this proposed timber sale in relation to any affects to peak flows that the off Forest regeneration units may be causing.

Riparian Habitat and Function

From Thinning Units

Alternative A

A total of 41 acres of thinning in Riparian Reserve are in the proposed action (Table 3-10). Riparian Reserve widths and untreated buffer widths differ between streams based on stream type and site conditions. The range of riparian reserves thinned within each sub-basin would be <1 to 2 percent (Table 3-11).

Table 3-10. Riparian treatments in the proposed units of the Canyon Timber Sale .

Unit #	Sub-basin	Acres Riparian Reserve Within unit	Acres Riparian Reserve Thinned	Percent of Riparian Reserve Thinned within Unit
2	Lower Canyon	0.0	0.0	0
3	Lower Siouxon	0.6	0.3	50
6	Lower Big Rock	6.6	2.6	39
8	Lower Canyon	2.3	1.1	48
9	Lower Canyon	0.0	0.0	0
10	Lower Big Rock	9.6	3	3
10	Lower Canyon	4.2	0.0	0
11	Lower Canyon	0.0	0.0	0
12	Lower Canyon	54.6	26.9	49
14	Jakes Creek	6.0	2.4	40
16	Upper Big Rock	3.1	1.3	42
17	Fly Creek	7.6	1.9	25
20	Middle Canyon	1.0	0.6	60
Total		**95.6**	**41**	

Table 3-11. Riparian treatment of the proposed action within each sub-basin.

Sub-basin	Acres of Riparian Reserves	Acres of Riparian Reserves Thinned	% Riparian Reserves Thinned
Jakes Creek	549.6	2.4	<1
Upper Big Rock	952.6	1.3	<1
Lower Big Rock	761.7	5.6	<1
Middle Canyon	837.5	0.6	<1
Lower Canyon	1275.6	28.0	2
Fly Creek	1279.3	1.9	<1
Lower Siouxon	1608.8	0.3	<1

In general, thinning prescriptions within Riparian Reserves are expected to result in variable canopy densities. Nearest the stream, canopy cover would remain as it is currently because there would be no

thinning. This untreated, no equipment buffer would be one site potential tree height (210 feet) for riparian areas along Fly Creek and the wetland in Unit 10, and 60 feet for the other streams. One stream in Unit 10 has a 100-foot untreated buffer, slightly larger than the other small streams due to its meandering nature and remnant old-growth trees. The 60-foot untreated, no equipment buffer incorporated the near stream riparian area where stand characteristics are different from the rest of the stand due to stands developing with additional disturbances mechanisms such as steeper stream adjacent slopes, wetter soils, and different vegetation species composition. The minimum 60-foot untreated no equipment buffer also allows for a fully vegetated non disturbed area to capture any sediment that potentially be generated from the managed part of the riparian reserve prior to being delivered to a stream. Outside the untreated buffer, stand characteristics and correspondingly, thinning prescriptions were similar within the riparian reserve and outside the riparian reserve.

The one site potential tree height buffer along Fly Creek would protect all shade producing trees. Stand densities within the one site potential tree height buffers were believed to be less dense and more variable adjacent to Fly Creek and Big Rock Creek. More solar radiation may reach the trees developing immediately adjacent to perennial streams due to the opening afforded by the stream itself. This can result in a more varied growth rate of trees along the stream edge and more varied species composition of the dominant trees and underneath the canopy, consequently requiring less need for decreasing tree density to promote growth.

These untreated buffers along all streams would protect the immediate area along streams from a number of potential effects including direct and indirect affects to channel functions or aquatic habitat, water temperature, sediment filtering, nutrient and detritus inputs, soils and ground cover, and microclimate. Connectivity and habitat protection within these core areas of the Riparian Reserves would be maintained.

Thinning occurring outside of the untreated buffers would be thinned to a 40 percent canopy cover to maximize the increased growth benefits of thinning with the exception of Units 8, 9 and 10. Effects of the thinning would be greatest in the outer portions of Riparian Reserves where the more intensive thinning has been proposed. Thinning would open treated portions of the Riparian Reserves to increased sunlight and increased variability in air temperature, relative humidity and winds. This would result in slightly drier conditions during summer months, and greater fluctuations in air temperature and humidity within treated portions of the Riparian Reserves. This immediate but short term effect would slowly decrease as individual tree canopies respond to the thinning and grow into the space created in the thinned forest canopy.

As the forest canopy in Riparian Reserves begins to close in following thinning treatments, the microclimate within Riparian Reserves would begin to recover to pre-treatment levels. The percent skylight through the canopy is estimated to decrease by an average of 2 percent per year after thinning (pers comm. Bruce Holmson). Over time, thinning conducted in Riparian Reserves should produce larger trees sooner than they may otherwise have developed. Over the course of 50 years, thinned stands would be expected to have grown an additional 6 to 7 inches in diameter as compared to trees in untreated stands (see Silviculture section below). The increased diameter growth would provide larger trees for future wood recruitment to the riparian floor and potentially streams. The thinning treatments within the Riparian Reserves include planting shade tolerant conifers and in some cases snag creation, which would increase structural and species diversity.

Another long-term, positive benefit of developing Riparian Reserves with larger trees and increased structural and species diversity is connectivity of late-seral characteristics in the Canyon Creek area where connectivity of Riparian Reserves with late-seral conditions has been disrupted by previous management. This would be particularly beneficial within Units 8, 9, 10, 11 and 12 where increased tree growth and species diversity within the Riparian Reserves would provide connectivity of the late-seral Riparian

Reserves of Canyon Creek and Big Rock Creek via the smaller tributaries and headwater areas capable of connecting the Lower Canyon Creek and Lower Big Creek Sub-basins.

Alternative B
Riparian thinning on about 41 acres would not occur. The riparian stands would continue developing at a slower rate compared with Alternative A. The opportunity to accelerate the development of structurally diverse stands with large trees would be forgone.

From Roads
Alternative A
Roads and culverts can alter the flow pattern of water, large wood, organic material and gravels through streams by creating physical barriers at road stream crossings. This can affect upstream and downstream movement of fish and invertebrates affecting fish migration and food availability and interrupt the downstream movement of large wood and other organic material and sediment, including gravels suitable for spawning.

The culvert installed on the temporary road that would cross one small perennial stream would be removed prior to the wet season, and stream banks stabilized and revegeted. This culvert would disrupt riparian habitat function during one dry period. Upon completion of thinning activities and prior to November 1, the culvert would be removed and connectivity reestablished.

Fly Creek has one culvert blocking downstream movement of large wood and gravels. This alternative would decommission FR 4205522 after thinning activities are complete, removing the barrier caused by the culvert.

Alternative B
The connectivity barrier caused by the culvert on FR 4205522 would not be removed in Alternative B.

Water Temperature
Alternative A
Harvest activities within the units do not affect shade of any streams flowing during the warm summer months. A thinning treatment and the 210 foot untreated buffers along Fly Creek and the 60 foot, and 100-foot no-cut buffers along the other narrower streams would retain existing shade in areas providing shade to the perennial streams. The 210 foot untreated buffer around the wetland would maintain the associated water table and vegetated shade.

Alternative B
No changes to temperature would occur from the No Action Alternative B.

Cumulative Effects
The Crayon Timber Sale is being implemented in the analysis area. The Crayon Timber Sale includes thinning 41 riparian acres, representing less than 1 percent of the Lower Canyon sub-basin. The Crayon Sale is thinning and so a functional riparian forest and forest canopy has remained or will remain intact in the Riparian Reserves. Timber harvest treatments within the Riparian Reserves were designed to enhance development of large diameter trees and a second canopy layer, and are considered to maintain species composition and structural diversity of plant communities in riparian areas and wetlands.

The probability of increased temperatures as a result of both of these projects would be entirely discountable due to the project design features that completely limit the removal of any shade producing trees within the prescribed no-cut buffers along perennial streams. Avoiding the removal of shade to

streams is assured by limiting the reduction in canopy closure to 40 percent in areas beyond the no-cut buffers but within the riparian reserves.

The Weyerhaeuser regeneration units' riparian buffers were managed leaving a narrow stream buffer of large trees, contributing to the fragmentation of riparian reserves in Canyon Creek.

Aquatic Conservation Strategy Objectives

Introduction
The Aquatic Conservation Strategy (ACS) is an integral part of the 1994 Northwest Forest Plan. The ACS was developed to restore and maintain the ecological health of watersheds and aquatic ecosystems within public lands. The ACS includes four components (Key Watersheds, Watershed Analysis, Watershed Restoration and Riparian Reserves) and has nine objectives toward meeting the goal of healthy ecosystems and watersheds. Aquatic Conservation Strategy Objectives are applied over time at watershed and broader scales.

The Canyon Timber Sale EA proposed action is to thin timber stands and includes road related activities, such as temporary road construction, log haul, under planting, and road decommissioning. Some of these activities occur within Riparian Reserves established by the Northwest Forest Plan.

Key Watersheds
Siouxon Creek is a Key Watershed located on the Mount St. Helens National Volcanic Monument. Key Watersheds are intended to serve as refugia for at risk stocks of native and anadromous fish. Activities to protect and restore aquatic habitat in Key Watersheds are higher priority than similar activities in other watersheds. Only thinning activities occur within the Riparian Reserve of the Siouxon Creek Key Watershed in the proposed action and only in less than one third of an acre. The magnitude of this activity within the key watershed is small to the degree that the proposed action is considered neither a benefit nor a detriment at the key watershed scale.

Watershed Analysis
Watershed analysis was conducted between 1995 and 1999 for watersheds on the Gifford Pinchot National Forest. The Lower Lewis River Watershed Analysis was reviewed and recommendations were integrated in the design of the proposed project. Specifically, previous timber harvest activity in riparian areas in the analysis area fragmented habitat within Riparian Reserves. Development of late-seral characteristics within Riparian Reserves of Canyon Creek would allow for spatial connectivity within and between watersheds which is critical for riparian and aquatic dependent species. Road decommissions were considered a high priority for restoration within the project analysis area as recommended in the watershed analysis.

Watershed Restoration
Watershed restoration is an integral part of the Aquatic Conservation Strategy to aid recovery of fish habitat, riparian habitat and water quality. The Lower Lewis River Watershed Analysis rated road decommissions as high priority, and silvicultural treatment of both riparian and upland stands as a moderate priority.

Riparian Reserves

Alternative A Proposed Action

> **Objective 1: Maintain and restore the distribution, diversity, and complexity of watershed and landscape-scale features to ensure protection of the aquatic systems to which species, populations and communities are uniquely adapted.**

Alternative A is expected to maintain the distribution, diversity, and complexity of watershed scale features. This alternative improves the proportion of forest in late-seral stage by enhancing growth of tree diameters and live crowns in previously harvested and stocked stands. This activity will enhance tree growth and stand diversity on about 479 acres. Although the proposed action has restorative benefits, the amount of acreage within the areas that drains into Canyon Creek and Siouxon Creek are limited in scope.

The proposed action does not involve any new permanent roads. Temporary roads will be decommissioned when activities are completed and so will not become new watershed features. Road decommission activities include best management practices such as completion timing requirement prior to November 1, removal of culverts and culvert fill material, and stable configuration of stream banks at culvert crossings. Design criteria and best management practices are listed in Appendix A of the Environmental Assessment for Canyon Timber Sale.

> **Objective 2: Maintain and restore spatial and temporal connectivity within and between watersheds. Lateral, longitudinal, and drainage network connections include floodplains, wetlands, upslope areas, headwater tributaries, and intact refugia. These network connections must provide chemically and physically unobstructed routes to areas critical for fulfilling life history requirements of aquatic and riparian-dependent species.**

Spatial connectivity is enhanced in Alternative A as the restoration of late-seral components such as large multi-species trees, multi canopies, and future coarse wood occurs by 1) enhancing tree growth in dense stands with stagnated growth rates and diminished crowns, 2) under planting with shade tolerant species and 3) creating or maintaining down logs and snags. This restoration is particularly prominent in the Riparian Reserves of the small tributaries and headwater areas that connect the Lower Canyon Creek Sub-basin to the Lower Big Rock Creek Sub-basin.

Spatial and temporal connectivity within and between watersheds will be maintained because no new permanent roads are proposed. Temporary roads will be designed with drainage features to minimize disturbance to surface flow and include adequately sized culverts and removal following use. Activities proposed for the Canyon Timber Sale will not create physical barriers or otherwise degrade access to aquatic organisms.

The non-treated riparian buffers maintain a high level of connectivity along stream courses. The decommissioning of Forest Road 4205522 will restore stream connectivity by removing culvert obstructions and allowing unimpeded movement of water, wood, sediment and invertebrate and vertebrate species.

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

Thinning will increase growth of standing live trees and will increase the quality of future large wood recruitment by optimizing the size and quantity of large wood from the riparian portion of the stands. This will contribute to sustaining the physical complexity and stability of the stream including retention and accumulation of smaller sediments such as spawning gravels.

Temporary road design includes crossing one perennial stream. Design criteria exist as described in the Canyon Timber Sale Environmental Analysis Appendix A to maintain the physical integrity of the stream banks and bottom configuration at this crossing.

Objective 4: Maintain and restore water quality necessary to support healthy riparian, aquatic, and wetland ecosystems. Water quality must remain within the range that maintains the biological, physical, and chemical integrity of the system and benefits survival, growth, reproduction, and migration of individuals composing aquatic and riparian communities.

The non-treated buffer width on perennial streams equal to at least 60 feet will protect all stream shade producing trees and therefore maintain stream temperatures of the creeks within or adjacent to the units.

The extent and range of riparian thinning is relatively small. Approximately 41 riparian acres would be treated in the watershed on both perennial and non-perennial streams. The small number of acres spread out across the watersheds would not cumulatively affect water temperatures of any one perennial stream flowing during the warm summer months. Therefore, the water quality will remain within the range that maintains the biological, physical, and chemical integrity of the system, which will benefit survival, growth, reproduction, and migration of individuals composing aquatic and riparian communities

Objective 5: Maintain and restore the sediment regime under which aquatic ecosystems evolved. Elements of the sediment regime include the timing, volume, rate, and character of sediment input, storage, and transport.

Riparian thinning in Alternative A has a low probability for producing sediment because activities are designed such that no ground disturbance will take place within the non treated riparian buffer and limited activities will occur outside this buffer. Activities outside this buffer are unlikely to contribute sediment to streams as the vegetated, non-treated riparian buffer would capture disturbed soil being transported across the ground. For example, the use of mechanical equipment within the Riparian Reserves will result in localized soil disturbance, but any transported sediment would settle within the vegetated non treated buffer and would likely not reach the stream.

Design criteria and best management practices to minimize erosion and sediment movement include ground based machinery generally limited to slopes less than or equal to 30 percent, skid trail spacing, and one end suspension in skyline yarding operations among others as listed in the Canyon Timber Sale Environmental Analysis Appendix A. The non treated riparian buffers were specified to allow any sediment being transferred from the thinning portion of the Riparian Reserve of the unit to settle out within the non treated buffer and not reach a stream.

Best management practices related to road haul minimizing sediment delivery to streams include limiting haul to dry periods, maintaining road drainage features prior to hauling activities, and the placement of sediment barriers and sediment traps in areas where ground disturbance occurs from reconstruction activities and sediment has the potential to be delivered to a stream course. Sediment will be mobilized from use of haul routes. Not all sediment from the haul route would reach a stream because many relief culverts intercept ditch flow and drain onto the forest floor away from streams. The character of the sediment delivered is fine grained sediment which is suspended within the stream flow and diluted from other contributing streams that are not impacted by road runoff. Increases to turbidity and suspended sediment levels from haul road sediment inputs are likely to be low due to the degree of dilution in the streams especially in the larger streams that support a majority of the fish. Dilution of the sediment delivery minimizes the accumulation of this sediment in any one downstream area.

The localized ground disturbance will re-vegetate within one growing season. The sediment increases from road haul and culvert work are short term in duration, will be significantly diluted and move downstream in random pulses. These short term effects will not be discernible against the range of variation of natural sediment processes at the watershed scale.

The proposed action alternative would decrease the chronic erosion source associated with Forest Road 4205522 by decommissioning the stream adjacent road which presently is confining the stream resulting in steep unstable stream banks delivering excessive sediment to Fly Creek.

> **Objective 6: Maintain and restore in-stream flows sufficient to create and sustain riparian, aquatic, and wetland habitats and to retain patterns of sediment, nutrient, and wood routing. The timing, magnitude, duration, and spatial distribution of peak, high, and low flows must be protected.**

Tree removal with the thinning units may reduce evapotranspiration rates, allowing more water in the soils for runoff. The magnitude of increased runoff is considered small and lasting from 3-5 years when crown expansion and ground vegetation response offset the short term reduction in evapotranspiration. This change is not measurable at the drainage scale encompassing the units and not cumulative at the larger watershed scale.

The magnitude of any changes in peak flows resulting from the proposed thinning is estimated to be undetectable due to only a few patches within the area having vegetation structure changed to the degree that would change the hydrologic maturity of any stands and consequently increase runoff rates during peak flows.

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

The 210 foot non treated riparian buffer around the wet meadow in Unit 10 will maintain the water table elevation. Floodplain inundation will be maintained as Canyon Creek is bedrock/large boulder controlled and actions do not include the floodplain or high water areas.

> **Objective 8: Maintain and restore the species composition and structural diversity of plant communities in riparian areas and wetlands to provide adequate summer and winter thermal regulation, nutrient filtering, appropriate rates of surface erosion, bank erosion, and channel migration and to supply amounts and distributions of coarse woody debris sufficient to sustain physical complexity and stability.**

Riparian thinning promoting the development of late-seral characteristics would continue to provide thermal regulation. The non treated buffer provides an adequate area for any sediment transport interception, protects diverse riparian plant communities and increased tree growth will provide future course wood to the riparian forest floor and stream. Alternative A requires no cut buffers along all riparian corridors and wetlands. These buffers encompass diverse plant communities, protect current shading levels for thermal regulation, protect stream banks from operational disturbances and ensure that soil disturbance does not get routed to streams or wetlands.

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

Establishing a no-cut riparian buffer zone will protect stream adjacent areas from disturbance and will maintain populations of native plant, invertebrate and vertebrate riparian-dependent species. The non-treated riparian buffer maintains the existing microclimate which is important for species that are sensitive to changes in temperature and humidity such as amphibians and certain types of vegetation as well as for those animals that use the stream adjacent riparian areas as travel corridors.

Alternative A provides for the development of habitat conditions within the riparian areas and across the landscape to support well-distributed populations of native plant, invertebrate, and vertebrate riparian-dependent species at the project and watershed scales.

Alternative B - No Action
All objectives of ACS listed below would be maintained at current level because no activities would be taking place under the no action alternative. Maintaining the sediment regime would not be enhanced with the No Action Alternative as Forest Road 4205522 would not be decommissioned.

Summary
Overall, the Canyon Timber Sale will help restore riparian vegetation and aquatic conditions within the Canyon Creek and Siouxon Creek watersheds by promoting the development of late-successional forest characteristics both within and outside of Riparian Reserves and by reconstructing some undersized crossings, improving road drainage, and decommissioning existing roads. The thinning treatments are designed to help meet the desired future condition as described in the Gifford Pinchot National Forest Land and Resource Management Plan. Because terrestrial vegetation and aquatic components and processes are so tightly inter-connected, meeting the Desired Future Condition for these land allocations will also contribute to abundant, well dispersed, high quality habitat for riparian-dependant species.

Designated no-cut buffers along all streamcourses; avoiding any fish bearing stream crossings when constructing temporary roads; and implementing Best Management Practices, management requirements, and required mitigation measures as part of the project will protect riparian areas and maintain the existing vegetation, connectivity, water flow, water quality, and habitat within the Canyon Creek and Siouxon Creek watersheds.

The Canyon Timber Sale will include some activities that will result in short term increases in sediment production at individual sites. For example, culvert installations or upgrades, and road decommissioning work all have the potential to create short term sediment movement but it is expected to be very localized and short-term. Disturbances to stream channel or adverse water quality impacts are not anticipated. Sediment inputs to streams from culvert work are likely to create turbidity pulses that last for only a few hours, at most, before water clarity returns to background levels. Construction sites may continue to produce small amounts of sediment throughout the first winter until the sites are fully revegetated and stable. Any short-term increases in sediment production or turbidity are expected to be well within the range of what would typically occur during high winter flows or as a result of natural streambank erosion. At the subwatershed and watershed scale, changes in water quality, turbidity or sediment production will not be detectable.

Fisheries

Introduction

Table 3-12 summarizes the effects from the proposed project on Proposed, Endangered, Threatened and Sensitive (PETS) fish species. Fish species listed are taken from the Pacific Northwest Region, USDA Forest Service Threatened, Endangered, and Species Proposed for Listing document, updated September 2006. When No Effect or No Impact is determined, those species will not be described or discussed in detail in this analysis.

Table 3-12. Summary of effects determinations for threatened, endangered, proposed, & sensitive fish species.

SPECIES NAME	SPECIES STATUS	FIELD REVIEW		EFFECTS	
		Habitat Present?	Species present?	Alt. A (No Action)	Alt. B (Proposed Action)
Columbia River Bull Trout *Salvelinus confluentus*	Threatened	No	No	No Effect	No Effect
Critical Habitat for Columbia River Bull Trout	Designated	No (not designated on NF lands)	N/A	No Effect	No Effect
Coastal Puget Sound Bull Trout *Salvelinus confluentus*	Threatened	No	No	No Effect	No Effect
Critical Habitat for Coastal Puget Sound Bull Trout	Designated	No (not designated on NF lands)	N/A	No Effect	No Effect
Lower Columbia River Steelhead Trout *Oncorhynchus mykiss*	Threatened	No	No	No Effect	No Effect
Critical Habitat for Lower Columbia River Steelhead Trout	Designated	No	No	No Effect	No Effect
Lower Columbia River Chinook Salmon *Oncorhynchus tshawytscha*	Threatened	No	No	No Effect	No Effect
Critical Habitat for Lower Columbia River Chinook Salmon	Designated	No	No	No Effect	No Effect
Lower Columbia River Coho Salmon *Oncorhynchus kisutch*	Threatened	No	No	No Effect	No Effect
Essential Fish Habitat for Coho and Chinook Salmon	N/A	No	No	No Effect	No Effect
Interior Redband Trout *Oncorhynchus mykiss*	USFS Sensitive	No	No	No Impact	No Impact
Pygmy Whitefish *Prosopium coulteri*	USFS Sensitive	No	No	No Impact	No Impact
Puget Sound Coastal Cutthroat Trout *Oncorhynchus clarki clarki*	USFS Sensitive	No	No	No Impact	No Impact

Action Area

The Action Area used for the fisheries analysis includes portions of the Merwin Reservoir – Lewis River fifth-field watershed (in the Lower Canyon Creek sub-watershed) and the Yale Reservoir – Lewis River fifth-field watershed (in the Lower Siouxon Creek sub-watershed). The stream systems that are within the action area are: Lower Canyon Creek, Middle Canyon Creek, Lower Siouxon Creek, Lower Big Rock Creek, Upper Big Rock Creek, Fly Creek, Jakes Creek, and their associated tributaries. Road hauling for two units (Units 16 and 17) is proposed within the East Fork Lewis River fifth-field watershed.

Most of the activities of the Canyon Timber Sale analysis area are within the Canyon Creek subwatershed which is found in the Merwin Reservoir – Lewis River fifth-field watershed. Canyon Creek is considered

a Class I fish bearing stream. Big Rock Creek and Jakes Creek are major tributaries to Canyon Creek and are also considered Class I fish bearing streams. Canyon Creek leaves the National Forest 8 miles upstream from where it drops into Merwin Lake. The lowest 1,000 feet of Canyon Creek has numerous waterfalls one of which is 18-20 feet high. This series of waterfalls is presumed to have been the barrier to anadromous fish access in the past before the Yale, Merwin, and Swift hydroelectric dams were built. These dams have no fish passage available for anadromy to exist above the dams.

There are federally-listed bull trout in Yale and Swift reservoirs created by the hydroelectric dams, as well as in some of their tributaries. Part of unit 3 is located at the watershed break between Siouxon Creek and Canyon Creek. Siouxon Creek subwatershed is located in the Yale Reservoir-Lewis River fifth-field watershed Siouxon Creek is considered a Class I fish bearing stream and is about 1 mile downslope from unit 3.

None of the drainages where harvest units are located contain federally listed fish or designated critical habitat.

Table 3-13. Subwatersheds and acres included in the Canyon Thin Timber Sale planning area

6th Field HUC Name (Number)	Acres	Drainage where units are located
Lower Siouxon Creek (170800020402)		
Unit 3	50	Lower Siouxon
Lower Canyon Creek (170800020602)		
Unit 2	17	Lower Canyon
Unit 6	24	Lower Big Rock
Unit 8	36	Lower Canyon
Unit 9	42	Lower Canyon
Unit 10	62	Lower Canyon
Unit 11	14	Lower Canyon
Unit 12	143	Middle Canyon
Unit 14	52	Jakes & Pelvy
Unit 16	49	Upper Big Rock
Unit 17	48	Fly
Unit 20	16	Puny

Existing Conditions

Streams adjacent to the harvest units of Canyon Timber Sale include perennial, ephemeral, and intermittent streams. Many perennial streams provide habitat for resident fish. Intermittent and ephemeral streams are normally dry in the summer months and, therefore, do not always provide habitat for fish. See Figure 3-7 for information on fish distribution in relation to the Canyon Timber Sale units.

Table 3-14. Culvert Location and Distances to Listed Fish Bearing Streams.

Culvert Location	Work Activity	Stream Type	Distance to Resident Fish Stream	Distance to Anadromous Fish Stream	Effect Determination to LCR Steelhead
Rd. 4205522 MP 0.2	Replace existing 18" culvert with 24" culvert	Intermittent	~1500 feet	~12 RM + ~ 10 miles (Lake Merwin) = 22 miles	NE*
Rd. 4205522	Replace existing	Perennial	On resident	~ 12 RM +	NE

MP 0.42	48" culvert with larger culvert		fish-bearing stream	~ 10 miles (Lake Merwin) = ~ 22 miles	
Rd. 53 MP 6.45	Place riprap at culvert outlet	Intermittent	~ ¾ RM**	~ 16 RM + ~ 10 miles (Lake Merwin) = ~ 26 miles	NE
Rd. 53 MP 5.95	Replace existing 18" culvert with 36" culvert	Intermittent	~ ½ RM	~ 16 RM + ~ 10 miles (Lake Merwin) = ~ 26 miles	NE
Rd. 57 MP 2.15	Replace existing rusted 18" culvert with new culvert of same size	Intermittent	~ 1 RM	~ 10 RM + ~ 10 miles (Lake Merwin) = ~ 20 miles	NE
5300610 and temporary road (Burma Rd.)	Place two 18" culverts, and one culvert crossing a perennial stream & then remove them after work is completed	Intermittent	~ ½ RM	~ 12 RM + ~ 10 miles (Lake Merwin) = ~ 22 miles	NE

* NE = No Effect
** RM = River Miles

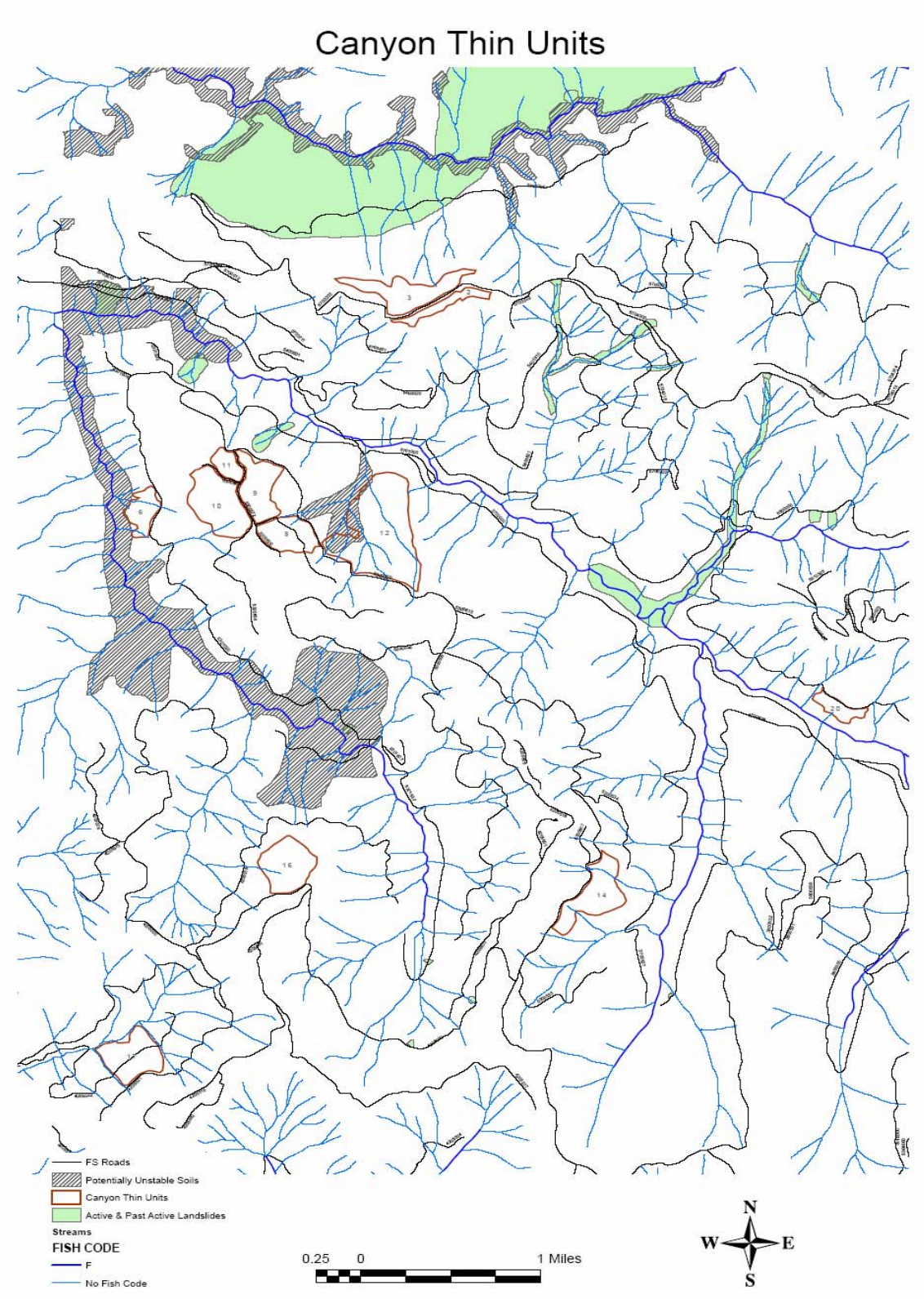

Figure 3-7. Fish Distribution

Fish Species and Critical Habitat

Resident fish species found in the Siouxon Creek and Canyon Creek sixth-field subwatersheds are: rainbow trout (*Oncorhynchus mykiss*), cutthroat trout (*O. clarki*), sculpin (*Cottus* spp.), mountain whitefish (*Prosopium williamsoni*), and suckers (*Catostomus* spp.). Genetic studies suggest that the wild rainbow trout in Canyon Creek and Siouxon Creek are each significantly different than hatchery stocks (Conklin 1992). None of these resident fish are federally listed or on the Regional Forester's Sensitive species list.

The Gifford Pinchot National Forest (GPNF) has a total of eight fish species that are either Endangered, Threatened, or Sensitive (see Table 3-12). No fish species or critical habitat on GPNF is currently proposed for federal listing. Steelhead, Chinook, and Coho are under the jurisdiction of NOAA Fisheries, and bull trout are under US Fish and Wildlife Service. Fish distribution data is from Washington Dept. Fish and Wildlife (WDFW) and local Forest Service fish biologists. None of the eight fish species found on GPNF are found within the project planning area or within a reasonable distance downstream from the planning area. The lowest 1,000 feet of Canyon Creek has numerous waterfalls one of which is 18-20 feet high. These series of waterfalls is presumed to have been the barrier to anadromous fish access in the past before the Yale, Merwin, and Swift hydroelectric dams were built. These dams have no fish passage available for anadromy to exist above the dams. Therefore, the proposed project is expected to have **no effect** on Chinook or Coho.

Although the Lower Columbia River steelhead trout is not found within the proposed Canyon Timber Sale planning area, it is present in the East Fork Lewis River watershed adjacent to portions of the haul route (FR 4205522 to FR 4205 to FR 4200) for units 16 and 17. Lower Columbia River steelhead is the only federally listed fish species found within the upper portions of the East Fork Lewis River watershed on National Forest lands. Chinook and Coho are found in the East Fork Lewis River up to river mile 26.1 located 11 miles downstream from the Forest boundary.

Bull trout (*Salvelinus confluentus*) are not present in the East Fork Lewis River watershed but are found only in a few of the streams draining into Yale Lake, which is located outside of the National Forest boundary. An impassable waterfall barrier in the lower reach of Canyon Creek precludes bull trout (*Salvelinus confluentus*) from accessing the upper Canyon Creek subwatershed. Extensive surveys throughout the Merwin Reservoir-Lewis River fifth-field watershed have determined there are no bull trout populations present in the Canyon Timber Sale planning area, in addition to determining the resident fish species that are present here (USDA 1996, GPNF Stream Survey Data – various years). Therefore, the proposed project is expected to have **no effect** on Columbia River Bull trout.

Discussions hereafter in regards to affected species will focus on the Lower Columbia River steelhead and their designated critical habitat because of potential effects from the haul route adjacent to the East Fork Lewis River (hauling along FR 42). The haul route for Units 16 and 17 of the Canyon Timber Sale would utilize FR 4205522 (outside the EF Lewis River watershed), 4205 (begins inside the EF Lewis River watershed), and FR 4200 (parallels the EF Lewis River).

Below is a brief discussion on the life history and status of the Lower Columbia River Steelhead. Additional information related to the life history and status of the Lower Columbia River Steelhead population at the Evolutionary Significant Unit (ESU) or Distinct Population Segment (DPS) scale can be found in the following sources:

- NMFS and USFWS Federal Register documents (http://www.nwr.noaa.gov/ESA-Salmon-Listings/Salmon-Populations/Index.cfm), (http://www.fws.gov/pacific/bulltrout/),
- Lower Columbia Salmon Recovery and Fish and Wildlife Plan (http://www.nwcouncil.org/fw/subbasinplanning/lowerColumbia/plan/

Lower Columbia River Steelhead (Oncorhynchus mykiss)
The Gifford Pinchot National Forest is located within the Lower Columbia River Steelhead ESU in Oregon and Washington. The Lower Columbia River steelhead ESU was listed as threatened on March 19, 1998 (63 FR 13347). The Lower Columbia River ESU encompasses all steelhead runs in tributaries between and including the Cowlitz and Wind Rivers to the Little White Salmon River on the Washington side of the Columbia River, and the Willamette and Hood Rivers on the Oregon side.

Recovery planning for Lower Columbia River steelhead is ongoing, and recovery planning status can be reviewed online at: http://research.nwfsc.noaa.gov/trt/trt_wlc.htm

The populations of steelhead that make up the Lower Columbia River ESU are distinguished from adjacent populations by genetic and habitat characteristics. The ESU consists of summer and winter coastal steelhead runs in the tributaries of the Columbia River as it cuts through the Cascades. These populations are genetically distinct from inland populations (east of the Cascades), as well as from steelhead populations in the Upper Willamette River basin and coastal runs north and south of the Columbia River mouth. The following runs are not included in the ESU: the Willamette River above Willamette Falls (Upper Willamette River ESU), the Little and Big White Salmon rivers (Middle Columbia River ESU), and runs based on four imported hatchery stocks (early-spawning winter Chambers Creek/Lower Columbia River mix, summer run Skamania Hatchery stock, winter Eagle Creek National Fish Hatchery stock, and winter run Clackamas River ODFW stock) (NOAA Fisheries 1998).

The major runs in the ESU for which there are estimates of run sizes and trends are the Coweeman River winter runs, North and South Fork Toutle River winter runs, Kalama River winter and summer runs, East Fork Lewis River winter run, Wind River summer runs, Clackamas River winter run, and Sandy River winter run.

Action Area Information
Steelhead distribution within the planning area includes up to river mile 41.0 on the East Fork Lewis River. The steelhead runs that inhabit the East Fork Lewis River fifth-field watershed are genetically distinctive and listed as threatened under the Endangered Species Act. The Washington Department of Fish and Wildlife (WDFW) determined that summer steelhead populations are in more jeopardy than the winter steelhead populations. This is a result of a sharp decline in escapement goals of summer steelhead populations. Additionally, the decline in steelhead can be attributed to the change in stream habitat found within the Gifford Pinchot National Forest (GPNF) boundary, habitat degradation from urbanization below the GPNF boundary, potential interbreeding with wild and hatchery steelhead, and predation on migrating winter steelhead (WDFW, 1993).

Critical Habitat
The National Marine Fisheries Service designates critical habitat based on physical and biological features that are essential to the listed species. Essential features of designated critical habitat are: (1) substrate, (2) water quality, (3) water quantity, (4)water temperature, (5) water velocity, (6) cover/shelter, (7) food for juveniles, (8) riparian vegetation, (9) space, and (10) safe passage conditions (50 CFR 226.212).

The three freshwater primary constituent elements of critical habitat are:

1. Freshwater spawning sites with water quantity and quality conditions and substrate supporting spawning, incubation and larval development.

2. Freshwater rearing sites with water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility; water quality and forage

supporting juvenile development; and natural cover such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks.

3. Freshwater migration corridors free of obstruction with water quantity and quality conditions and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks supporting juvenile and adult mobility and survival.

Recent designated critical habitat on the Gifford Pinchot National Forest includes the stream channels in each designated reach, and a lateral extent as defined by the ordinary high water line (Sept. 2, 2005; 70 FR 52629). The primary constituent elements essential for conservation of listed ESUs are those sites and habitat components that support one or more fish life stages, including freshwater spawning sites, freshwater rearing sites, and freshwater migration corridors.

Action Area Information

There is no designated critical habitat for any listed species in the portion of the Lewis River watershed that constitutes the analysis area for the Canyon Timber Sale. This is due to the lack of anadromy (caused by the migratory blockages at the three hydroelectric dams on the Lewis River).

The East Fork Lewis River in the East Fork Lewis River fifth-field watershed, which is included in this analysis due to the haul route for units 16 and 17, contains designated critical habitat for Lower Columbia River steelhead. Designated critical habitat for steelhead includes all streams that steelhead use in the Upper East Fork Lewis sixth-field sub-watershed. This would include the portion of the East Fork Lewis River adjacent to FR 4200 and downstream from FR 4205 and FR 4205522 that serve as the haul route for units 16 and 17 of the Canyon Timber Sale.

Environmental Consequences

For purposes of this analysis, the Canyon Timber Sale was divided into four Project Elements and includes information from the Hydrology Report completed by Ruth Tracy, Forest Hydrologist. Activities that fall within the scope of these Project Elements will be analyzed for each alternative. The Project Elements are:

1. Thinning outside the Riparian Reserves
2. Thinning inside the Riparian Reserves
3. Log hauling
4. Road activities

For the purposes of this analysis, only log hauling has potential to impact fish. The Hydrology section above displays the potential effects to riparian resources from the thinning treatment, and road activities. There would be no impact to fish or fish habitat from the thinning treatment, or road activities as planned.

Environmental Baseline of Action Area

The Canyon Thin Timber Sale proposed units, located within the Lewis River watershed, do not contain fish-bearing streams. Implementing the thinning as planned will not degrade any indicators for fish at the sixth-or fifth-field scale. Associated road maintenance activities will improve road conditions at the sixth-field scale, however, indicators will remain within background levels.

Proximity and Probability of Potential Effects to Federally Listed Fish
The majority of the timber sale activity is focused in the Lower Canyon Creek sub-watershed of the Merwin Reservoir - Lewis River watershed. One unit is located within the Lower Siouxon Creek sub-watershed of the Yale Reservoir – Lewis River watershed. No aquatic impacts are expected from the proposed action in either of these subwatersheds. Below is a summary of potential effects from the proposed action on each indicator of the environmental baseline for the Lewis River. These potential effects are assessed for determining whether an adverse affect is expected for the Lower Columbia River steelhead and/or their designated critical habitat.

All project elements, with the exception of road hauling, of the Canyon Timber Sale within the Merwin Reservor-Lewis River fifth-field watershed and the Yale Reservoir –Lewis River fifth-field watershed are not within proximity to federally listed fish or their designated habitat. Therefore, there is no probability for adverse affects. No anadromous fish currently access the portion of the Lewis River Basin where the project's planning area is located because upstream fish passage is blocked by the dams at both Yale Lake and Swift Reservoir (USDA 1990 & 2005).

Road hauling activities of the Canyon Timber Sale within the East Fork Lewis River fifth-field watershed are in relative proximity to Lower Columbia River steelhead and their designated critical habitat. Therefore, discussions below will focus on the probability of potential adverse affects to fish from the project element of road hauling only.

Effects of Road Hauling
The only indicators potentially impacted by the proposed action are sediment/turbidity. Those indicators not affected by the proposed action are not discussed below because there is no potential for adverse affects from road haul activities on FR 4200 or FR 4205.

The haul route for Units 16 and 17 of the Canyon Timber Sale would utilize FR 4205522 (outside the EF Lewis River watershed), FR 4205, and FR 4200. Forest Road. 4200 enters into the East Fork Lewis River fifth-field watershed and parallels the East Fork Lewis River up to the confluence of the Green Fork, paralleling Green Fork up to the headwaters. Road hauling would be limited along FR 4200 up to where FR 4205 begins. Approximately 0.5 mile of FR 4205 parallels FR 42 until it enters the Slide Creek drainage. Road 4205 has approximately a 300 to 500 feet elevational difference from the creek itself until the ridgetop is reached and then continues into the headwaters of the Fly Creek drainage, which is in the Canyon Creek watershed.

Slide Creek is an anadromous tributary to the East Fork Lewis River with fish currently accessing the mainstem of Slide Creek. The intermittent headwater tributaries to the left fork of Slide Creek are where sediment impacts from hauling on FR 4205 would be most probable. However, there is no anadromy use in the left fork of Slide Creek.

The East Fork Lewis River enters the mainstem Lewis River at River Mile (RM) 3.5. Lower Columbia River steelhead is the only anadromous species occupying the East Fork Lewis River (USDA 2004). Therefore, steelhead (Lower Columbia River steelhead) is the only anadromous species occupying the East Fork Lewis River adjacent to the haul route on FR 4200 (USDA 2004).

Fine sediments, even at relatively low levels, deposited on spawning areas during critical life cycle states (fall and spring) can decrease survival of eggs and emerging fry by decreasing inter-gravel dissolved oxygen content and suffocation. Suspended sediments increase the physiological stress of juveniles and adults by causing gill abrasion, leading to a higher incidence of disease and infection. Sediments deposited over streambeds can reduce the habitat available for spawning and for aquatic insect communities, which in turn influences the available food supply for larger aquatic organisms. Pool

siltation reduces the available refugia for juvenile and adult fish. Fine sediments can also cause higher stream temperatures due to reduced water reflectivity and a reduction in the stream's width-to-depth ratio (shallow water heats faster than deep water).

Alternative A

The hydrology report for Canyon Timber Sale modeled sediment production from hauling activities and estimated a sediment production increase of 0.9 tons/year from haul activities in the Upper East Fork Lewis. Given the assumptions used in the model and actual stream conditions, there is a low probability that measurable amounts of sediment from haul traffic along FR 42 and FR 4205 would impact Lower Columbia River steelhead and their designated critical habitat. Sediment and dust generated by the road related activities (log haul and road maintenance) is expected to be delivered to the intermittent tributaries of the left fork of Slide Creek and the East Fork Lewis River during the time of hauling or subsequent periods of runoff. However, the amount generated from road hauling would not be at a level of concern because any sediment delivered would move down in pulses through the intermittent streams and eventually to the non-fish bearing perennial portion of the left fork of Slide Creek through time and eventually to East Fork Lewis River. It is unlikely that sediment as a result of road hauling on FR 4205 would be discernable at this point in the system. The sediment production would be delivered in smaller quantities spread out through time. The small pulses of sediment in both Slide Creek and East Fork Lewis (from FR 4200) would be quickly transported through the system off National Forest lands in quantities that could not be discernable from natural variability.

The potential for significant sediment delivery is very low because log hauling would be limited to the dry summer months of June through September for most units. The exception to this is for Units 2, 6 and 20 where haul can occur during October and November dry periods, if they occur. The potential to deliver measurable amounts of sediment to the East Fork Lewis River as a result of hauling is unlikely with implementation of Alternative A, though the potential sedimentation levels resulting from roadwork, thinning, and haul route usage are different. Under Alternative A, the sedimentation levels resulting from the Canyon Timber Sale will have **no effect** on Lower Columbia River steelhead or their designated critical habitat in the East Fork Lewis River due to an indiscernible amount of sediment expected to be transported downstream to where there are steelhead and habitat present.

No new permanent road construction will occur in Alternative A. However, 420 feet of new road prism will occur for unit 12. Six units will have temporary roads constructed (Table 3-6) and all are located outside of the East Fork Lewis River watershed. Therefore, there will be **no effect** to Lower Columbia River steelhead and their designated critical habitat.

Under Alternative A, two roads are proposed for decommissioning, FR 5300607 (0.2 miles) and FR 4205522 (1.9 miles). Forest Road 4205522 parallels Fly Creek for approximately half a mile and is also outside the East Fork Lewis River watershed. Both of these roads proposed for decommissioning will remove all culverts, re-contour streambanks for stability, and revegetate all disturbed ground. There will be **no effect** to Lower Columbia River steelhead and their designated critical habitat from the proposed road decommissioning.

Although sediment is expected to be generated from the road related activities in Canyon Timber Sale, Project Design Criteria and Best Management Practices will minimize the erosion and sediment delivery to nearby small, perennial, non-fish bearing streams while fish bearing streams downstream from the timber sale units should not be affected by sediment at all. Lower Columbia River steelhead and their designated critical habitat are not expected to be affected by sediment production from the proposed activities.

Haul route usage for Units 16 and 17 within the East Fork Lewis River watershed may result in relatively low amounts of sediment in tributaries to Slide Creek and the East Fork Lewis River. Some of this sediment may result from dust caused by timber hauling and from turbid ditchflow. Sedimentation/turbidity is not expected to be of concern because:

- One effective mitigation measure to reduce sedimentation will be the implementation of dust abatement practices. Therefore, it is unlikely that a notable amount of sediment from dust will occur in the mainstem of the East Fork Lewis River. It is more likely to occur on FR 4205 but will be mitigated through dust abatement practices. Sedimentation in streams will be reduced by restricting haul route usage to dry summer months and to dry periods of the early fall.

- Any sediment reaching perennial fish bearing streams in the East Fork Lewis Watershed as a result of dust or sediment from road hauling will have dissipated to background levels. Most sediment will have been delivered in ditch outflows where ditch relief culverts are located. Some portion of the ditch relief culverts do not deliver sediment to the stream system because they discharge to unchanneled slopes where water can infiltrate the ground surface and/or sediment can be filtered and dropped out of suspension.

- The road surface and general condition of FR 4200, which parallels the East Fork Lewis River, is adequate for the purpose of hauling. Road work was completed on FR 4200 in September, 2006. There were 6 culvert replacements and new aggregate surfacing was placed on FR 4200 from the FR 4205 junction to the asphalt paving at Sunset Campground (0.8 miles). This greatly reduces the potential for significant amount of sediment reaching fish habitat.

Cumulative Effects

The potential to experience cumulative sedimentation effects to perennial fish-bearing streams is low with the implementation of Alternative A, the action alternative and neutral with Alternative B, the no action alternative. Other timber sale activities near the Canyon Timber Sale planning area are the Divot Timber Sale, Crayon Timber Sale, and Tee Timber Sale. The potential for cumulative sedimentation or turbidity effects is low from the combined actions of Canyon, Tee, and Crayon Timber Sales due to road improvements and similar mitigation measures and best management practices being implemented at all three sales. Road improvements that incorporate road decommissioning may result in short-term increases of sediment. Fish and their habitat would potentially be impacted in the short-term because of the amount of sediment generated through the first winter flush. However, it is reasonable to assume that it would be difficult to discern the amount from natural variability in watersheds with previous land treatments and road building. Long-term benefits would be derived from road decommissioning or road improvements because of standards that provide for full fish passage or adequately sized culverts and natural processes within ephemeral/intermittent drainages would not be compromised.

The Crayon Timber Sale had 10 units with thinning prescriptions and 0.3 miles of temporary road construction in the vicinity of the Canyon Thin Timber Sale. Three units had short, flat, ridge-top temporary roads constructed. None of these entered any riparian areas, thus, they could not deliver sediment to the streams. Best management practices included directional felling, ground-based machinery limited to slopes less than or equal to 30 percent, adequate skid trail spacing, 10 foot limits on rutting, and one- end suspension in skyline yarding operations. Additionally, minimum 60 foot stream buffers within the riparian reserves assured any sediment movement was captured on the ground prior to reaching any streams.

The cumulative amount of fine sediment delivered from the road surface and ditchlines during haul of the Canyon Timber Sale is expected to be reduced as it utilizes many of the same haul routes as the Crayon,

Divot, and Tee Timber Sales. Additionally, the Divot and Tee Timber Sales' road reconstruction activities improved or will improve the drainage features and road surfacing of the main haul route through the Upper East Fork Lewis River watershed. However, there will be some small amounts of sediment delivered to the stream systems in the analysis area due to the combined hauling activities on Forest Service roads from the Canyon Thin, Tee, Divot, and Crayon Timber Sales.

Weyerhaeuser managed a large tract of land adjacent to the Canyon Thin Timber Sale analysis area which is delivering sediment to Canyon Creek from its road system. Due to the geomorphology of this stream system, this sediment is thought to be quickly transported through Canyon Creek and downstream into the uppermost part of Merwin Reservoir.

Any sediment delivered to the streams in the Canyon Thin Timber Sale analysis area from these four timber sales and the Weyerhaeuser land tract is presumed to move through in small pulses through time and be in quantities that are too small to be discernible from background levels. The quantities, timing and transport rate are considered to be similar to the sediment regime under which the aquatic ecosystems in the analysis area evolved.

Summary of Effects by Alternative

Alternative A
No adverse effects to fish or fish habitat are expected as a result of implementing Alternative A. Short-term localized sediment is expected in the following areas: (1) the non-fish bearing streams of Unit 12 due to the temporary road construction, (2) non-fish bearing portion of upper Fly Creek due to a culvert removal and haul route usage for Units 16 and 17, and (3) Canyon Creek due to haul route improvements and usage for the other sale units (besides Units 16 and 17), and (4) the intermittent tributaries to the upper left fork of Slide Creek in the Upper East Fork Lewis River watershed. Adverse effects from sedimentation and turbidity are not expected occur in anadromous reaches of Slide Creek or the mainstem of East Fork Lewis River.

Alternative B
Fish habitat would remain unchanged from present day conditions. This alternative would create the least amount of short-term impact, however, no culverts would be upgraded and no roads would be decommissioned as proposed in Alternative A. Therefore, in the long-term, this alternative would lead to a continuation of the fine sediment introduction to the Canyon Creek watershed as a result of poorly maintained roads and undersized culverts. Also, late-successional riparian conditions, along with their associated beneficial riparian and instream effects, would not be attained as quickly due to the lack of a riparian thinning prescription.

Silviculture

Existing Condition for Vegetation

The Canyon Creek Watershed lies within the Southern Washington Cascades Province of the Pacific Northwest (Franklin & Dyrness 1973). The vegetation is temperate coniferous rainforest. All of 12 stands proposed for treatment are within the western hemlock zone. In particular: the western hemlock/dwarf Oregon grape/swordfern (TSHE/BENE/POMU), western hemlock/dwarf Oregon grape/Salal (TSHE/POMU-OXOR), western hemlock/dwarf Oregon grape (TSHE/BENE), western hemlock/sword fern (TSHE/POMU), western hemlock/Alaska huckleberry/salal (TSHE/VAAL-GASH), and western hemlock/Alaska huckleberry/oxalis oregano (TSHE/VAAL/OXOR) plant associations.

- The TSHE/BENE/POMU association sites are warm sites and occur on well-drained soils. Stands are highly productive for tree growth. Site Index, at 100 years, averages 142 feet (height) for Douglas-fir (*Pseudotsuga menziesii*). Potential for site degradation following careful timber management practices is low, according to The Plant Association and Management Guide for the Western Hemlock Zone (R6-ECOL-230A-1986).
- (TSHE/POMU-OXOR) association sites indicate easy-to-manage sites, with high timber productivity. Site Index, at 100 years, averages 157 feet (height) for Douglas-fir. The presence of this association generally indicates conditions favorable for most management activities.
- TSHE/BENE association sites represent sites that are somewhat drier and cooler. Timber productivity is moderate. Site Index, at 100 years, averages 125 feet (height) for Douglas-fir. Plantability on these sites may be restricted due to soils with a high rock content.
- TSHE/POMU association sites represent warm and moist sites with high productivity. Site Index, at 100 years, averages 161 feet (height) for Douglas-fir.
- TSHE/VAAL-GASH association sites represent sites with moderate moisture and somewhat cool conditions. This association has relatively low forest productivity. Site Index, at 100 years, averages 100 feet (height) for Douglas-fir.
- TSHE/VAAL/OXOR association sites represent moist, cool sites with productive soils. Productivity in this association is moderate to high. Most management activities are favorable within this association. Site Index, at 100 years, average 136 feet (height) for Douglas-fir.

All of the timber stands proposed for commercial thinning originated from artificial plantation as a result of clear-cut timber harvests in the 1960 – 1970s. These young stands are essentially dense, even-aged and are comprised of mostly Douglas-fir, with a component of western hemlock. These stands are also currently experiencing individual tree mortality from inter-tree competition, reduced diameter growth and tree canopies from high tree densities.

Table 3-15 contains the results of field examination conducted during the summer of 2006.

Table 3-15. Canyon stand exam summary

Unit	Acres	DBH	TPA	BA	RD	Vol/ac	Age	Plant Association
2	17	13.7	301	307	83	71,831	42	TSHE/POMU-OXOR
3	50	13.6	289	293	79	71,675	39	TSHE/POMU-OXOR
6	24	12.0	289	227	66	49,836	37	TSHE/POMU-OXOR
8	36	9.9	359	190	60	38,825	32	TSHE/BENE
9	42	11.1	331	224	67	44,712	30	TSHE/POMU-OXOR
10	62	10.7	229	144	44	28,566	28	TSHE/POMU-OXOR
11	14	11.6	219	160	47	30,868	29	TSHE/POMU
12	143	12.8	277	248	69	58,326	37	TSHE/POMU-OXOR
14	52	11.6	227	168	49	34,674	38	TSHE/VAAL-GASH
16	49	12.0	265	208	60	39.747	37	TSHE/VAAL/OXOR
17	48	14.1	222	240	64	53,697	37	TSHE/POMU-OXOR
20	16	11.4	283	200	59	41,186	29	TSHE/BENE/POMU

Table notes:

- DBH – Average stand diameter (inches) measured at 4 ½ feet above the ground.
- TPA – Average number of trees per acre.
- BA – Average stand basal area measured in square feet per acre.
- RD – Relative Density (Curtis).

- Vol/ac - Scribner board feet
- Age – At DBH

Site index for the 12 units, based on Douglas-fir at 100 years, averages 165 feet. Site potential tree height equals 210 feet for Riparian Reserve buffers.

Stand Structure

Stand structure is the physical and temporal distribution of trees within a stand. Stand structure provides a way to describe the various timber stands within the watershed, and when utilized with stand dynamics (changes within a stand over time), future stand structures and development patterns can be predicted. Stand structure definitions have been developed based on a number of different criteria (Hall et al. 1985), and have been expanded to include a total of 16 categories (see the Silvicultural report, Appendix A in the analysis file for definitions). Table 3-16 shows structure stages present for the affected sub-basins of the Lower Lewis River watershed. Calculations exclude non-National Forest System Lands and were obtained from the 1996 Lower Lewis River Watershed Analysis.

Table 3-16. Vegetation structures (percentages) for the various sub-basins of the Lower Lewis River Watershed.

Sub-Basin	Grass/Forb/ Seedling	Open Sap/Pole/ Small Tree	Closed Sap/Pole/ Small Tree	Lg Tree Single Layer	Lg Tree Multi-Layer	Hard-wood	Non-Forest
Jakes Creek	28	17	34	9	9	0	3
Middle Canyon Creek	40	14	18	8	20	0	0
Upper Big Rock Creek	42	4	26	4	22	0	1
Lower Big Rock Creek	11	4	34	37	13	1	0
Fly Creek	26	11	44	2	16	0	1
Lower Canyon Creek	43	3	35	2	15	0	2
Lower Siouxon Creek	2	1	86	0	0	10	1

All of the timber stands proposed for commercial thinning treatment are within the closed small tree structural stage.

Riparian Reserve areas (within the proposed harvest units) were previously harvested along with the upland portion of the units. Since then, these areas have grown back and currently contain a dense component of conifers which, like the uplands, are beginning to experience inter-tree competition for water, nutrients, and light. Snags and large, woody debris are lacking within these areas and currently do not meet the Forest Plan standards and guidelines nor meet the Aquatic Conservation Strategy objectives.

Structure and composition of forested stands within the analysis area are a result of a variety of disturbances. Fire and past timber harvesting are the most obvious disturbance. Since the 1800's, five large fires of catastrophic intensity have occurred within the Canyon Creek Watershed. The sub-basins associated with Siouxon Creek were heavily impacted by these fires. Since the 1940's, approximately 31 percent of the National Forest System lands within the watershed has been harvested. Most of these acres involved clear-cutting practices and were hand planted, primarily with Douglas-fir. Currently, these previously harvested acres lack a component of large, down wood debris, snags, and tree species diversity. Table 3-17 illustrates the percentage of harvested acres by sub-basin as of 1996.

Table 3-17. Past timber harvest acres (percentages) for the various sub-basins of the Lower Lewis River Watershed.

Sub-Basin	Percent Harvested
Jakes Creek	53
Middle Canyon Creek	64
Upper Big Rock Creek	59
Lower Big Rock Creek	29
Fly Creek	34
Lower Canyon Creek	63
Lower Siouxon Creek	2

Three forest insects, that inhabit forests and related areas, are active within the watershed. While none of these insects are currently significantly affecting the area, and are important for the development of snags and forest canopy gap creation, they are indicators of tree stress. The Douglas-fir beetle normally attacks green Douglas-fir trees that are felled, injured, or diseased. Since 1989, the effect of this beetle has been light. The fir engraver beetle attacks trees that are from pole size (>7" dbh) to large diameter mature trees. Periodic epidemics can occur following periods of drought. Trees infected with root rot are especially subject to attack. The current activity is most likely confined to pockets of root disease that occurs throughout the area. The silver fir beetle also attacks weakened trees. No significant damage or loss of timber has occurred for several years.

Armillaria root rot (*Armillaria ostoyae)* is scattered throughout the Gifford Pinchot National Forest, including the Lower Lewis Watershed. This disease is generally noticeable in areas where tree stress is created through inter-tree competition, off-site seed source, or compacted soils. Usually, scattered individual trees or occasional tree clumps are affected.

Hemlock dwarf mistletoe (*Arceuthobium tsugense*) is infecting the hemlock component within many of the stands in the planning area. This small, seed-bearing plant lives exclusively as a parasite on living hemlock trees. Infections produce witch's brooms and swellings, which divert the tree's resources to these points of infection. This can adversely affect tree height and diameter growth, reduce tree vigor, and make infected trees more susceptible to insects and other diseases. The degree of growth loss is directly correlated to the intensity of infection (the number and size of infections). Lightly infected trees have no measurable growth loss, but severely infected trees can lose up to 40 percent of their potential growth. The current mistletoe infection occurring on the hemlock trees within several of the proposed treatment units is light (Hawksworth rating 1-2).

Commercial thinning of young, second growth stands (past clear-cuts), within the watershed, began in the early 2000s with the sale of the Crayon Timber Sale. A total of approximately 387 acres of dense, closed, small tree stand types, 41-80 years old were sold in 2003 and logging in these areas started in 2006.

Environmental Consequences

Stand density is a primary factor affecting growth and vigor of the timber stands within the Canyon Timber Sale analysis area. High stand densities can produce water, light, and nutrient stress on trees. Trees with low vigor are more likely to be subject to mortality, especially during incidences such as climatic cycles, wildfires, and/or insects and disease. Reducing stand density by thinning, consistently shows increases in diameter, growth/vigor (Reukema et al. 1977), and reduces moisture stress on the residual stand.

Single layered, mono-cultured stands, within the riparian areas, are also a factor preventing these areas from meeting the Aquatic Conservation Strategy objectives in a timely manner. These mono-cultured stands are even-aged, single species stands, consisting of Douglas-fir with one, single canopy layer. Mono-cultured stands tend to increase the risk of disturbance, i.e. insects, disease, and/or fire. Single-layered stands lack structural diversity characteristics needed for Riparian Reserves. These conditions impede riparian dependent and associated species and prevent the Riparian Reserves from serving as connectivity corridors through the watershed. Reducing stand density within Riparian Reserves can accelerate development of larger diameter trees, provide large diameter coarse woody debris more quickly, and often times provide revenues to create snags and woody debris and plant shade tolerant trees for the establishment of a multi-layered, species-diverse timber stand. Under planting within these areas would accelerate the development of secondary tree canopies and increase tree species diversity.

The number of acres of treatment, as discussed above, which accomplishes density management and creates multi-layered stands within the Riparian Reserves, was used to evaluate the alternatives. Table 3-18 compares the treated acres for each alternative that affect stand density and the establishment of multi-layered/species diverse stands within the riparian reserves.

Table 3-18. Summary comparison of treatments by alternative

Alternative A	Evaluation Criteria	Alternative B
479	Density Management Treatment (Acres)	0
41	Establishes Multi-Layered/species diverse stands within the riparian (Acres)	0

Measurement Methods for Alternative Analysis:

Acres of treatment activity that accomplishes density management
Acres of treatment activity that creates multi-layered stands within the riparian

Alternative A

Analysis Summary: Alternative A is determined to be a good alternative for meeting the silvicultural objectives of density reduction and establishing multi-layered, species diverse stands within the watershed.

Direct, Indirect and Cumulative Effects (1-5 years)

A total of 438 acres of upland timber stands and 41 acres of riparian stands would be directly treated using a variable density reduction thinning prescription (VDT). Variable density thinning increases diversity through leave tree selection, creates small openings, leaves small thickets, and enhances growth of the dominate trees (Washington State DNR – 2006). Young stand thinning would keep the trees

growing vigorously. The hemlock component should be able to put on height growth faster than mistletoe infections can intensify upward. Studies in Alaska have shown that, in these cases, the dwarf mistletoe may eventually die out as stands reach 40 years of age or so and infected lower branches die. At the same time, opportunities are available to begin to replenish the snag and large, down woody debris component, within these units, through KV funding (timber receipts).

Thinning of the matrix stands 2, 6, 8, 9, 10 11, 12, 14, 16, 17, and 20 would allow adequate density reduction for maintaining and/or increasing individual tree growth. The degree of competition between trees within a stand, is developed from a mathematically derived parameter known a Relative Density (RD). The higher the RD number, the denser the stand, which results in more inter-tree competition. As a general rule, commercial thinning entries should reduce existing RDs by at least 20 RD points from the pre-thinning RD and generally no more than 40 percent of the pre-thinning RD. This degree of thinning is sufficient to allow the residual trees approximately 15-20 years of free growth.

Within portions of units 8, 9, and 10, about forty percent of the acreage (55 acres) would be thinned heavily to between an RD25-34 (85 trees per acre) to provide a mix of forage and cover for deer and elk. Although these acres would not be understocked, the thinning grade would be high enough to reduce the stand level volume growth to a point that is below the wood production goal of the Matrix lands. Tree canopy closure, within these acres, would be delayed an additional 5-10 years.

Thinning of the Late-Successional Reserve (LSR) unit 3 (45 acres) and the outer portions of the Riparian Reserves within units 3, 6, 8, 10, 12, 14, 16, 17, and 20 would also allow adequate density reduction for maintaining and/or increasing individual tree growth, and providing a favorable understory environment to allow for the survival/growth of the under planted shade tolerant tree species to develop a second canopy layer.

Approximately 22 acres of gaps (1/3-1/2 acre openings) would be well distributed within the upland ground of units 2, 3, 6, 11, 12, 14, 16, 17, and 20 to increase stand complexity and biodiversity. Gaps were not included in the silvicultural prescription in the deer/elk winter range units 8, 9, and 10 due to the forty percent of the upland acreage already proposed for heavy thinning. Approximately 74 acres of skips (retention islands) would be retained for no-cut leave areas. These areas would also add complexity as thickets and special niches, such as skips around an old snag or large woody debris concentrations. Approximately eighty percent of the skip acreage would be within the no-cut-portion of the Riparian Reserves and the remainder distributed within the units.

Table 3-19 displays the pre-thinning and post thinning RD levels. At the end of this period, the tree canopies would begin to close, inter-tree competition begins, and another density reduction treatment would usually be needed. The exceptions would be units 8, 9, and 10, where 55 acres is planned for heavy thinning. Both vertical and horizontal structure would develop, but the rate of development would slow markedly as the tree canopy closes over time. It is estimated that the percent skylight through the canopy will decrease by an average of 2 percent per year because of the rapid and dynamic live crown development in the stands (Chan, et. al. 2006). As a result from "thinning from below" the cut trees are from the smallest diameter size class within the stand. The smaller diameter size class trees are usually the trees that produce the mortality within a stand when inter-tree competition is high. This alternative "captures" and utilizes a portion of this component for wood products.

Table 3-19. Pre and post relative density levels and harvest by stand

Unit	Existing RD Level	Post RD Level	Harvest Volume (mbf)
2	83	50	460
3	79	47	1329
6	66	40	255
8	60	36*	413
9	67	40*	526
10	44	31*	231
11	47	31	71
12	69	41	2359
14	49	31	503
16	60	36	559
17	64	38	708
20	59	35	194
Total	--	--	7608

* - Does not include deer/elk thinning acres

Alternative A would help establish 41 acres of multi-layered/species diverse stands within the Riparian Reserves. After the density reduction treatment, these acres would be planted with shade tolerant conifer species (western hemlock and western redcedar). A RD34-47 thinning grade, proposed for these acres, would leave approximately 125-140 trees per acre and allow a short-lived window for sufficient growing space for understory trees, shrubs, and herbs establishment. These additions to the Riparian Reserves would help these areas meet the ACS objectives in a more, timely manner. Recent research on forest ecosystems has clarified the importance of structural complexity to forest ecosystem functioning and the maintenance of biodiversity (Franklin et. al., 1993). Important structural features include snags, woody debris, multiple canopy layers, and varied tree sizes. Meeting ACS objectives would improve riparian dependent and associated species habitat and provide quality connectivity corridors through the watershed.

To help determine the tree growth benefits gained from thinning, data from unit 12 was used to illustrate the conifer diameter growth in five years. The Forest Vegetation Simulator (FVS) was used to simulate forest growth and portray structural and compositional characteristics for the vegetation analysis. Table 3-20 compares the diameter gain of stand 12, with and without thinning, based on the FVS Simulator results.

Table 3-20. Five year projected diameter growth – Unit 12

Treatment	Average Stand Diameter in 5 years
No Thinning (Alternative B)	13.6" dbh (0.8" diameter growth)
Thin to Curtis RD41 (Alternative A)	15.4" dbh (1.0" diameter growth)

Alternative A not only increases the annual diameter tree growth more than Alternative B, the residual average stand tree diameter (dbh) is also larger since the smaller diameter trees are removed during thinning.

Within the next five years, it is anticipated that the Crayon Timber Sale (387 acres) and this sale would be commercially logged on National Forest System Lands within the Lower Lewis River Watershed. No additional, planned, large-scale vegetative treatments during this 1-5 year time period are proposed or foreseen at this time on National Forest Lands.

Alternative A: Cumulative Effects (10 and 50 years)
The inter-tree competition within the proposed units would not be expected to be a limiting growth factor in ten years since the tree canopies would still be enlarging into unoccupied space. A 44 percent average stand diameter growth gain is realized within the first 10 years compared to the No Action alternative. The significant point here is the rate of diameter increase that occurs after the density reduction treatment in 10 and 50 years as a result of thinning. The rate of increase is higher as spacing of the residual trees increase. For example, no thinning shows an average stand diameter increase of 7.8 inches and thinning shows an average stand diameter increase of 9.2 inches over a 50-year period. The effect on forest health would be increased stand vigor, as the remaining trees would have less stress associated with competition for moisture, light, and nutrients.

Over the long-term, these stands could help fill in the current acres within the late-successional stand structure in a more, timely manner. In 1996, the Lower Lewis River Watershed contained nineteen percent late-successional forest stands, compared to 35-45 percent historically. This component is important to ecosystem diversity and is ecologically significant in functioning as refugia for a host of old-growth associated species. Watersheds with less than 15 percent late-successional forest component are considered at risk for local extirpation of an array of species.

Table 3-21. Ten and fifty year projected diameter growth – Unit 12

Treatment	Average Stand Diameter in 10 years	Average Stand Diameter in 50 years
No Thinning (Alternative B)	14.5" dbh (1.7" diameter growth)	20.6" dbh (7.8" diameter growth)
Thin to Curtis RD41 (Alternative A)	16.4" dbh (2.0" diameter growth)	23.6" dbh (9.2" diameter growth)

No additional planned, large-scale vegetative treatments within the watershed during the next 10 year time period are currently proposed or foreseen, on National Forest System Lands. However, in approximately 20 years and every 20 years thereafter, it is anticipated that the watershed would be re-entered for additional commercial density reduction treatments. These treatments would most likely be scheduled on some of the same acres as the Canyon units and also on new acres needing thinning.

Alternative B – No Action
Analysis Summary: Alternative B fails to meet the silvicultural objectives of density reduction and establishing multi-layered, species diverse stands within the watershed.

Direct, Indirect and Cumulative Effects (1-5 years)
Under the No Action alternative, all of the proposed treatment stands would continue to experience inter-tree competition due to high tree densities. A loss of tree vigor, especially in the overtopped and intermediate tree crown class, would continue. As a result, these stands would continue to self thin from natural causes and trees with sparse crowns and reduced live crown canopies would likely be candidates for future mortality, particularly during the drier years. Reduced sunlight through these dense tree canopies would continue the self-pruning process in which the lower limbs of the trees die from too much shading. This would prevent the trees from developing deep, live crowns. When the live crown of a tree is reduced, the tree will respond with decreased diameter and height growth. These conditions would also result in a less-stable stand more prone to large-scale disturbances.

This alternative would also prevent the opportunity to improve the percentage of desirable species and increase the biodiversity within portions of the riparian reserves. Approximately 41 acres of riparian reserves and 45 acres of unit 3, proposed for under planting of shade tolerant species, would not occur. Natural stand development would be relatively slow. The current mono-cultured condition and single layer canopy within these areas would continue for some time until the watershed re-establishes a diverse, native seed source and natural regeneration occurs. Restoring ACS objectives, in a timely manner, would be delayed within these acres.

Alternative B: Cumulative Effects (10 and 50 years)
In 10 years, the landscape, within the Canyon Creek watershed, reflected in Alternative B, would continue on the same trajectory as described for the first 1-5 years. The dense Douglas-fir component would continue to grow in the overstory. However, individual tree growth would continue status quo or slightly decline due to moisture, light, and nutrient stress within the trees. Mortality of single trees would continue and would be inversely related to the density levels. The trees with sparse crowns and reduced live crown canopies would likely be candidates for future mortality. The FVS Simulator shows the stand experiences about 7 percent mortality by the end of the 10-year period and 30 percent of the trees would die within 50 years. The forest floor of these stands would remain shaded and suppress the establishment and growth of shade intolerant grass, forbs, brush, and conifer species.

In 50 years, a small percentage of these stands may start to become populated, with scattered shade tolerant conifer species, most likely western hemlock, in the understory. Mortality of single and groups of trees would continue and accelerate in denser stands.

Botany

The analysis area used for the Botany effects analysis lies within the Lower Canyon Creek and Lower Siouxon sixth-field watersheds, which are within the Southern Washington Cascades Province of the Pacific Northwest (Franklin & Dyrness 1973). The analysis area ranges from approximately 1,000 ft. to approximately 3,000 ft. elevation, and is located within the western hemlock vegetation zone (Franklin & Dyrness 1973).

The dominant overstory cohort of trees within stands ranged from 28-42 years of age, and includes *Tsuga heterophylla* (western hemlock) and *Pseudotsuga menziesii* (Douglas-fir). Some of the proposed units contain springs and wetlands, and most contain large rotting logs.

Unit Descriptions:

Units 2 and 3 are located on ridgelines between Canyon Creek and Siouxon Creek, and forested with approximately 40 year old second growth *Tsuga heterophylla* and *Pseudotsuga menziesii*. Copious rotten logs are found within the units, along with pockets of hardwood trees and shrubs.

Unit 8 is a hilltop unit that contains no aquatic features, and is dominated by second growth (32 years old) *Tsuga heterophylla* and *Pseudotsuga menziesii* in the forest overstory. Rotten logs are fairly common and abundant within this unit.

Unit 9 contains a small spring and moist *Alnus rubra* (red alder) bench in the southwest section of the unit. The forest overstory is dominated by second growth (30 years old) *Tsuga heterophylla* and *Pseudotsuga menziesii*. Rotten logs are common and abundant within the unit.

Unit 10 contains a sizeable wetland complex. The center of the complex is occupied by a thriving patch of *Carex obnupta*, with is surrounded by healthy hardwood communities dominated by *Alnus rubra* and *Acer circinatum* (vine maple). Rotten logs are common and abundant within the unit. The upland forest surrounding the wetland is dominated by second growth *Tsuga heterophylla* and *Pseudotsuga menziesii* that are approximately 30 years old. Early spring surface water flows from the sedge wetland north through Unit 11 and to Canyon Creek as well as to the southwest to Big Rock Creek.

Unit 11 is a second growth 30 year old stand that is densely stocked, and as a result, dark at the ground level. Rotten logs are common and abundant in the unit. Widely dispersed surface water converges into an intermittent channel within the unit; water appears to be overflow from the wetland located in Unit 10.

Unit 12 is a mid slope unit in the Canyon Creek drainage. The overstory is dominated by second growth (35-40 years old) *Tsuga heterophylla* and *Pseudotsuga menziesii*, with some *Abies procera* (noble fir). *Alnus rubra* dominated hardwood communities occur along stream drainages and in wet pockets. Three small perennial streams flow across the unit, and *Corydalis scouleri* (an understory herb) is unusually abundant in some riparian areas. There are some large rotten logs located within this unit. This unit is located adjacent to an old-growth stand.

Unit 14 is an approximately 40 year old stand dominated by *Pseudotsuga menziesii*, *Tsuga heterophylla*, and *Abies procera*, with an undergrowth of *Tsuga heterophylla* that is very dense (dog hair) in some places. The stand sits above a band of cliffs that separate it from the footslope and valley below. Two small intermittent channels cross the unit and drop down through the cliffs into Jakes Creek below.

Unit 16 is located on a ridge separating two upper forks of Big Rock Reek north of Gumboot Mountain. The stand is fairly uniform, and dominated by approximately 40 year old *Tsuga hetrophylla* and *Abies*

procera, with some *Pseudotsuga menziesii* and *Abies amabilis* (Pacific Silver Fir). The understory is very shaded, and vegetation is very sparse. Rotten logs were plentiful, but appeared dry, hosting few bryophytes.

Unit 17 is an approximately 40 year old stand in the Fly Creek drainage west of Gumboot Mountain. The unit is surrounded by riparian habitats associated with Fly Creek and two smaller perennial tributaries. Large woody debris was common and abundant in the unit.

Unit 20 is located on a south-facing slope above Canyon Creek. The stand is dominated by young (~ 40 years old) *Pseudotsuga menziesii*, with a thick understory of *Gaultheria shallon* (salal) and *Berberis nervosa* (Oregon grape), with inclusions of *Polystichum munitum* (sword fern). There were fewer large rotten logs than in other stands, and the logs tended to be dry.

Pre-Field Analysis:

In order to determine whether the activities proposed in this project pose a potential threat to Regional Forester's Proposed Threatened, Endangered, or Sensitive (PETS) botanical species, a pre-field review was performed. This review consists of an analysis of the potential effects of the project on known sites of species of concern, or on potential habitat for these species. Aerial photographs, the July, 2004 Regional Forester's Sensitive Plant list (USDA Forest Service 2004b), forest GIS information, Interagency Species Management System databases (ISMS/GEOBOB), data from CVS Random Grid Surveys (2005), district files, and Sensitive Plants and Noxious Weeds of the Gifford Pinchot National Forest (USDA Forest Service 1992) were consulted for the pre-field review. Based upon this information, the list of PETS species can be narrowed to focus on those species potentially present in the project area.

The Regional Forester currently lists 88 PETS botanical species documented or suspected to occur on the Gifford Pinchot National Forest. This list was updated in July 2004 and includes 52 vascular plants, 18 lichens, 4 bryophytes and 14 fungi (USDA Forest Service 2004b). See Canyon Timber Sale Botanical Report, Appendix A for the list of these species.

In addition, as a result of Judge Pechman's court order dated January 6, 2006, the Forest Service is directed to resume implementation of the 2001 Survey and Manage Record of Decision (as amended by annual species' reviews) (USDA & USDI 2001a). See Canyon Timber Sale Botanical Report, Appendix C for the list of these species.

The pre-field review for this project was performed during April, 2006. Pre-field review documentation is on file at Mt. Adams Ranger District, in the Canyon Thinning Timber Sale Project Botany files. Table 3-22 lists all PETS and Survey and Manage Category A and C (surveys required) botanical species documented or suspected to occur within the project area.

Table 3-22. Regional Forester's sensitive botanical species documented or suspected to occur within the Canyon Timber Sale planning area

Scientific name	Documented (D) or Suspected (S) within project area	Site location identification within project area	Documented (D) within adjacent 5th field watershed	Likelihood that species is present within the project area? (based on professional opinion of pre-field review preparer) **
VASCULAR PLANTS				
Agoseris elata	S			Low
Bolandra oregana	S			Low
Botrychium montanum	S			Low
Chrysolepis chrysophylla	S		D	Low-Moderate
Cimicifuga elata	S			Low
Coptis asplenifolia	S			Low
Coptis trifolia	S			Low
Corydalis aquae-gelidae	D	WNHP Element Occurrence # 011*		High
Cypripedium fasciculatum	S			Low
Erigeron howellii	S			Low
Erigeron oreganus	S			Low
Euonymus occidentalis	S			Low
Fritillaria camschatcensis	S			Low
Galium kamtschaticum	S			Low
Heuchera grossulariifolia var. *tenuifolia*	S			Low
Howellia aquatilis	S			Low
Liparis looselii	S			Low
Montia diffusa	S			Low
Ophioglossum pusillum	S			Low
Parnassia fimbriolata var. *hoodiana*	S			Low
Pityopus californica	S			Low
Platanthera orbiculata var.	S			Low

Scientific name	Documented (D) or Suspected (S) within project area	Site location identification within project area	Documented (D) within adjacent 5th field watershed	Likelihood that species is present within the project area? (based on professional opinion of pre-field review preparer) **
orbiculata				
Platanthera sparsiflora	S			Low
Poa laxiflora	S			Low
Poa nervosa	S			Low
Polemonium carneum	S			Low
Ranunculus populago	S			Low
Rorripa columbiae	S			Low
Sidalcea hirtipes	S			Low
Sisyrinchium sarmentosum	S		D	Low
Utricularia intermedia	S		D	Low
LICHENS				
Cetrelia cetrarioides	S		D	High
Chaenotheca subroscida	S			Low
Collema nigrescens	S			Low
Dendriscocaulon intricatulum	S		D	Low
Dermatocarpon lurdium	S		D	High
Hypogymnia duplicata	S			Low
Hypotrachyna revoluta	S			Low
Leptogium burnetiae	S			Low
Leptogium cyanescens	S			Low
Leptogium rivale	S		D	Moderate
Lobaria linita var. *tenuoir*	S			Low
Nephroma bellum	S			Low
Nephroma occultum	S		D	Low-Moderate
Pannaria rubiginosa	S			Low
Peltigera neckeri	S			Low
Peltigera pacifica	S		D	High
Pilophorus nigricaulis	S			High
Platismatia lacunosa	S		D	Low
Pseudocyphellaria	S		D	Moderate

Scientific name	Documented (D) or Suspected (S) within project area	Site location identification within project area	Documented (D) within adjacent 5th field watershed	Likelihood that species is present within the project area? (based on professional opinion of pre-field review preparer) **
rainierensis				
Tholurna dissimilis	S		D	Low
Usnea longissima	S		D	Moderate
BRYOPHYTES				
Schistostega pennata	S		D	Moderate
Tetraphis geniculata	S		D	High
FUNGI List includes species that are Sensitive. With the exception of *Bridgeoporus nobillisimus*, all species listed below are considered survey impractical.				
Albatrellus ellisii	S			Low
Bridgeoporus nobilissimus	S			Low
Cordyceps capitata	S			Low
Gomphus kauffmanii	S			Low
Gyromitra californica	S			Low
Leucogaster citrinus	S			Moderate
Mycena monticola	S			Low
Otidea smithii	S			Low
Ramaria cyaneigranosa	S			Low-Moderate
Ramaria gelatiniaurantia	S			Low-Moderate
Ramaria rubrievanescens	S			Low
Sarcodon fuscoindicus	S			Low-Moderate
Sowerbyella rhenana	S			Low
Spathularia flavida	S			Moderate

* Location just outside project unit boundary.
** The methodology used to determine the likelihood of occurrence was based on an example thought process for evaluating likelihood of occurrence and/or project effects prepared by R6 Interagency Special Status Sensitive Species Program staff, and which is posted for use on the Interagency Special Status Sensitive Species Program website at: http://www.or.blm.gov/ISSSP/Conservation_Planning-and-Tools.htm (USDA Forest Service 2004c). This method uses a dichotomous key approach.

Field Surveys:

Botanical surveys were conducted in Canyon Timber Sale from July 12 through September 11, 2006 (for complete survey documentation, consult Mt. Adams Botany Canyon Timber Sale Project file). Surveys were conducted for Sensitive botanical species, based on the Regional Forester's July 2004 list (USDA Forest Service 2004b); surveys for Survey and Manage species were also conducted, based on the 2001 Survey and Manage Record of Decision (USDA & USDI 2001a,b) (but inclusive of changes implemented through Annual Species Reviews through 2004).

Due to the seasonal nature of plant identification it is not always possible to completely survey a given area with a one time survey, however, the knowledge of plant-habitat relationships, growth habit, and flowering dates helps the investigator in this regard. The phenology of Sensitive/Survey and Manage lichens, bryophytes and the fungus *Bridgeoporus nobillisimus*, is such that they can be identified throughout most of the year. Based upon this, surveys for these species are generally conducted at the same time as surveys for PETS species.

In the 2004 Survey and Manage Record of Decision (USDA & USDI 2004a, pg. 6), the assumption was made that species being transferred from the Survey and Manage Program to the Sensitive Species Program that were not considered "survey practical" under the Survey and Manage Standards and Guidelines (most category B & D species, including most fungi), and would not require survey under the Sensitive Species Program. Rather, other components of pre-project clearances (i.e. habitat evaluations) would be utilized to evaluate potential risks to the species resulting from project activities. This evaluation is then used to prescribe project design features and/or mitigations to address these risks. Of the Sensitive species not specifically targeted during surveys, the project area may provide habitat for 13 fungi and 1 lichen species. These species are addressed within the environmental consequences section below.

Field Survey Results

Threatened, Endangered & Proposed Plant Species: None were located within the project area.

Sensitive Plant Species: Multiple sites for three Sensitive Species were found within the Canyon Timber Sale project area, including *Corydalis aquae-gelidae*, *Tetraphis geniculata*, *Peltigera pacifica*, and *Usnea longissima*. Occurrences are listed in Table 3-23.

Table 3-23. Sensitive species occurrences within Canyon Timber Sale.

Location (Unit)	Species	Voucher collection number(s) & monumentation	Databased in NRIS Rare Plants?
3	*Peltigera pacifica – 2 occurrences* *Usnea longissima**	MTALICH120; flagged from Rd 57 120 ft @324^0 MTALICH112	Y Y
9	*Tetraphis geniculata – 2 occurrences*	MTABRYO231; flagged with red striped and lime	Y

		flagging and marked on Rd 572	
10	*Peltigera pacifica – 1 occurrence*	MTALICH110	Y
12	*Tetraphis geniculata – 1 occurrence* *Usnea longissima**	MTABRYO230; flagged with red striped and lime flagging on west bank of stream. No collection made	Y Y
14	*Peltigera pacifica – 2 occurrences*	MTALICH114	Y
17	*Tetraphis geniculata – 5 occurrences* *Peltigera pacifica – 4 occurrences* *Corydalis aquae-gelidae**	MTABRYO223 MTALICH113 WNHP element occurrence # 011	Y Y N (in WNHP)
20	*Usnea longissima**	MTALICH117	Y
* Found outside unit.			

Survey and Manage Plant Species:
In addition to being Sensitive Species, *Corydalis aquae-gelidae* and *Tetraphis geniculata* are Category A Survey and Manage Species, with a mandate to conduct surveys and to manage all known sites, while *Peltigera pacifica* is a Category E Survey and Manage Species, with a mandate to manage all known sites.

Other botanical resources of concern:
Wetlands within the project area (including those in Unit 10, 11 and 12) provide valuable habitat for moisture loving botanical species such as *Carex obnupta* and *Corydalis scouleri*. The edges of wetlands and riparian zones along stream channels host hardwood dominated communities that provide an important element of diversity in conifer dominated forests. Hardwood gaps hosting tall shrubs (such as *Acer circinatum* and *Corylus cornuta*) and hardwood trees (such as *Alnus rubra* and *Acer macrophyllum*), are particularly important from the perspective of creating microhabitat diversity for epiphytes and understory species within an otherwise fairly homogeneous forest. Large woody debris (large old stumps, logs and snags) provide current and future potential habitat for a suite of Sensitive and Survey and Manage bryophytes and lichens.

Environmental Consequences

Threatened, Endangered & Proposed Plant Species:
At this time there are no federally listed (proposed, endangered, threatened - PET) plant species known to occur on the Forest, however one federally threatened species, (*Howellia aquatilis*) is suspected. *Howellia aquatilis* has an extremely narrow habitat tolerance, generally confined to palustrine emergent wetlands with seasonal drawdown. Wetlands to be impacted by this project were surveyed and no PET species were located. Thus, project action alternatives would have **no effect** on federally listed botanical species.

Sensitive Species:
Surveys performed within and immediately surrounding the project area located four Sensitive species: *Corydalis aquae-gelidae*, *Tetraphis geniculata, Peltigera pacifica*, and *Usnea longissima* (Table 3-23). A determination of impact for each species is documented, below (summarized in Table 3-24). Many resources were referenced in developing the rationale for effects determinations and recommended mitigations, including (but not limited to): Arora (1986), Castellano et al. 2003, Chen et al. 1990, Harpel and Helliwell 2005, Hitchcock et al. 1969, Lawton 1971, Lesher et al. 2000, Survey and Manage Management Recommendations for lichens and bryophytes, McCune and Geiser 1997, Pojar and MacKinnon 1994.

Table 3-24. Summary of conclusion of effects for sensitive plant species in Canyon Timber Sale

Species	Alt A: Proposed Action	Alternative B: No Action
1. *Corydalis aquae-gelidae*	No impact (NI)	No impact (NI)
2. *Tetraphis geniculata*	May impact individuals or habitat, but would not likely lead to a trend towards federal listing (MIIH)	No impact (NI)
3. *Peltigera pacifica*	May impact individuals or habitat, but would not likely lead to a trend towards federal listing (MIIH)	No impact (NI)
4. *Usnea longissima*	No impact (NI)	No impact (NI)
5. Survey impractical species (likelihood of presence estimated, as described above).	May impact individuals or habitat, but would not likely lead to a trend towards federal listing (MIIH)	No impact (NI)

Corydalis aquae-gelidae
Corydalis aquae-gelidae is a showy perennial vascular plant that grows in cold water seeps and springs and along creek and stream margins, often occurring within the stream channel itself. The species is thought to require an upper canopy closure of 70 to 90 percent, and a gravelly sand substrate. The species is a Pacific Northwest endemic species with 93 of a total of 159 known sites found on the Gifford Pinchot National Forest. Of these 93 sites, 17 are located within the Merwin Reservoir fifth-field watershed (where the majority of the proposed Canyon units are found), while an additional 4 sites are found within the Yale Reservoir fifth-field watershed, which incorporates proposed units 2 and 3. One site (Washington Natural Heritage Program Element Occurrence # 11) is found just outside the boundary of Unit 17. On the Gifford Pinchot National Forest, *Corydalis aquae-gelidae* is most often found associated with headwaters and tributaries (stream order 0 to 2). The species is Forest Service (FS) Region 6 Sensitive in Oregon and Washington, and is a Survey and Manage Category A species throughout the Northwest Forest Plan area (USDA and USDI 2001). *Corydalis aquae-gelidae* is Bureau of Land Management (BLM) Bureau Sensitive in Oregon, and BLM Bureau Assessment in Washington. NatureServe ranks *Corydalis aquae-gelidae* with a Global Heritage Rank of G3, representing a global condition of vulnerable and at moderate risk of extinction due to very restricted range, relatively few populations, recent and widespread declines, or other factors (Oregon Natural Heritage Information Center 2004). The Oregon Natural Heritage Information Center also ranks the species S3 and Heritage List 1, which they consider critically imperiled, and the Washington Natural Heritage Program (WNHP)

ranks the species as S2S3 (imperiled, to rare or uncommon). This species is also a federal Species of Concern (SoC). Most known sites of this species are on federal land; approximately 70 percent are within the Matrix land allocation. Because of the close proximity of sites to perennial water, many sites are located within Riparian Reserve land allocations.

Surveys of Canyon Timber Sale did not locate any new sites for this species, but one known occurrence is located northeast of Unit 17 (outside the treatment area), near the head of Fly Creek. Project design features incorporate a 210-foot no-cut buffer along this creek which would maintain desirable (undisturbed, shaded) habitat conditions for the species. Harvest activities within this unit would not directly impact the known occurrence. For this reason, **Alternatives A and B** would have **no impact** upon this species.

Tetraphis geniculata

Tetraphis geniculata is a bryophyte (moss) that grows on rotten stumps and logs, in shady, humid forests at low to middle elevations. The species ranges from northern California to Alaska. According to a 2005 ISMS query, 103 sites for this species have been located in Washington and Oregon, 60 from the Gifford Pinchot National Forest. In addition, 34 new locations for this species were located during surveys of the Tee Timber Sale during 2005. The remaining sites are from the Columbia River Gorge National Scenic Area (1), Mt. Baker Snoqualmie National Forest (3), Mt. Hood National Forest (6), Mt. Rainier National Park (1), Olympic National Park (3), Olympic National Forest (20), Salem District BLM (1) and from other unidentified public lands. Superficially, it appears that the Gifford Pinchot National Forest may provide some of the best habitat for this species within the Northwest Forest Plan area.

Tetraphis geniculata reproduces asexually by means of gemmae cups; when raindrops hit the cups, the gemmae are ejected out of them. The species also reproduces sexually though the production of capsules and spores. The success of the species in establishing itself on new substrate probably depends on propagules landing on large decaying wood that remains moist.

Threats to this species include disturbance of the coarse woody debris substrate, and alteration of the microclimate of the site through opening of the surrounding forest canopy (i.e. increasing solar and wind penetration, with subsequent dessication of coarse woody debris substrate.) (Harpel and Helliwell 2005).

Alternative A incorporates project design features designed to minimize the impact of project activities upon the known *Tetraphis geniculata* sites, by maintaining the moist shaded microclimate around known sites found within the harvest area of units through implementation of site buffers (see Appendix A for buffer specifications), by maintaining no-cut buffers along many streams, and by providing large coarse woody debris for potential future substrate. Although surveys for this species revealed eight new locations within the Canyon Timber Sale area, other sites and habitat for this species might also exist within the project area. For this reason, **Alternative A may impact** individuals or habitat for this species, but would not likely contribute to a trend towards federal listing or cause a loss of viability to the population or species as a whole. **Alternative B** would have **no impact** upon this species.

Peltigera pacifica

Nine new sites for this species were located in the Canyon Timber Sale during 2006 surveys. An ISMS query (2005) showed that there are 114 sites for this species recorded from across the range of the Northwest Forest Plan; at least 23 of these sites are reported from the Gifford Pinchot National Forest. In addition, 4 additional occurrences were discovered during surveys of Tee Timber Sale in 2006.

Peltigera pacifica is a foliose lichen species that often grows on soil, duff or woody debris, and occasionally on tree bases. It is generally a distinctive species with copious lobules produced at the edge of lobes, giving the species the appearance of "frilly" edges. Surveys on the Gifford Pinchot National

Forest have located this species in abundance spread throughout stands regenerated after fire, growing on mineral soil and woody debris – it seems to be fairly well distributed across the Forest.

Alternative A incorporates project design features designed to minimize the impact of project activities upon *Peltigera pacifica* occurrences, by maintaining the moist shaded microclimate around known sites found within the harvest area of units through implementation of a site buffers (see Appendix A for buffer specifications), by maintaining no-cut buffers along many streams, and by providing large coarse woody debris for potential future substrate. Although surveys for this species revealed 9 new occurrences of this species within the Canyon Timber Sale area, other sites and habitat for this species might also exist within the project area. For this reason, **Alternative A may impact** individuals or habitat for this species, but would not likely contribute to a trend towards federal listing or cause a loss of viability to the population or species as a whole. **Alternative B** would have **no impact** upon this species.

Usnea longissima

Usnea longissima is a distinctive epiphytic, fruticose, green-algal lichen. This species grows as long, pendulous, branches forming 'ropes' that can grow to 2 meters or longer. The species is most often found growing within riparian zones or along ridges. *Usnea longissima* is thought to be dispersal limited (McCune & Geiser 1997). Its main (only confirmed) form of dispersal is by vegetative means; portions of the long branches of this species may fragment and be dispersed by wind or birds to new locations. For this reason, well developed occurrences of this species may provide important dispersal centers, and are sometimes associated with old-growth forests (where the species has presumably had much time to establish and grow).

This species is known from 342 sites across the range of the Northwest Forest Plan; 8 of these sites are located on the Gifford Pinchot National Forest.

The three new occurrences of this species located during project surveys were all located outside unit boundaries, and within (or directly adjacent to) old-growth stands. It is likely that the fragments located during surveys were dispersed from high in the canopy of the old-growth stands. Project activities would have no direct impact upon this species. A potential indirect impact of thinning adjacent to the old-growth habitat of this species may be an increase in light and wind penetration to the host stands, but this is unlikely to negatively impact *Usnea longissima* unless wind penetration is increased to such an extent that the thalli are blown out of the host trees. This is unlikely to be the case in a thinning project that retains about 40 percent canopy cover. In addition, the riparian no-cut buffers would likely form a buffer to prevent substantially increased wind penetration into unit 12 (the no-cut buffers would be located along the border of the harvest unit and the old-growth stand that hosts *Usnea*), unit 20 (old-growth stand is adjacent to Canyon Creek) and unit 3 (where species was found in a small old-growth pocket along the edge of a spring fed channel). For this reason, **Alternatives A and B** would have **no impact** on *Usnea longissima*.

Survey-impractical Sensitive & Survey and Manage Species

Within all units of Canyon Timber Sale there is potential habitat for a number of Sensitive species, including 13 fungi species and 1 lichen species, that were not specifically targeted during surveys. These species are all thought to be associated primarily with late-successional/old growth forests (USDA & USDI 1994, 2001), though some of these species have been located in forests less than 80 years old. Because fungi "fruit" (produce visible sporocarps) unpredictably (i.e. may not fruit each year, vary in fruiting timing from year to year), surveys are not reliable indicators of presence or absence. In addition, many fungi species require laboratory examination by a taxa expert for reliable identification. As a result, it is probable that many Sensitive fungi species are under-reported and under-collected across their ranges. In addition, the habitat requirements for many of the species are too broad or too poorly

understood to allow for reasonable mitigations at a project scale, particularly when no sporocarps have been located within the project area.

It is unknown whether the survey impractical Sensitive species occur within the project's area of impact. For the purpose of analysis, it is assumed that there is potential for occurrence within the project area and an estimate is made whether the likelihood of occurrence is low, moderate, or high, using guidelines set by Region 6 of the Forest Service (USDA Forest Service 2004c); the impact analyses (see below) reflect this assumption.

Lichens

Chaenotheca subroscida
This species is an epiphytic "pin lichen". It grows deep in the furrows of the bark of mature and old-growth conifers. On the Gifford Pinchot National Forest, there is one known site for this species on the Cowlitz Valley Ranger District (ISMS Query, 2005). The site is located at 4,600 ft. elevation, just southeast of the junction of Killen Creek and Forest Road 2329, in a mixed stand of *Picea englemannii*, true firs and pine in an area of the 1918 Cispus Burn. The species was found growing on a mountain hemlock (*Tsuga mertensiana*) at this site. Three additional sites for this species are recorded in ISMS, all from the Six Rivers National Forest, Lower Trinity Ranger District.

The Canyon Timber Sale is located at approximately 1,000-3,000 ft. elevation, and the plant community type is quite different from the site which hosts this species on the Cowlitz Valley District, i.e. dominated by fairly homogeneous conifer stands dominated by Douglas-fir and western hemlock (*Pseudotsuga menziesii* and *Tsuga heterophylla*). Because the habitat within Canyon Timber Sale is quite dissimilar to the site from which the species is known on the Gifford Pinchot National Forest, and the project area is located at considerable distance from any known site for this species, the potential for occurrence within the project area is estimated to be low.

Since *Chaenotheca subroscida* is a small, cryptic species that takes specialized knowledge to identify accurately (for these reasons this species is considered survey impractical), it is likely under-reported and under-collected. Based on the known site habitat description from the Gifford Pinchot National Forest, it is presumed that the montane habitat located within the mountain hemlock zone (such as that located on the slopes of Mt. Adams, within the Mt. Adams Wilderness area) would continue to provide undisturbed habitat for this species outside of the Canyon Timber Sale. For these reasons, **Alternative A may impact** *Chaenotheca subroscida* individuals or habitat, but would not likely lead to a trend towards federal listing or a loss of viability to the species. **Alternative B** would result in **no impact** to this species.

Fungi

Timber harvest has demonstrated negative effects upon fungi (Amaranthus & Perry 1994; Byrd et al. 2000; Kranabetter & Kroeger 2001; Kranabetter & Wylie 1998; Perry et al. 1989; and others). Direct effects include removal of host trees necessary to sustain mycorrhizae, and destruction of mycelial networks. Indirect impacts include a reduction in the moisture retention capability of soils, duff and woody debris that provide habitat for fungal species, as a result of increased solar and wind penetration into stands. In addition, ground-based harvest techniques result in soil compaction that can harm mycelia in the soil. The same techniques also tend to disturb existing woody debris and duff layers that support sabrobic species of fungi.

Albatrellus ellisii
This species is a mycorrhizal fungus that grows solitary, scattered, gregarious, or in fused clusters on the ground in forests. It fruits in late summer and autumn. Very little is known about the habitat needs of

this species, except that it is a forest dwelling species. It is known from widely scattered sites (15 sites reported in 2005 ISMS query; 0 from random grid CVS plots) from California, Oregon and Washington. On the Gifford Pinchot National Forest, this species is known from the south side of Mt. Adams, in the Morrison Creek and Hole-in-the-Ground drainages. The one site currently recorded from the Forest in ISMS (2005) is located at 3,680 ft. elevation. It is unknown whether the area encompassing Canyon Timber Sale hosts this species, but the likelihood of occurrence within the area is estimated to be low, since the habitat from which it has been reported on the Gifford Pinchot National Forest is dissimilar to that found within the project area, and located at great distance from the known site. Similar habitat located adjacent to the project area would presumably continue to provide undisturbed habitat for this species, if it is present in the area. In addition, the prescriptions for thinning within the project area would retain a diverse mixture of species within the stands, and many riparian zones would remain untreated. It is presumed that harvest selectivity would result in the maintenance of a diversity of mycelial networks that currently exist within these stands. Based on these factors, **Alternative A may impact** *Albatrellus ellisii* individuals or habitat, but would not likely lead to a trend towards federal listing or a loss of viability to the species. **Alternative B** would result in **no impact** to this species.

Cordyceps capitata

This species is a fungus that grows as a parasite on *Elaphomyces* species (another fungus); *Elaphomyces* are sequestrate (below ground) fungi. *Elaphyomyces* spp. may be mycorrizally associated with various conifer species. *Cordyceps capitata* is recorded from 16 sites across California, Oregon and Washington (ISMS query 2005); it is known from one site on the Gifford Pinchot National Forest, from a 1997 collection from Skamania County (Forest Sciences Laboratory (FSL) database query 2005); no additional habitat information is available for this site. It is unknown whether the area encompassing Canyon Timber Sale hosts this species, but if *Cordyceps capitata* grows within the project area, it is likely associated with the *Pseudotsuga menziesii*, *Tsuga heterophylla* or other conifer species that grow within the timber sale area (the association would be indirect through direct association with *Elaphomyces*). The likelihood of occurrence within the area is estimated to be low, since only one site for this species has been located on the Forest, and there were no random grid "hits" for this species, suggesting that it is quite rare across the range of the Northwest Forest Plan. Similar habitat located adjacent to the project area would presumably continue to provide undisturbed habitat for this species' host, if it is present in the area. In addition, the prescriptions for thinning within the project area would retain a diverse mixture of species within the stands, including some "skips" where the forest structure would remain undisturbed, and undisturbed riparian areas. Therefore, **Alternative A may impact** *Cordyceps capitata* individuals or habitat, but would not likely lead to a trend towards federal listing or a loss of viability to the species. **Alternative B** would have **no impact** on *Cordyceps capitata*.

Gomphus kauffmanii

This species is a mycorrhizal fungus that fruits in autumn, and grows closely clumped to caespitose, partially hidden in deep humus, and appears to be associated with *Pinus* and *Abies* spp. It was collected in 1998 from Skamania County in October (3 sites) (Forest Sciences Laboratory Database 2005). The species is recorded in ISMS from 22 additional sites across California, Oregon and Washington (ISMS query 2005); CVS random grid surveys located 3 sites for this species, 2 from the Willamette National Forest, and 1 site from the Shasta Trinity National Forest (CVS query 2005). If *Gomphus kauffmanii* grows within the project area, it is likely associated with western white pine (*Pinus monticola*), grand fir (*Abies grandis*) or silver fir (*A. amabilis*). The likelihood of occurrence within the project area is estimated to be low, since the project area lacks stand diversity, and is heavily dominated by Douglas-fir and western hemlock, with few inclusions of *Pinus* or *Abies* species. In addition, few sites for this species have been located on the Gifford Pinchot National Forest, none within the fifth-field watershed adjacent to the project area. It is presumed that similar habitat located adjacent to the project area would continue to provide undisturbed habitat for this species, if it is present in the area. Therefore, **Alternative A may**

impact *Gomphus kauffmanii* individuals or habitat, but would not likely lead to a trend towards federal listing or a loss of viability to the species. **Alternative B** would have **no impact** on *Gomphus kauffmanii*.

Gyromitra californica

This species is a saprobe on wood and litter, and normally fruits in June (late April – early July) on or adjacent to well-rotted conifer stumps or logs, or on soil that incorporates a lot of well rotted woody debris. This species is known from 34 sites in California, Oregon and Washington (ISMS query 2005). Random grid surveys across the Northwest Forest Plan area located five sites for this species on the Willamette, Mt. Baker-Snoqualmie and Olympic National Forests. Five additional sites for this species (4 in Washington and 1 in Oregon) are recorded in Forest Science Laboratory database (query 2005). On the Gifford Pinchot National Forest, the species is known from one site on the Cowlitz Valley District, in an old-growth riparian forest near East Canyon Creek, at 2,400 ft. Based on the habitat attributes of this site, and dissimilarity to the habitat available within the project area, it is estimated that there is a low likelihood of occurrence for this species within the project area. Canyon Timber Sale does contain pockets of well-decomposed large woody debris. Some of the best large woody debris within the stands overlaps closely with sites where the Sensitive bryophyte species *Tetraphis geniculata* was located; *Tetraphis* grows on decomposing large woody debris, particularly the cut ends of old logs. *Tetraphis geniculata* occurrences that were found within the harvest units of Canyon Timber Sale would be buffered in order to preserve the moist microclimate, and physically protect those sites from damage. Along with these buffered areas, riparian no-cut buffers would probably provide some of the best habitat for *Gyromita californica* available in these stands. In addition, similar habitat located adjacent to the project area would presumably continue to provide undisturbed habitat for this species, if it is present in the area. Therefore **Alternative A may impact** *Gyromitra californica* individuals or habitat, but would not likely lead to a trend towards federal listing or a loss of viability to the species. **Alternative B** would have **no impact** on *Gyromitra californica*.

Leucogaster citrinus

This species is a Pacific Northwest endemic, fall fruiting, sequestrate fungus that is a mycorhizzal associate of conifer species including *Abies concolor*, *A. lasiocarpa*, *Pinus contorta, P. monticola*, *Pseudotsuga menziesii*, and *Tsuga heterophylla* from 280 to 6,500 feet elevation. It is recorded in ISMS from 12 sites across the Northwest Forest Plan area (ISMS query 2005); the FSL database lists 7 sites from Thurston County, Washington; Linn, Benton, and Curry Counties in Oregon; and in Siskiyou County, California (query 2005). The CVS random grid surveys detected this species at 52 sites, 10 of which occurred on the Gifford Pinchot National Forest. These locations are scattered across the forest (CVS query 2005). This data suggests that the species may be fairly well distributed across the Gifford Pinchot National Forest. Because it is a sequestrate (below ground) fungus, it is likely under-reported. If *Leucogaster citrinus* grows within the project area, it is likely associated with the *Pseudotsuga menziesii*, *Tsuga heterophylla* or other conifer species that grow there. Based on the high level of random grid detections, and the apparent availability of suitable habitat, there appears to be a moderate likelihood of occurrence within the project area. The prescriptions for thinning within the Canyon Timber Sale would retain (through selective thinning) and improve (through planting) conifer species diversity within the stands. Presumably, this would result in the maintenance of some of the mycelial networks that may currently exist within these stands, and create future conditions more conducive to mycelial diversity than currently exist. In addition, similar habitat located adjacent to the project area, and allocated reserve areas (Riparian Reserves, Late-Successional Reserves, Wilderness areas and Administratively Withdrawn areas) would presumably continue to provide undisturbed habitat for this species on the Forest. Therefore, **Alternative A may impact** *Leucogaster citrinus* individuals or habitat, but would not likely lead to a trend towards federal listing or a loss of viability to the species. **Alternative B** would result in **no impact** to *Leucogaster citrinus*.

Mycena monticola

This species is mostly fall fruiting (though it was collected from Klamath County, Oregon in March). It is a saprobe on wood or litter, and is generally restricted to conifer forests (especially with *Pinus* spp. present) above 3,300 feet in elevation. It is a Pacific Northwest endemic species; ISMS lists 143 sites for this species within the range of the Northwest Forest Plan (ISMS query 2005). The Forest Sciences Laboratory database records an additional 20 sites throughout Oregon, Washington and California (2005 query). The CVS random grid surveys detected this species at 16 sites across California, Oregon and Washington, two of these detections occurred on the Gifford Pinchot National Forest. On the Gifford Pinchot National Forest, it has been found growing west of Goose Lake, and south of Council Lake, growing near Forest Road 60, adjacent to the Big Lava Bed (Mt. Adams District), and in a Silver-fir/vanillaleaf-beadlily plant community at 3,100 ft. on the Mount St. Helens District. Based on the habitat attributes of known sites on the Gifford Pinchot National Forest, and dissimilarity to the habitat available within the project area, it is estimated that there is a low likelihood of occurrence for this species within the project area. The Canyon Timber Sale area does contain pockets of well-decomposed large woody debris. Some of the best large woody debris habitat available for this species within the project stands overlaps closely with sites where the Sensitive bryophyte species *Tetraphis geniculata* was located. *Tetraphis* grows on decomposing large woody debris, particularly the cut ends of old logs. Sites for *Tetraphis geniculata* that are found within the harvest units of project area would be buffered in order to preserve the moist microclimate, and physically protect those sites from damage. These buffered areas, along with Riparian Reserves probably provide some of the best habitat for *Mycena monticola* available in the sale area. Therefore, **Alternative A may impact** *Mycena monticola* individuals or habitat, but would not likely lead to a trend towards federal listing or a loss of viability to the species. **Alternative B** would have **no impact** upon *Mycena monticola*.

Otidea smithii

This species grows as a saprobe on wood and litter, and grows solitary to gregarious, often under *Populus trichocarpa*, *Pseudotsuga menziesii*, and *Tsuga heterophylla*. The species fruits in late summer and fall. ISMS records this species from 10 sites across California, Oregon and Washington; 3 from the Gifford Pinchot National Forest. The Forest Sciences Laboratory database records an additional 12 sites for this species, 2 from the Gifford Pinchot National Forest. The CVS random grid surveys failed to detect this species. On the Gifford Pinchot National Forest, this species has been located on the Cowlitz Valley District, near the confluence of the Cispus River and Yellowjacket Creek, and near the Camp Creek Falls trailhead. It is unknown whether the project area provides suitable habitat for this species. Based on the habitat attributes of the Cowlitz Valley District sites, dissimilarity to the habitat available within the project area, and substantial distance of known sites from the project area, there appears to be a low likelihood of occurrence for this species within the project area. Some of the best large woody debris habitat available for this species within the project stands overlaps closely with sites where the Sensitive bryophyte species *Tetraphis geniculata* was located. *Tetraphis* grows on decomposing large woody debris, particularly the cut ends of old logs. Sites for *Tetraphis geniculata* that are found within the project area would be buffered in order to preserve the moist microclimate, and physically protect those sites from damage. These buffered areas, along with riparian no-cut buffers, probably provide some of the best habitat for *Otidea smithii* available in the sale area. Retention of large woody debris within harvested stands would presumably result in the maintenance of some of the mycelial networks that may currently exist within these stands. In addition, similar habitat, located adjacent to the project area, would presumably continue to provide undisturbed habitat for this species, if it is present in the area. Therefore, **Alternative A may impact** *Otidea smithii* individuals or habitat, but would not likely lead to a trend towards federal listing or a loss of viability to the species. **Alternative B** would result in **no impact** to *Otidea smithii*.

Ramaria cyaneigranosa

This species is a Pacific Northwest endemic, fall fruiting fungus (mostly in October) recorded in ISMS from 32 sites in California, Oregon and Washington (ISMS query 2005). The Forest Sciences Laboratory database records an additional 15 sites from California, Oregon and Washington. The CVS random grid surveys failed to detect any sites for this species. On the Gifford Pinchot National Forest, the species is known from a single site within the Cispus River drainage (within the Cispus burn area), at 1,900 feet. It is likely a mycorrhizal species. It is generally associated with conifer species, including *Abies* spp., *Pseudotsuga menziesii*, and *Tsuga heterophylla*. It is unknown whether the project area provides suitable habitat for this species. Based on the habitat attributes of the Cowlitz Valley District site (damp, west Cascades, in an area where extensive burns had occurred early in the century), there appears to be a superficial similarity between habitat at this site and that found within the Canyon Timber Sale project area, which is also damp west Cascades habitat located at similar elevation. However, the project area is a product of regeneration from harvest during the middle part of the last century, whereas the Cispus area was naturally regenerated after fire. In addition, the known occurrence for this species on the Forest is widely disjunct from the project area. Based on this information, it is estimated that there is a low to moderate likelihood of occurrence for this species within the project area. Similar habitat located adjacent to the project area would presumably continue to provide undisturbed habitat for this species, if it is present in the area. In addition, the prescriptions for thinning within the Canyon Timber Sale seek to retain (through thinning prescriptions) and increase (through planting) the current level of conifer diversity within stands. Presumably, this would result in the maintenance of some of the mycelial network diversity that may currently exist within these stands, and create conditions that may allow for greater fungal diversity in the future. Therefore **Alternative A may impact** *Ramaria cyaneigranosa* individuals or habitat, but would not likely lead to a trend towards federal listing or a loss of viability to the species. **Alternative B** would result in **no impact** to *Ramaria cyaneigranosa*.

Ramaria gelatiniaurantia

This species is a Pacific Northwest endemic, fall fruiting mycorrhizal fungus. ISMS reports this species from 24 sites in California, Oregon and Washington (none from the Gifford Pinchot National Forest). The FSL database records 11 additional sites for this species within these states, including one site from Skamania County, on the Gifford Pinchot National Forest (Forest Sciences Laboratory database query 2005). The CVS random grid surveys failed to detect this species. *Ramaria gelatiniaurantia* is generally associated with conifer species, including *Abies* spp., *Pseudotsuga menziesii*, and *Tsuga heterophylla*. It is unknown whether the project area provides suitable habitat for this species. Since little is known about the habitat characteristics of the site in Skamania County, it is impossible to know whether it corresponds closely with habitat found within the project area. However, most of the sites reported for this species within ISMS and the Forest Sciences Laboratory database seem to be from moist westside conifer forests (sites in California are from coastal counties, and those reported from nearby Mt. Hood National Forest are all from Clackamas County, which is west of Mt. Hood). The Canyon Timber Sale is also located in the wet western Cascades. However, such broad scale interpretation of habitat similarities does not provide substantive information on which to base an estimate of likelihood of occurrence. Lacking further information about this species, and the Skamania County site where it is found, it is estimated that the likelihood of occurrence is low to moderate. The prescriptions for thinning within the project area would retain a diverse mixture of species within the stands. In addition, similar habitat located adjacent to the project area would presumably continue to provide undisturbed habitat for this species, if it is present in the area. Presumably, this would result in the maintenance of some of the mycelial networks that may currently exist within these stands. Therefore, **Alternative A may impact** *Ramaria gelatiniaurantia* individuals or habitat, but would not likely lead to a trend towards federal listing or a loss of viability to the species. **Alternative B** would result in **no impact** to *Ramaria gelatiniaurantia*.

Ramaria rubrievanescens
This mycorrhizal species fruits in humus or soil, and matures above ground in June, September and October. *Ramaria rubrievanescens* is associated with Pinaceae spp. This species is recorded in ISMS from at least 53 sites across California, Oregon and Washington State (ISMS query 2005). The Forest Sciences Laboratory database records the species from 20 additional sites within these states. The CVS random grid surveys detected this species at 4 sites, all in Oregon. On the Gifford Pinchot National Forest, this species is reported from one site, near Takhlakh Lake, at 4,300 ft. in elevation, on the western foot of Mt. Adams. At this site, the species is probably associated with *Pinus contorta* (lodgepole pine). If lodgepole pine (or other pine species) are found within Canyon Timber Sale project area, it is found at very low levels of occurrence (stand description information collected during botany surveys in 2006 make no mention of *Pinus*). It is clear that the habitat from which this species is known to occur on the Forest is quite different from that located within the project area. For this reason, the likelihood that this species occurs within the project area is low. Based on this information, it appears that **Alternative A may impact** *Ramaria rubrievanescens* individuals or habitat, but would not likely lead to a trend towards federal listing or a loss of viability to the species. **Alternative B** would result in **no impact** to *Ramaria rubrievanescens.*

Sarcodon fuscoindicus
This mycorrhizal species fruits on soil, in autumn and winter. In the Pacific Northwest, the species is most often found in conifer forests, and appears to associate with hemlock and pine. In ISMS, this species is recorded from at least 41 sites across California, Oregon and Washington, including 2 sites from Gifford Pinchot National Forest (ISMS query 2005). The Forest Sciences Laboratory database reports 56 additional sites; 2 from Skamania County and 1 from Lewis County. The CVS random grid surveys detected this species from 9 sites across the Northwest Forest Plan area, 5 on the Gifford Pinchot National Forest. On the Gifford Pinchot National Forest, this species is known from the Cowlitz Valley District, at LaWisWis Campground, and from two sites in Skamania County (one on the Mount St. Helens National Volcanic Monument). It is unknown whether the project area provides suitable habitat for this species; little is known about the specific habitat characteristics of random grid sites on the Forest, or sites reported by FSL to occur in Skamania County. Lacking more detailed information, but based on the proximity of the known sites to the project area, the likelihood of species occurrence within the project area is estimated to be low to moderate. It is presumed that similar habitat located adjacent to the project area would continue to provide undisturbed habitat for this species, if it is present in the area. As a result, **Alternative A may impact** *Sarcodon fuscoindicus* individuals or habitat, but would not likely lead to a trend towards federal listing or a loss of viability to the species. **Alternative B** would result in **no impact** to *Sarcodon fuscoindicus*.

Sowerbyella rhenana
This species in a saprobe on litter, known from 68 scattered sites from California to Washington (2005 ISMS query); the Forest Sciences Laboratory database reports this species from 21 additional sites across this range; one site from Lewis County, on the Gifford Pinchot National Forest. A 2005 ISMS query reports 2 additional sites near the confluence of the Cispus River and Yellowjacket Creek on the Gifford Pinchot National Forest. The CVS random grid study failed to detect this species. Its habitat appears to be moist duff in relatively undisturbed, older conifer forests. Since (in contrast) the stands comprising Canyon Timber Sale have a fairly recent disturbance history of harvest 30-50 yrs ago, and lacking more detailed information, it appears that the likelihood of species occurrence within the project area is low. Similar habitat located adjacent to the project area would presumably continue to provide undisturbed habitat for this species, if it is present in the area. As a result, **Alternative A may impact** *Sowerbyella rhenana* individuals or habitat, but would not likely lead to a trend towards federal listing or a loss of viability to the species. **Alternative B** would result in **no impact** to *Sowerbyella rhenana.*

Spathularia flavida
This species is a saprobe on litter, and grows in clusters or fairy rings on woody debris in forests, fruiting in summer-fall. ISMS reports this species from 38 sites across the Northwest Forest Plan area (ISMS query 2005). The CVS random grid surveys detected this species at 10 locations, 5 from the Gifford Pinchot National Forest. The Forest Sciences Laboratory database also reports this species from the Cispus Environmental Learning Center on the Gifford Pinchot National Forest. From the wide variety of reported areas where this species has been found, this species appears to have a rather wide ecological amplitude and environmental tolerance. It is unknown whether the project area provides suitable habitat for this species, but based on habitat information from records of known sites, it probably has a moderate likelihood of hosting the species. Some of the best large woody debris habitat within the stands overlaps closely with sites where the Sensitive bryophyte species *Tetraphis geniculata* was located; *Tetraphis* grows on decomposing large woody debris, particularly the cut ends of old logs. The sites for *Tetraphis geniculata* that are found within the project area would be buffered in order to preserve the moist microclimate, and physically protect sites from damage. These buffered areas, along with riparian no-cut buffers, would probably provide some of the best habitat for *Spathularia flavida* in these stands. Retention of large woody debris within harvested stands would presumably result in the maintenance of some of the mycelial networks that may currently exist within these stands. Similar habitat located adjacent to the project area would presumably continue to provide undisturbed habitat for this species, if it is present in the area. As a result, **Alternative A may impact** *Spathularia flavida* individuals or habitat, but would not likely lead to a trend towards federal listing or a loss of viability to the species. **Alternative B** would result in **no impact** to *Spathularia flavida.*

Survey and Manage Botanical Species:
Tetraphis geniculata and *Peltigera pacifica* are both Survey and Manage species that require management of all known sites. Project design features have been incorporated into Canyon Timber Sale that provide for the protection of all known sites of these species within the project area. Project design features were designed in order to provide for site persistence, and site viability. Conservation Assessments, Management Recommendations, and pertinent literature were used as resources during the development of project design features. For a full description of project design features at specific known sites for these species, refer to Appendix A.

Cumulative Effects
Project design features designed to protect known occurrences of *Tetraphis geniculata* and *Peltigera pacifica* have been incorporated into the Canyon Timber Sale project, and are regularly incorporated into all projects in which Sensitive and/or Survey and Manage species are found (and will continue to be incorporated for as long as these species maintain their rank as Sensitive or Survey and Manage). This does not preclude the possibility that undetected sites and suitable habitat for these species have been impacted by past actions or will be impacted by future actions. *Tetraphis geniculata* and *Peltigera pacifica* are both widely distributed across the Gifford Pinchot National Forest, with many sites identified on the Forest. There are undoubtedly many occurrences of these species that remain undetected on the Forest, including occurrences within protected land allocations, such as Wilderness. Based on current understanding, these species are neither so limited in distribution, habitat, or number that project activities (with incorporated design features), in combinations with past or reasonably foreseeable future actions on nearby federal land and adjacent private land, are likely to lead to a trend towards federal listing for these species, or threaten the viability of entire populations or species as a whole.

Survey-Impractical Species
Cumulative effects of timber harvest on survey-impractical species sites and habitat are unknown. Implementing the project design criteria attempts to minimize impacts to these species. It is assumed that, by practicing thinning, retaining a high degree of species diversity within the stands, maintaining woody debris substrate (for sabrobes), and live trees (for mycorrhizal species), this project, while having some

impact, will not devastate entire mycelial networks and colonies. Though project level mitigations attempt to preserve potential habitat and analyze risk associated with particular projects upon these species, a true understanding of the impacts or these projects would require a more complete understanding of habitat associations, distribution, and abundance of these species across their ranges. Currently, there are multiple efforts within Region 6 of the Forest Service to gain more information about the habitat associations, distribution, and abundance of these species ((compilation of the results and statistical inferences based on the CVS random grid study is one example). Additional information gained through these surveys and studies will aid in identifying potential habitat, judge risk, and mitigate for impacts in the future.

In summary, none of the Sensitive botanical species that were located, or presumed to exist within the project area are either so limited in distribution, habitat, or number that project activities (including incorporated design features), in combination with past or reasonably foreseeable future actions on nearby federal land or adjacent private land, are likely to lead to a trend towards federal listing for these species, or threaten the viability of the species as a whole.

NOXIOUS WEEDS/INVASIVE PLANTS

Under Canyon Timber Sale Alternative A, there will be a certain amount of ground disturbance, and opening of the canopy during the course of timber harvest activities. Ground disturbance exposes available habitat for noxious weeds, while timber harvest exposes newly created disturbed areas to increased solar radiation, ideal conditions for early-seral, weedy species. Areas experiencing ground disturbance within the timber sale would, therefore, be highly susceptible to noxious weed and invasive plant colonization, particularly since there are already invasive species growing along access roads to the units (see list below). In order to control noxious weed colonization and spread under Alternative A, weed-spread prevention and weed eradication activities should be implemented before, during and after project activities.

Noxious weeds (shown with approximated occurrence level of low, medium, high) that are known to occur within or adjacent to the project area include:

Class A Weeds

None

Class B Weeds

Centauria debeuxii (meadow knapweed) – moderate to heavy

Meadow knapweed grows in light to moderate amounts along FR 5300, 5301, 5300572 (where roadside openings occur), including adjacent to units 9, 10, 11, 12, 14 (heavy infestation), and within Unit 8, in the clear-cut on its southern border, and in the rock-pit on its eastern boundary. There is also a heavy infestation located along FR 5400 adjacent to Unit 20.

Cytisus scoparius (scotch broom) – low to moderate

Scotch broom is found scattered to patchy along FR 5300572, along the southern boundaries of Units 9, 10, 11, 12, and along FR 5300, adjacent to Unit 12 and near Unit 20, within Unit 8 and in the clear-cut on its southern border. A scattered infestation is also located along FR 5400 adjacent to Unit 20.

Hypochaeris radicata (cat's ear) – low to moderate

Cat's ear is found along FR 5300 where it borders the western edge of Unit 14, and along FR 5400 adjacent to Unit 20.

Leucanthemum vulgare (oxeye daisy) – moderate

Oxeye daisy grows in light to moderate infestations along FR 5700, adjacent to Units 2 and 3. It is also found within the wetland located in Unit 10, and along FR 5300 where it borders the western edge of Unit 14. It is found in scattered in light to moderate infestations along (grown over) access roads to Unit 17.

Senecio jacobaea (tansy ragwort) – moderate

Tansy ragwort grows in light to moderate infestations along FR 5700 adjacent to Units 2 and 3, along FR 5300, where it borders the western edge of Unit 14, and within the wetland in Unit 10. Light to moderate infestations are scattered along the (grown over) access road to Unit 17.

Class C Weeds

Hypericum perforatum (St. John's wort) – light to moderate

St. John's wort grows in light to moderate infestations along FR 5700 adjacent to Units 2 and 3, and along FR 5300, where it borders the western edge of Unit 14. It is also located along FR 5400 adjacent to Unit 20.

Circium arvense (Canada thistle) – light to moderate

Canada thistle grows along FR 5300572 adjacent to Unit 8, in the clear-cut on its southern border, and in openings along FR 5300572, along the southern boundary of Units 9 and 11. It is also growing along FR 5300, adjacent to the southern boundary of Unit 12.

Other undesirable invasive plants known to occur in the project area include:

Lathyrus latifolius (perennial pea) – low

Perennial pea grows along FR 5300 where it borders the western edge of Unit 14.

Daucus carota

Wild carrot grows along FR 5400 adjacent to Unit 20.

Of the three types of weed classifications in Washington, Class A weeds require immediate eradication efforts, Class B weeds require active control, and Class C weeds require monitoring, and project work, with the eventual goal of elimination.

Noxious Weed and Invasive Non-Native Species Risk Assessment with Project Design Criteria and Mitigations

Non-native plants include those species introduced intentionally or unintentionally to areas where they do not naturally occur. Invasive non-native plants in the Pacific Northwest most often originate from Europe and Asia. Problems can arise when the associated natural predators and diseases that controlled these species in their native habitats are not present in the habitat where they are introduced. If a species is unchecked by predators, it may become invasive, dominating the site and altering ecosystem balance. The results may include changes in biodiversity, fire frequency, soil erosion and hydrology of a site. Other effects include poisoning of livestock and reducing the quality of recreational experiences. There

are an estimated 2,000 invasive and noxious weed species in the United States and 130 class A, B, and C weeds listed in Washington in 2006.

Forest Service Manual direction requires that Noxious Weed Risk Assessments be prepared for all projects involving ground-disturbing activities. For projects that have a moderate to high risk of introducing or spreading noxious weeds, recent Forest Service policy requires that decision documents must identify noxious weed control measures that will be undertaken during project implementation (FSM 2081.03, 11/29/95). In addition, the Pacific Northwest Region Invasive Plant Program Record of Decision for Preventing and Managing Invasive Plants (USDA 2005) provides invasive plant prevention and treatment/restoration standards and direction on all National Forest Lands within Region 6.

Risk Ranking

Factors and Vectors considered in determining the risk level for the introduction or spread of noxious weeds are:

FACTORS

A. Known noxious weeds in close proximity to project area that may foreseeably invade project.
B. Project operation within noxious weed population.
C. Any of vectors 1-8 in project area.

VECTORS

1. Heavy equipment (implied ground disturbance including compaction or loss of soil "A" horizon.)
2. Importing soil/cinders/gravel/straw or hay mulch.
3. ORVs or ATVs.
4. Grazing.
5. Pack animals (short term disturbance).
6. Plant restoration.
7. Recreationists (hikers, mountain bikers, etc.)
8. Forest Service or other project vehicles.

High, moderate, or low risk rankings are possible. For the high ranking the project must contain either a combination of factors A+C or B+C above. The moderate ranking contains any of vectors #1-5 in the project area. The low ranking contains any of vectors #6-8 in the project area or known weeds within or adjacent to the project area, without vector presence.

Weed Risk Ranking Results

Project	Factors	Vectors	Risk Ranking
Canyon T.S.	A, B, C	1, 2, 8	High

Wildlife

The analysis area used for this effects analysis for wildlife consists of three sixth-field watersheds. Table 3-25 below summarizes the watersheds that make up the analysis area. The analysis area for this analysis consists of about 32,300 acres of National Forest system lands, and all of the proposed Canyon timber sale units are within this area.

Table 3-25. Analysis area for wildlife effects analysis

Fifth-field Watershed	Sixth-Field Watershed	Sixth-field total acres	Sixth-field acres on National Forest	Canyon Units
Yale Reservoir	Lower Siouxon Cr.	11,361	7,697	Units 2 and 3
Merwin Reservoir	Upper Canyon Cr.	12,343	12,343	Unit 20
	Lower Canyon Cr.	30,232	12,277	Units 6, 8, 9, 10, 11, 12, 14, 16, 17
Total		53,934	32,317	

Table 3-26 lists the TES species considered in this evaluation, and summarizes the effect to each with the action alternative (Alternative A).

Table 3-26. Summary of effects to threatened, endangered, proposed, and sensitive species

SPECIES NAME	SPECIES STATUS	Species habitat present within or adjacent to the project area?	Species documented in the project area?	Effect Determination
Gray Wolf *Canis lupus*	Endangered	No	No	No Effect
Grizzly Bear *Ursus arctos*	Threatened	No	No	No Effect
Canada Lynx *Lynx canadensis*	Threatened	No	No	No Effect
Pacific Fisher *Martes pennanti pacifica*	Candidate	No	No	No Impact
California Wolverine *Gulo gulo*	USFS Sensitive	No	No	No Impact
Western Gray Squirrel *Sciurius griseus*	USFS Sensitive	No	No	No Impact
Townsend's Big-eared Bat *Corynorhinus townsendii*	USFS Sensitive	No	No	No Impact
Bald Eagle *Haliaeetus leucocephalus*	Threatened	Potential	No	No Effect
Northern Spotted Owl *Strix occidentalis caurina*	Threatened	Yes	Yes	May Affect, Not Likely to Adversely Effect
Critical Habitat for the Northern Spotted Owl	Designated	No	No	No Effect
Marbled Murrelet *Brachyramphus marmoratus*	Threatened	No	No	No Effect
Critical Habitat for the Marbled Murrelet	Designated	No	No	No Effect
Common Loon	USFS	No	No	No Impact

SPECIES NAME	SPECIES STATUS	Species habitat present within or adjacent to the project area?	Species documented in the project area?	Effect Determination
Gavia immer	Sensitive			
Ferruginous Hawk *Buteo regalis*	USFS Sensitive	No	No	No Impact
American Peregrine Falcon *Falco peregrinus anatum*	USFS Sensitive	No	No	No Impact
Green-tailed Towhee *Pipilo chlorurus*	USFS Sensitive	No	No	No Impact
Northwestern Pond Turtle *Clemmys marmorata marmorata*	USFS Sensitive	No	No	No Impact
Striped Whipsnake *Masticophis taeniatus*	USFS Sensitive	No	No	No Impact
California Mountain Kingsnake *Lampropeltis zonata*	USFS Sensitive	No	No	No Impact
Oregon Spotted Frog *Rana pretiosa*	Candidate	No	No	No Impact
Larch Mountain Salamander *Plethodon larselli*	USFS Sensitive	Yes	Yes	No Impact
VanDyke's Salamander *Plethodon vandyke*i	USFS Sensitive	Yes	No	May impact individuals, no trend towards federal listing (the action alternative)
Cope's Giant Salamander *Dicampton copei*	USFS Sensitive	Yes	No	May impact individuals, no trend towards federal listing (the action alternative)
Cascade Torrent Salamander *Rhyacotriton cascadae*	USFS Sensitive	Yes	Yes	May impact individuals, no trend towards federal listing (the action alternative)
Mardon Skipper *Polites mardon*	Candidate	No	No	No Impact
Puget Oregonian *Cryptomastix devia*	USFS Sensitive	Yes	No	No Impact
Burrington's Jumping Slug *Hemphillia burringtoni*	USFS Sensitive	Yes	Yes	May impact individuals, no trend towards federal listing (the action alternative)
Warty Jumping Slug *Hemphillia glandulosa*	USFS Sensitive	Yes	Yes	May impact individuals, no trend towards federal listing (the action alternative)
Malone's Jumping Slug *Hemphillia malonei*	USFS Sensitive	Yes	Yes	May impact individuals, no trend towards federal listing (the action alternative)
Panther Jumping Slug *Hemphillia pantherina*	USFS Sensitive	Yes	No	No Impact
Columbia Duskysnail *Lyogyrus n. sp. 1*	USFS Sensitive	No	No	No Impact

SPECIES NAME	SPECIES STATUS	Species habitat present within or adjacent to the project area?	Species documented in the project area?	Effect Determination
(Amnicola sp. 4 - G2)				
Blue-gray Taildropper *Prophysaon coeruleum*	USFS Sensitive	Yes	No	No Impact
Dalles Sideband *Monadenia fidelis minor*	USFS Sensitive	No	No	No Impact

Species Dropped from Further Analysis

Only those species that were identified in Table 3-26 above as having a potential to be affected by this project will be discussed further.

The following species are found in habitat that does not occur in the project area and would not be affected by any of the alternatives: Gray wolf, grizzly bear, and wolverine because the high open road density in the project area (more than 2 miles per square mile) makes it unlikely that these species would occur there (Jenson et al. 1986, Mech 1988, Thiel 1985); Pacific fisher because it is thought to be extirpated in Washington, and the project would not affect suitable habitat (Jacobson et al. 2003); Canada lynx because the project area does not contain subalpine fir habitat (Canada lynx Conservation and Assessment Strategy 2000); Marbled murrelet because the project area is too far from the Pacific Ocean (Ralph, et al. 1995); Peregrine falcon because the project area does not contain cliff habitat (USDI 1982); Striped whipsnake or California Mountain kingsnake (Washington State. undated); Common loon and western pond turtle because the project area does not contain water bodies suitable for these species (Richardson, et al. 2000); Ferruginous hawk (Richardson 2004); Green-tailed towhee because it occurs in pine-sagebrush communities; Western gray squirrel because there are no oak communities in the project area (Washington State. 1993c); Townsend's big-eared bat because the project area does not contain caves, old mines, or buildings that could provide roost sites for this species (Gifford Pinchot National Forest Land and Resource Management Plan); bald eagle because the Canyon Creek does not support large fish, and large trees that could be roost trees would not be affected; Mardon skipper butterfly because there are no grassland meadows in the project area where this species could be found; and Mountain goat because the project area does not contain suitable steep rocky habitat (Dalrymple 1978).

Description of Affected Federal Species and Environmental Consequences

Northern Spotted Owl

Species Account: The northern spotted owl (*Strix occidentalis caurina*) was listed as a threatened species throughout its range in Washington, Oregon and northern California effective July 23, 1990 (USDI, 1990a). Loss of late-successional forest habitat from timber harvest was the primary reason for the listing.

The status review for the northern spotted owl completed in 2004 found that the major threats at this time include effects of past and current timber harvest, loss of habitat from fire, and competition with barred owls. Of the threats identified at the time of listing, only one (predation linked to forest fragmentation) does not now appear well supported (Courtney et al. 2004).

The amount of suitable spotted owl habitat that existed in the analysis area historically was reduced by large fires in the early 1900s, and old-growth timber harvest beginning in the 1950s. The northern portion

of the analysis area, generally north of FR 5700, was naturally regenerated following the Siouxon Burn, which occurred in 1902, and portions of the southern edge of the analysis area were burned in the Yacolt Burns beginning also in 1902. These fire-regenerated stands are single-story conifer stands that generally contain abundant down wood, scattered remnant snags, and minor mortality from inter-tree competition. These fire-regenerated stands don't appear to be suitable spotted owl nesting habitat, but they are dispersal habitat and some in the Siouxon drainage are mapped as foraging habitat due to the high density of large down wood and mature conifer overstory.

Since the 1950s, a significant amount of old-growth habitat that was not burned in the fires of the early 20th century was clear-cut harvested in the analysis area. Today these sites are generally dense single-story Douglas–fir and western hemlock stands. Some of these stands have been thinned, most recently with the Crayon Timber Sale, which is a variable density commercial thinning treatment covering 218 acres. The stands that were regenerated after timber harvest in the 1950s and 1960s minimally meet the definition of spotted owl dispersal habitat.

Standards and guidelines in the Northwest Forest Plan require retention of late-successional stands in fifth-field watersheds where late-successional stands currently comprise less than 15 percent of the watershed. An analysis done for National Forest Land on the Gifford Pinchot National Forest in 2001 found that the Yale Reservoir fifth-field watershed is comprised of about 20 percent late-successional stands, and the Merwin Reservoir fifth-field watershed is comprised of about 24 percent late-successional stands.

The amount of suitable spotted owl habitat in the analysis area is shown in Table 3-27. The data used for this analysis is from the 1999 version of the vegetation database for the Gifford Pinchot National Forest. Since the data used was from 1999, it appears to underestimate the amount of spotted owl dispersal habitat. Dispersal habitat requires an average stand diameter of 11 inches, and a canopy cover of at least 40 percent. Stand exams show that the average diameter growth of the trees in the proposed thinning units is 0.2 inch per year. Given that, it was assumed for this analysis that all stands that had an average diameter of at least 9 inches in the data from 1999, meet the definition of dispersal habitat in 2007.

Using this assumption, only proposed units 2, 3, and 12 contain dispersal habitat, but based on stand exams done in the units in 2006, the average tree diameter in units 11, 14, 16, 17, and 20 is also large enough to meet the definition of dispersal habitat. The trees in the other units are too small and/or too dense to provide dispersal habitat for spotted owls. Unit 3 is in LSR, and all the other units are in Matrix.

Table 3-27. Spotted owl habitat in the analysis area

Suitable Nesting Habitat	5,134 acres	15.9%
Suitable Foraging Habitat	5,707 acres	17.6%
Dispersal Habitat	6,545 acres	20.2%
Total Suitable for Dispersal	**17,386 acres**	**53.7%**

Units 6, 8, 10, 11, 12, 16, and 20 are adjacent to unsurveyed suitable spotted owl nesting habitat (see Figure 3-8).

All of the proposed Canyon units are managed plantations that were regenerated following clear-cut logging. Stand ages range from 28 to 42 years old. Stand exams in the units show that the number of commercial-sized trees in the units ranges from about 219 to 331 per acre. The average for all of the units

is about 290 trees per acre. The proposed thinning units do not contain suitable nesting or foraging habitat for spotted owls.

Since the previous stands were clear-cut, all of the proposed units are currently single-story stands that contain very few hard snags or large hard logs. The units contain large soft logs that were left after the previous stands were logged.

The analysis area contains seven historic spotted owl activity centers; four are in Matrix and three are in the LSR (Figure 3-9). In 1995 core habitat areas, consisting of 100 acres of the best available habitat, were designated around each of the activity centers in Matrix as required in the Northwest Forest Plan. There are no current owl surveys for this area, but a spotted owl was detected in the northern part of Unit 12 in 1999. The detection was near the old-growth stand that exists along Canyon Creek. An analysis of suitable habitat within historic home range circles was not done for this proposal since no suitable habitat would be affected.

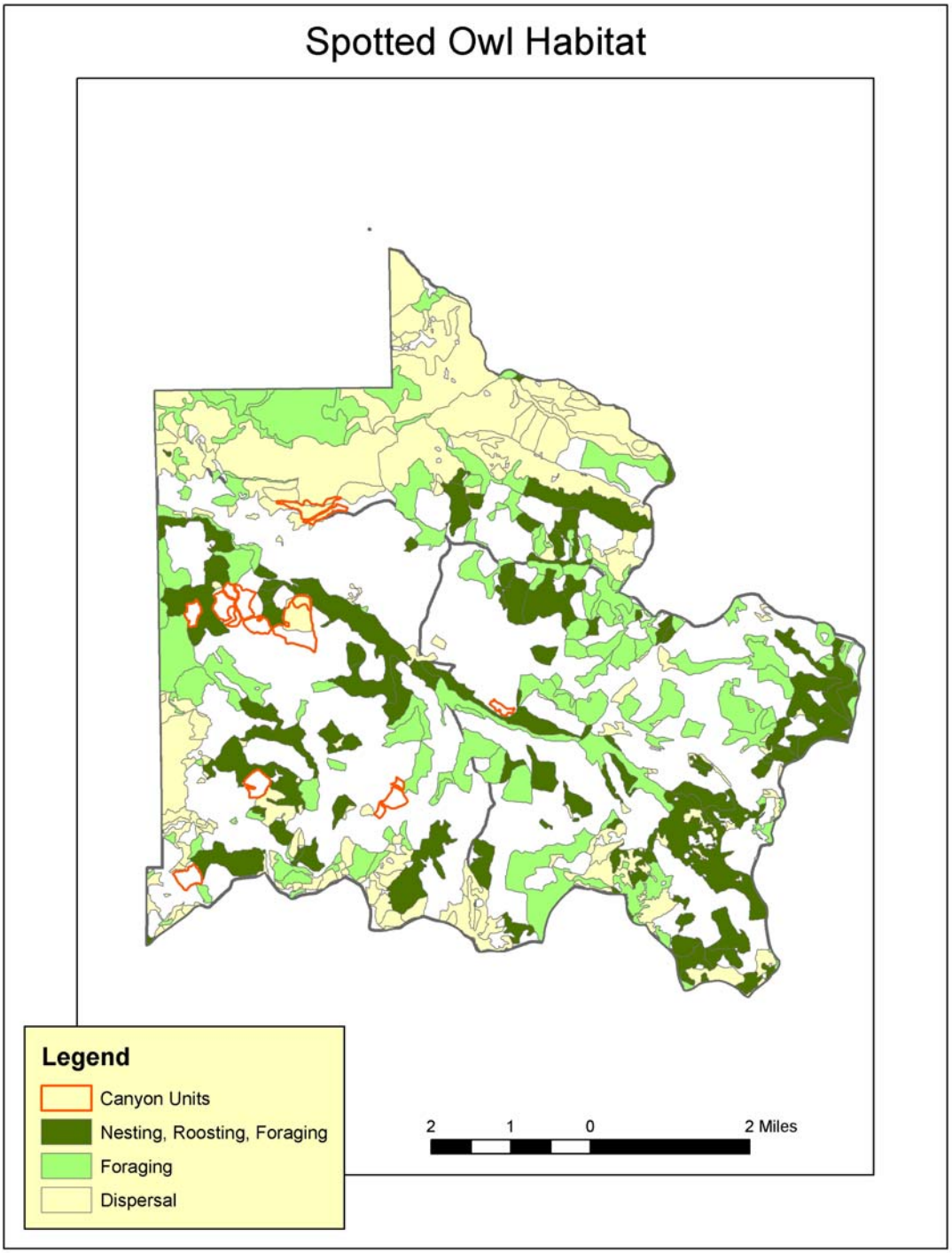

Figure 3-8. Spotted owl habitat in the analysis area.

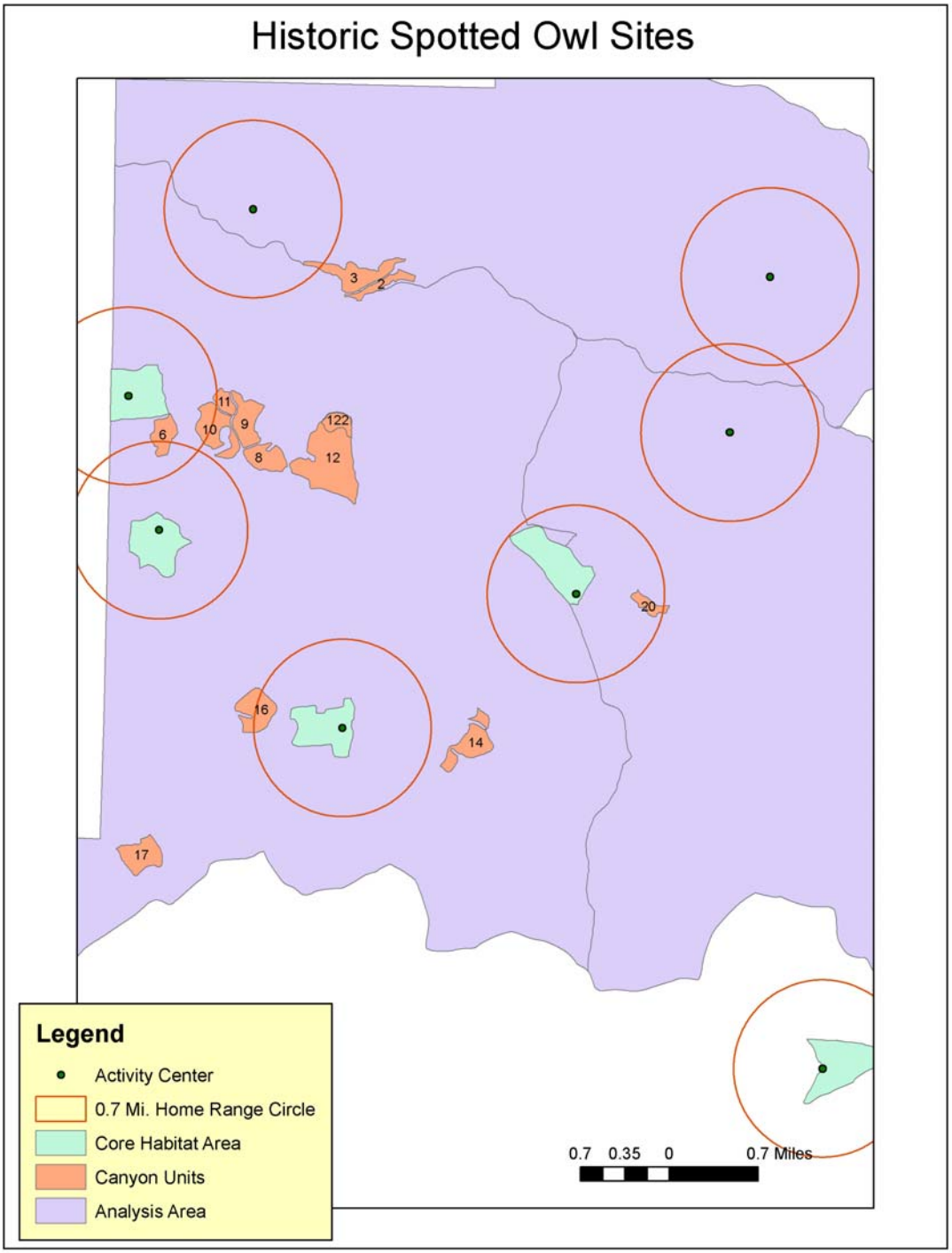

Figure 3-9. Historic spotted owl activity centers in the analysis area.

The eastern edge of the analysis area contains designated critical habitat, but none of the proposed thinning units are located near critical habitat.

Environmental Consequences

Alternative A This alternative would thin a total of 479 acres out of a total of 553 acres within the units. Of the acres to be thinned, about 327 acres meet the definition of spotted owl dispersal habitat (Units 2, 3, 11, 12, 14, 16, 17, and 20). The thinning prescription calls for a variable spacing that would leave some small areas within each unit relatively open, and other small areas unthinned. Overall, the canopy closure in the treated units would average about 40 percent after thinning, and so, still meet the definition of dispersal habitat. While it would still qualify as dispersal habitat, it would be degraded somewhat by decreasing the canopy cover from 70 to 80 percent currently to about 40 percent.

The amount of dispersal habitat present in the analysis area would remain above 50 percent, so the ability of spotted owls to disperse within the analysis area would be negligibly impacted.

There would be no change in the amount of suitable nesting and foraging habitat within the analysis area, including in the home range circles of the historic activity centers.

In the long-term, growth on the residual trees in all units would be accelerated, and the Riparian Reserves that would be thinned would be under planted, establishing a second conifer layer. The proposed thinning would cause a reduction in the number of small snags and logs that would have been recruited over time without the treatment, this effect would be partially offset by mitigation to create these structures. In addition, the snags and logs that would have developed in the absence of thinning, would have had marginal value for wildlife due to their small size. The proposed thinning would reduce the amount of time needed to achieve suitable spotted owl habitat in the treated stands. Development of large trees with deep crowns, multiple canopy layers, and structural diversity would be accelerated.

Since dispersal habitat would be degraded on 327 acres, and since noise disturbance generated by logging would not occur in areas adjacent to suitable nesting habitat during the early nesting season, **the project may affect but is not likely to adversely affect** spotted owls.

There would be **no effect** to critical habitat.

Cumulative Effects
The Crayon timber sale is currently being logged in the analysis area. This timber sale is thinning 218 acres and includes an additional 23 acres of retention within the units. All of the Crayon units are within the Lower Canyon sixth-field watershed. A total of 200 acres in Crayon is being thinned using a variable spacing, and 18 acres are being thinned to a uniform spacing. It is expected that the two units that are thinned to a uniform spacing would become more variable over time due to expected windthrow.

All Crayon units were spotted owl dispersal habitat before thinning, and were expected to remain dispersal habitat following the treatment. Development of suitable spotted owl habitat is expected to be accelerated on the Crayon units.

Since dispersal habitat was maintained with the Crayon Timber Sale, and would be maintained with the Canyon Timber Sale, there would be no cumulative loss of habitat.

With both projects there would be a reduction in the number of small logs and snags recruited on a total of about 695 acres, but since these small structures have marginal value for wildlife, the cumulative effects would be minor. The benefits of accelerating tree growth and increased structural habitat diversity on 479 acres with Canyon would be cumulative to the 218 acres treated with Crayon.

Alternative B With this alternative none of the proposed units would be treated. In the short-term, no spotted owl dispersal habitat would be degraded or downgraded to non-habitat. However, the opportunity to accelerate the development of late-successional habitat in the analysis area, and in the watershed would be forgone at this time. It is likely that, in the absence of commercial thinning, suitable habitat would develop over time as normal forest stand dynamics result in the death of overtopped trees. This would result in natural thinning of the stands, but this process would take longer without the treatment.

This alternative would have **no effect** to spotted owls. There would be no cumulative effects.

Description of Affected Survey and Manage, Region 6 Sensitive Species and Impact Analysis

Larch Mountain Salamander

Species Account: This species occurs in old-growth forest, young naturally regenerated forest with residual late-successional features (large logs, bark piles), shrub-dominated communities, scree, talus, and lava tubes entrances where debris has accumulated. The surface geology and soil formation in the central portion of its range has been influenced by pumice deposits from volcanic eruptions. In this area, which includes much of the Gifford Pinchot National Forest, the species appears to be closely associated with old-growth forest, and is often found under woody debris. In the remainder of its range, (including the Canyon analysis area) where surface rock is abundant, populations are found in numerous vegetation types, and animals are generally found under gravel and cobble, and under woody debris to a lesser extent.

As of 2003, there were 112 known sites in Washington. This species is known from at least four sites in the analysis area, which is outside of the portion of its range that has been influenced by volcanic eruptions. At all four sites, it is found in relatively open talus or boulder fields and in timbered talus edges around the open talus.

None of the proposed units contain open or forested talus, or old-growth habitat on steep slopes that are indicative of suitable habitat on the Gifford Pinchot NF. The four known sites are not adjacent to any of the units or haul routes. Since the units do not contain suitable habitat, there would be **no impact** with either alternative.

Van Dyke's Salamander

***Species Account*:** Van Dyke's salamanders are often associated with rocky, steep-walled stream valleys. In the Cascade Range, they are usually found under cobble and sometimes wood, within a few meters of a stream. They are most often in loose rock piles, seeps in the valley wall with loose rock or gravel, splash zones at the base of waterfalls, or adjacent to chutes and cascades. Van Dyke's salamanders have persisted at numerous locations that were severely disturbed by the 1980 eruption of Mount St. Helens (Jones et al. 2005). In addition, this species can be found in upland talus sites similar to Larch Mountain salamander.

Van Dyke's salamander is known from at least one site in the analysis area, a steep stream drainage about 0.5 mile east of Unit 16. Of the proposed Canyon units, Unit 17 appears to have habitat that is suitable for this species. Fly Creek and the two tributaries that form the east and west boundaries of the unit are fairly steep and contain rock and down wood. Searches for this species and for Cascade torrent salamander were conducted during the spring of 2006, and no amphibians were detected. None of the units contain talus.

Environmental Consequences

Alternative A Riparian Reserve thinning would occur with this alternative, however there would be a minimum no-cut buffer of 60 feet along each tributary stream, and about 210 feet along Fly Creek. There would be no new stream crossings constructed across the high gradient streams around Unit 17, and the road accessing the lower part of the unit along Fly Creek would be decommissioned following the thinning.

The no-cut buffers would protect the habitat that is most likely to be occupied from disturbance, and the residual canopy cover in the remainder of the Riparian Reserves would help to maintain microclimatic conditions near the stream edges.

Road decommissioning would require removal of a culvert across Fly Creek, and would have the potential to affect salamanders in the short-term. As mitigation, the work would be done during the dry time of the year when salamanders are not active near the surface, and sediment retention measures would be taken to minimize sediment moving downstream. For these reasons, it is not likely that there would be significant negative impacts to the species' habitat, life cycle, microclimate, or life support requirements. In the long-term removing the culvert and closing the road would improve habitat for salamanders. Due to short-term impacts associated with road decommissioning, the project **may impact** individuals or habitat but would not likely lead to a trend towards federal listing or a loss of viability to the species.

Cumulative Effects

There would be no impacts to known Van Dyke's salamander sites with this project, nor were there any with the Crayon Timber Sale. There are various road improvement and culvert projects planned in the analysis area that in the long-term would improve habitat for Van Dyke's salamander by removing barriers to movement, and reducing sedimentation. However the short-term effects are cumulative to the road work that is proposed in this alternative. The mitigations for these projects would be the same as required for the work in Fly Creek. The mitigations would minimize sediment, and only a minor percentage of the total available habitat would be disturbed. The cumulative effects of Canyon would be negligible.

Alternative B With this alternative there would be **no impact** to Van Dyke's salamander as a result of timber harvest activities.

There would be no road decommissioning with this alternative, so the opportunity to reconnect habitat blocked by the culvert on Fly Creek, and reduce long-term sedimentation would be forgone.

Cope's Giant Salamander and Cascade Torrent Salamander

***Species Account*:** Cope's giant salamanders are usually found in small rocky streams in coniferous or mixed forests, and are most abundant under large rocks in the pools in these streams. They are most abundant in undisturbed forests, but are somewhat resilient to logging and usually recover as the forest matures (Jones et al. 2005). Fully metamorphosed adults are uncommon for this species, so they are nearly always found in the streams and the streams need to be flowing year-round. There are no known locations in the watershed.

Cascade torrent salamanders are found in similar habitats. They require cool, wet environments. Both larvae and metamorphosed individuals occur along high-gradient, cold, rock-dominated stream courses and near seeps. The aquatic larvae are associated with valley and headwall seeps and spray zones at the base of waterfalls and cascades, where gravel and cobble are present with shallow (<1 cm), low-velocity flows. Adults are often interspersed among the larvae or on stream banks under rocks or wood. They are usually within 1 meter of the water, but during prolonged rain they may be found more than 10 meters

away. This species has persisted in streams impacted by the 1980 eruption of Mount St. Helens, suggesting that forest cover may not be a critical habitat feature at higher elevations (Jones et al. 2005).

Cascade torrent salamanders have been found at at least four sites analysis area, but none of the known sites are within or near any of the proposed units. None have been documented in Fly Creek.

Environmental Consequences
Alternative A - Effects to these species would be similar to those described for Van Dyke's salamander above. However, since Cope's giant, and Cascade torrent salamanders are tied more closely to water than Van Dyke's salamander, the no-cut buffers along streams should be more effective in protecting them.

The potential impacts and benefits from road decommissioning near Fly Creek described for Van Dyke's salamander would be the same for these species.

The mitigations described that would be in place to protect water quality would also benefit salamanders, and only a very small amount of the suitable habitat would be affected.

This alternative **may impact** individuals or habitat but would not likely contribute to a trend towards federal listing or cause a loss of viability to the population or species.

Cumulative Effects
There would be no impacts to known Cascade torrent or Cope's giant salamander sites with this project, nor were there any with the Crayon Timber Sale. There are various road improvement and culvert projects planned in the analysis area that in the long-term would improve habitat for these salamanders by removing barriers to movement, and reducing sedimentation. However the short-term effects are cumulative to the road work that is proposed in this alternative. The mitigations for these projects would be the same as required for the work in Fly Creek. The mitigations would minimize sediment, and only a minor percentage of the total available habitat would be disturbed. The cumulative effects of Canyon would be negligible.

Alternative B – With this alternative there would be **no impacts** to these salamander species as a result of timber harvest activities.

There would be no road decommissioning with this alternative, so the opportunity to reconnect habitat blocked by road culverts and reduce long-term sedimentation would be forgone.

Terrestrial Mollusks
***Species Account*:** Under the 2001 Record of Decision for Survey and Manage Species the following species are Category A (pre-disturbance surveys, manage known sites): *Cryptomastix devia, Cryptomastix hendersoni, Hemphillia burringtoni, Monadenia fidelis minor*, and *Prophysaon coeruleum*. The following species is Category C (pre-disturbance surveys, manage high-priority sites): *Hemphillia malonei* and *Hemphillia glandulosa*.

Blue-gray taildropper (*Prophysaon coeruleum*) is only known on the Forest from three sites, all are late-successional sites on the Cowlitz Valley District. Columbia Oregonian (*Cryptomastix hendersoni)* is known from both sides of the Columbia River from The Dalles east to Rufus, and more recently from the Clackamas River, and Hood River Ranger Districts on the Mount Hood National Forest, The management recommendations for this species reports that there is no reason to expect this species on the Gifford Pinchot National Forest, but that surveyors should be able to recognize it. Dalles sideband (*Monadenia fidelis minor*) is known from sites within the Columbia River Gorge in the vicinity of The Dalles and at the mouth of the Deschutes River. It is considered to have occurred historically in the

central and eastern Columbia Gorge and south up the Deschutes River. It is unlikely that these four species exist within any of the proposed units and unlikely that they would be affected by any of the alternatives.

Mollusk surveys were conducted to protocol in the entire pool of proposed units during the spring and fall of 2006. A total of eighteen jumping slug sites were documented during the surveys. Warty jumping slugs (*Hemphillia glandulosa*) were found in Units 7 (2), 9 (2), 10 (3), 12 (2), 15 (2), 17 (2), and 20 (1). Malone's jumping slugs (*Hemphillia malonei*) were found in Units 13 (1), and 16 (2). Burrington's jumping slug (*Hemphillia burringtoni)* was found in Unit 14 (1). No other Survey and Manage/Sensitive species were detected. All of the sites were these species were detected are associated with moderate to large class IV logs. Since the surveys were completed, Units 7, 13, and 15 were dropped from the Proposed Action and the sites detected in them would not be affected.

In addition to the sites found in the Canyon surveys, surveys conducted for the Crayon Timber Sale in 1998 and 1999 detected warty jumping slugs at a total of 36 sites, and Malone's jumping slugs at 27 sites. All these sites were protected with buffers during sale layout.

Environmental Consequences

Alternative A In general, terrestrial mollusk species could be impacted by reduction of the overstory canopy, which would result in warmer and drier conditions at the ground surface, and by destruction of large class IV logs during ground-based logging and slash treatment.

The standards and guidelines for Malone's jumping slug and warty jumping slug require that they be protected at known sites sufficient to ensure its persistence in a watershed. Under the management recommendation for Malone's jumping slug, given that the species is well-distributed in the watershed, at least 70 percent of the suitable habitat in each 6th field watershed must be managed as "high priority sites" before habitat disturbance can occur at any of the known occupied sites. When sufficient occupied habitat is identified as high priority sites, or habitat identified within reserves that can be assumed to be occupied given the number of known sites in the watershed, the habitat at known sites within the proposed units can be disturbed or modified. There is sufficient protected habitat in the Lower Siouxon watershed, but the Lower Canyon Creek and Upper Canyon Creek watersheds would require protection as high-priority sites for 714 acres and 1,425 acres respectively outside of reserves before any known sites could be disturbed. All known sites within the units for both species would be buffered by 120 feet to protect microclimatic conditions at the sites.

The Survey and Manage requirement for Burrington's jumping slug is to protect all known sites. The known site in Unit 14 would be buffered by 120 feet to protect microclimatic conditions at the site.

There are a total of thirteen jumping slug sites that would have to be buffered; they are located in Units 9 (2), 10 (3), 12 (2), 14 (1), 16 (2), 17 (2), and 20 (1). The resulting unthinned patches, consisting of slightly more than one acre each, would be part of the unthinned area that is planned in each unit under the variable thin prescription.

Mitigation to protect existing remnant logs would provide habitat outside of the buffered sites as the overstory canopy expands again to shade more area. Eventually the remnant logs that are important habitat for these mollusks would become too decayed to support them. In the absence of large hard logs to replace them, habitat suitability may decline in the stands. In the long-term the commercial thinning treatment on 479 acres would improve habitat in the units by accelerating the development of large trees that eventually could become large logs as the stands mature.

This alternative **may impact** individuals but would not likely contribute to a trend towards federal listing or cause a loss of viability to the population or species.

Cumulative Effects
Warty jumping slugs were detected at a total of 36 sites, and Malone's jumping slugs were detected at 27 sites during mollusk surveys done in the analysis area for the Crayon Timber Sale in 1998 and 1999.

The Crayon Timber Sale would commercially thin 218 acres, and all of the jumping slug sites found in the Crayon units were buffered to protect them. Since the entire unit is not searched during the protocol surveys, it is possible that some unknown number of undetected sites could be lost during implementation of the project. However, by protecting the known sites as required in the management recommendations, these species would be maintained in the units and would likely repopulate other sites as they become suitable.

Management recommendation for Malone's jumping slug states that highly suitable habitat is conifer stands at least 70 years old with a canopy closure of at least 50 percent. It would be similar for warty jumping slug. Based on this, approximately 53 percent of the analysis area (16,705 acres) consists of suitable habitat. Crayon and the proposed Canyon Timber Sales are treating stands that are younger than 70 years old, so the better habitat in the analysis area would not be affected. The cumulative effects of these projects would be negligible.

Alternative B – With this alternative there would be no impacts to the known mollusk sites in the proposed Canyon Timber Sale units. Smaller logs would be recruited in the stands over time as trees become over-topped and die. Without the thinning treatment it would take longer to develop large logs to replace the well-decayed remnants.

There would be no cumulative effects.

Description of Affected Forest Management Indicator Species

Cavity Excavators
***Species Account*:** Cavity excavators represent species requiring snags and down logs. Within the analysis area, many of the snags created by the fires early in the century were either felled by the 1960s to reduce the potential for new fire starts, or have fallen naturally. Based on observation by the author, the stands regenerated after the Siouxon fire still contain scattered soft snags that number few to several per acre.

In the Westside Lowland Conifer-Hardwood Forest Habitat Type, as described in DecAID (DecAID, Mellen et al. 2006), the abundance of snags and down wood generally peaks in the first 50 years after a fire or other disturbance They are least abundant at about 150 years post disturbance, and increase again after about 200 years. The fire-regenerated stands in the watershed are at the stage of successional development where snags are at naturally low levels, and approaching the age when natural types of mortality start to occur to the smaller overtopped trees.

Old-growth patches in the analysis area contain numerous snags and live trees with dead tops. Approximately 33 percent of the analysis area consists of stands that are at least 130 years old, representing the stands that were not affected by the Siouxon or Yacolt Burns. These stands likely contain snags sufficient to provide for 100 percent of the potential population of cavity excavators, and would provide snags and down logs at the 80 percent tolerance level in DecAID. About 26 percent of the analysis area was regenerated between 1880 and 1950, likely representing younger stands that were fire-

regenerated. These stands may contain scattered large remnant soft snags and large logs, but few hard snags. These areas probably provide snags and logs at the 50 percent tolerance level as described in DecAID. About 40 percent of the analysis area is made up of stands that were regenerated since 1950, likely representing all of the clear-cut harvesting that has occurred. These stands contain few if any large snags, and provide snags at or below the 30 percent tolerance level in DecAID. The percent cover of down logs is probably near the 30 percent tolerance level due to the presence of the remnant logs.

Based on GIS data for the Gifford Pinchot National Forest, approximately 40 percent of the analysis area is in the Westside Lowland Conifer-Hardwood habitat type with small/medium trees (stands 40 to 130 years old).

Data from DecAID show that in all inventory plots in the Westside Lowland Conifer-Hardwood habitat type with small/medium trees, 46 percent of the area would have 0 to 6 snags per acre that are at least ten inches diameter, and that 21 percent of the area would have 6 to 12 snags per acre at least ten inches diameter (DecAID, Fig. WLCH_WCA_S.inv-18). In addition, 50 percent of the area would have 0 to 2 snags per acre that are at least twenty inches diameter, and an additional 16 percent of the area would have 2 to 4 snags per acre that are at least twenty inches diameter (DecAID, Fig. WLCH_WCA_S.inv-19) These figures indicate that about two-thirds of this habitat type contains low snag numbers that are at or below the 30 percent tolerance level.

For down wood cover in this habitat type 23 percent of the area would have 0 to 2 percent cover of logs at least 10 inches diameter and an additional 16 percent would have 2 to 4 percent cover of logs this size (DecAID Fig. WLCH_WCA_S.inv.-20). In addition, 62 percent of the area has 0 to 2 percent cover of logs that are at least 20 inches diameter, and an additional 20 percent has 2 to 4 percent cover of logs this size (DecAID, Fig. WLCH_WCA_S.inv-21). These figures are also at or below the 30 percent tolerance level.

There are no remnant snags in the proposed Canyon Timber Sale units since the previous stands were clear-cut. In addition, the forest stands that regenerated following the harvest are generally healthy at this time, and do not yet contain many snags that are the result of suppression mortality, or insects and disease. In addition, these stands do not yet generally contain large trees (at least 21" diameter) that could be expected to become large snags in the near future, or be killed to create large snags.

The hard snags and logs in the proposed units are small diameter and don't contribute significantly to habitat for cavity excavators. The existing hard snags and logs are made up of primarily small over-topped trees that have died recently, and in some cases have fallen over.

The Land and Resource Management Plan for the Gifford Pinchot National Forest (Amendment 11) provides guidelines for retention of snags and logs in areas of regeneration harvest. In areas of partial harvest, such as proposed with this project, the guidelines are to be modified to reflect the timing of stand development cycles where partial harvest is practiced (Amendment 11, 6-2).

Environmental Consequences

Alternative A – With this alternative a total of 479 acres in the small tree structure stage would be thinned, which is about 1.6 percent of the analysis area, and about 4 percent of the conifer habitat in the analysis area that is in the Small Tree structure stage. The thinning treatment would affect some of the existing snags as some may need to be felled for safety reasons. These snags are all small diameter, and likely would not stand for very long if left alone. These felled snags would be added to the percent down wood cover in the stands. Snags currently existing in the hardwood stands and buffered areas would not be affected since these areas would not be treated.

After thinning, an average of 2.6 trees per acre that is at least 17 inches diameter would be topped or girdled to create snags in the three units that have larger trees (2, 3, and 12), and two trees per acre felled to create logs in all units. Small snags and logs would likely continue to develop naturally in the unthinned portions of the units.

The thinning treatment would reduce the number of small diameter snags in the units that would be expected to develop over the next few decades because it would reduce natural mortality that would result from suppression of the smaller trees, and reduce the potential for insect and disease mortality. The tolerance level in these stands would likely remain near 30 percent for snag density and diameter after thinning, and snag and log creation. At a watershed scale, the condition would be within the natural range of variability with the Canyon Timber Sale units representing the portion of the habitat type that has 0 to 6 snags per acre. Suppression mortality would continue to occur in the majority of the habitat type in the analysis area that is left unthinned, so the tolerance level at the watershed scale would gradually increase.

The thinning would accelerate the development of large trees in the units, and in the long-term these stands would be a source of large snags and logs. This alternative would be consistent with the Forest Plan.

Cumulative Effects
The Crayon timber sale, which is currently being harvested, would commercially thin about 218 acres and have similar effects to snags and down wood as described for this project. The Crayon project represents an additional 0.6 percent of the analysis area. Commercial thinning is likely to occur in additional managed stands in the analysis area in about 10 years, however no other projects have been proposed at this time.

The Canyon Timber Sale would have minor cumulative effects by affecting snags on a small portion of the analysis area.

Alternative B – With this alternative the there would be no effects to existing snags and down wood, and suppression mortality would occur in the proposed units. The tolerance level in the analysis area and in the watershed would gradually rise as the smaller trees die.

The opportunity to more quickly develop large trees by thinning 479 acres within the analysis area with this project would be forgone.

There would be no cumulative effects.

Pileated Woodpecker and Pine Marten

***Species Account*:** Pileated woodpecker and pine marten represent species that require old-growth and mature forest conditions. According to the Habitat Suitablility Index models, canopy closure in optimal habitat for pileated woodpecker and pine marten is 75 percent and 50 percent respectively, and both species require abundant large down wood and snags to provide habitat for their prey species, and nest sites (Allen 1982, and Schroeder 1983). Currently, about 60 percent of the analysis area supports stands that are at least 80 years old. These areas are likely to provide habitat for these species. About 27 percent of the analysis area is at least 200 years old, and would provide the best nesting/denning habitat. In addition, the stands regenerated after the fires in 1902 are suitable foraging habitat due to the presence of large soft snags and down wood.

The stands proposed for thinning are only marginally suitable for these species due to the lack of large trees, tall hard snags, abundant down wood, and multi-story tree canopy.

Environmental Consequences

Alternative A All of the proposed units are less than 50 years old, and so provide poor habitat for these species. The short-term effect of the thinning would be to reduce canopy closure in the proposed units making it less likely that marten and pileated woodpeckers would utilize the stands for dispersal or foraging until the crowns of the residual trees close in again.

There would be minimal effects to the existing logs and snags in the units. However, thinning would reduce the number of smaller snags and logs that would otherwise develop in these stands over the next few decades since it would reduce suppression mortality. This effect is minor in the context of the whole analysis area because the best habitat, which includes old-growth as well as fire-regenerated stands, is not being thinned.

In the long-term, habitat in the thinned stands would be improved for these species as growth on residual trees is accelerated, reducing the time needed to produce large trees and eventually large snags and logs.

The short-term loss of the ability to disperse through the stands is insignificant.

Cumulative Effects

The Crayon Timber Sale is thinning similar poor quality habitat for these species, and as such, the cumulative effects are negligible.

Alternative B With this alternative the Canyon units would continue to be marginal habitat for these species. They would continue to develop suitable habitat over time, but at a slower pace that with Alternative A. Suppression mortality would mean that there would be more small snags in the analysis area. There would be no immediate impacts to these species but the opportunity to accelerate habitat development would be forgone.

There would be no cumulative effects.

Deer and Elk

Species Account: Historically, elk and deer numbers in the western Cascades probably increased in response to large disturbance events, such as stand-replacing fires or volcanic eruptions, because the disturbances resulted in increased forage availability. These populations likely declined again as conifers eventually shaded out the forage plants in the disturbed areas. In general on the Gifford Pinchot National Forest, and especially in winter range areas, the reduction in regeneration timber harvest since the mid-1990s, combined with control of wildfires, has reduced the amount of high quality forage available to the elk and deer herds, and populations are thought to be declining.

Conditions in the analysis area for large ungulates reflect what is happening on the Forest in general. Based on the 1999 vegetation database, about 35 percent of the analysis area provides foraging habitat, 17 percent is hiding cover, 33 percent is thermal cover, and 12 percent is optimal thermal cover. Optimal habitat for elk and deer would have 50 to 60 percent of the area in dispersed foraging habitat and about 40 percent of the area in thermal and optimal cover.

In the past, clear-cut harvest created forage areas, but these areas are providing less forage as the regenerated stands mature, and regeneration harvest that would open large areas in the analysis area is not anticipated at this time. Commercial thinning has the potential to increase forage to a lesser degree by increasing sunlight reaching the ground, thereby increasing the cover and diversity of understory vegetation. The degree to which forage is increased is directly related to the intensity of the thinning. Moderate to heavy thinning would result in a greater increase in forage production than light thinning (Chan et al. 2006). In addition, the increased production would be sustained longer with a heavy thinning

prescription before the understory plants are again shaded out by the overstory trees.

Biological winter range in the analysis area contains about 35 miles of open roads, which equates to a road density of about 2 miles per square mile. Additional miles of road would be closed with the Crayon Timber Sale when a winter range gate is installed on the FR 3700 with timber receipt funds (KV) funds. This closure would reduce the open road mileage enough to meet the biological winter range standard of 1.7 miles of open road in the Gifford Pinchot National Forest Land and Resource Management Plan.

The standard in the Forest Plan for winter range states that 44 percent of the area should be in optimal thermal cover. Optimal thermal cover consists of multi-story conifer stands that have a high canopy closure with deep crowns to intercept snow, and small openings where forage plants can grow. The biological winter range in the analysis area consists of about 12 percent optimal thermal cover, which is found mainly along Canyon Creek. Creating additional forage while accelerating development of optimal thermal cover would benefit deer and elk.

The Canyon Timber Sale units currently provide thermal cover and hiding cover for elk and deer, but do not provide much forage due to shading of the forest floor. Forage plants that can still be found in the units include vine maple, huckleberry, swordfern, salal, and various forbs.

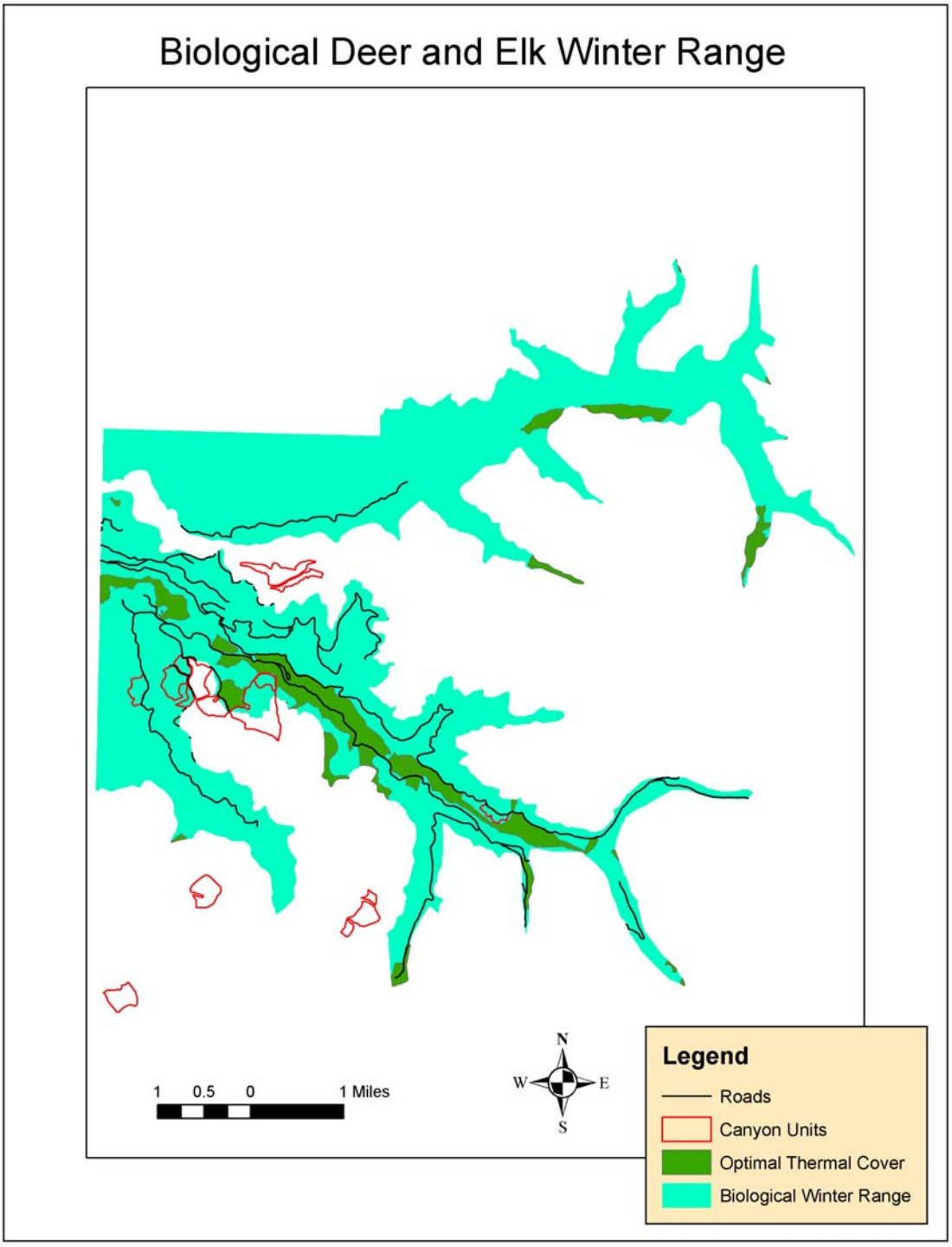

Figure 3-10. Biological Winter Range in the Canyon Analysis Area.

Environmental Consequences

Alternative A Proposed thinning on 479 acres, including about 150 acres in winter range would result in a moderate increase in forage production in the areas that are thinned. Heavy thinning on 55 acres in Units 8, 9, and 10 and creating small gaps on a total of about 22 acres in other units would increase the diversity and cover of browse and herbaceous forage plants on these acres. Increased forage production on these acres should last for 15 years or more. Under planting conifers in the Riparian Reserves and natural regeneration in the heavily thinned areas would accelerate development of optimal thermal cover. Reducing the overstory canopy in units with moderate variable density thinning on about 402 acres would have a similar effect as in the heavy thinning areas, but the increase in forage production would be less and the increase production would not last as long.

In the long-term, growth on the residual trees in the thinning units would be accelerated, and these areas could become optimal thermal cover in the future if allowed to mature. This would probably take 100 years or more.

Roads used to access the units with heavy thinning, (Units 8, 9, 10) would be closed after the harvest is completed, thereby reducing motorized vehicle use in the areas of highest forage production.

In the short-term, this alternative impacts elk and deer by increasing noise disturbance and human activity during the harvest process. This activity would likely cause animals to move away from the units where it is occurring. In the long-term the alternative would benefit elk and deer by increasing forage production, while accelerating development of optimal thermal cover.

Cumulative Effects

The benefit of increased forage production in the thinned units of Canyon would be cumulative to the acres that were thinned with the Crayon Timber Sale (218 acres).

Alternative B None of the proposed units would be treated with this alternative. The existing forage in the proposed units would continue to be shaded, and probably would decline in production until openings are created by natural mortality of the overstory trees.

The opportunity to accelerate the development of optimal thermal cover would be forgone, as would the opportunity to decommission roads with this project.

Wood Duck and Goldeneye Duck

***Species Account*:** Wood ducks represent species that require mature and old-growth deciduous riparian habitat. Goldeneye duck represent species that require mature and old-growth coniferous riparian habitat. The fast-flowing rivers and streams in the analysis area do not constitute good breeding habitat for these species.

Environmental Consequences

Alternative A None of these alternatives would affect habitat that is likely to be used by these species. No deciduous or conifer habitat close to suitable water bodies is proposed for thinning.

Alternative B There would be no effects to these species with this alternative.

Neotropical Migratory Birds

***Species Account*:** A conservation strategy for land birds in coniferous forests in western Oregon and Washington was prepared in 1999 by Bob Altman of American Bird Conservancy for the Oregon-Washington Partners in Flight. The strategy is designed to achieve functioning ecosystems for land birds

by addressing the habitat requirements of 20 "focal species". By managing for a group of species representative of important components of a functioning coniferous forest ecosystem, it is assumed that many other species and elements of biodiversity would be maintained.

Table 3-28 below displays the focal species potentially positively or negatively affected changes in habitat, and the forest conditions and habitat attributes they represent.

Table 3-28. Focal bird species

Forest Structure	Habitat Attribute	Focal Speecies
Old-growth	Large snags	Vaux's swift *
Old-growth/Mature	Large trees	Brown creeper *
Old-growth/Mature	Conifer cones	Red crossbill
Mature	Large snags	Pileated woodpecker
Mature	Mid-story tree layers	Varied thrush *
Mature/Young	Closed canopy	Hermit warbler
Mature/Young	Deciduous canopy trees	Pacific-slope flycatcher
Mature/Young	Open mid-story	Hammond's flycatcher
Mature/Young	Deciduous understory	Wilson's warbler
Mature/Young	Forest floor complexity	Winter wren
Young/Pole	Deciduous canopy trees	Black-throated gray warbler
Pole	Deciduous subcanopy/understory	Hutton's vireo
Early-seral	Residual canopy trees	Olive-sided flycatcher *
Early-seral	Snags	Western bluebird
Early-seral	Deciduous vegetation	Orange-crowned warbler
Early-seral	Nectar-producing plants	Rufous hummingbird *

* Significantly declining population trends in the Cascade Mountains physiographic areas.

Table 3-29 below displays the number of acres in the major structure stages in the analysis area. Data is from the 1999 vegetation database and includes the effects of the Crayon Timber Sale.

Table 3-29. Structure stages in the analysis area

Structure Stage	Acres and percent
Large Tree, Single and Multiple Canopy	7,826 24%
Closed Small Tree	7,326 23%
Open Small Tree	1,367 4%
Open and Closed Sapling/Pole	4,822 15%
Shrub/Seedling/Grass/Forb	9,100 28%

The proposed Canyon thinning units would currently provide habitat for birds species found in mature/young stands represented by hermit warbler, Wilson's warbler and winter wren. There are no species associated with this habitat type from the Partners in Flight report that are thought to be declining.

Environmental Consequences

Alternative A The proposed thinning would open the stands enough to encourage growth of understory deciduous shrubs such as vine maple. Opening the mid-story, increasing the deciduous understory and forest floor complexity would improve habitat conditions for Hammond's flycatcher, Wilson's warbler

and winter wren. No mature deciduous trees would be cut, so these minor elements of the current habitat that add habitat diversity would remain.

This alternative would treat habitat that is common in the watershed, and improve conditions in the short-term by adding complexity and structural diversity. For these reasons, the project would not result in significant effects to neotropical migratory bird populations. In the long-term, the treatment would accelerate development of habitat that is more limited in the analysis area (Large Tree), and improve habitat for Vaux's swift, red crossbill, pileated woodpecker, and varied thrush in the proposed units.

Cumulative Effects
The beneficial effects of Canyon Timber Sale that would improve habitat diversity in the analysis area would be cumulative to the similar effects of the Crayon Timber Sale (218 acres).

Alternative B – Since no thinning would occur with this alternative, the opportunity to increase habitat diversity, by treating a common habitat type to create types that are less common would be forgone.

Scenery

Existing Condition
There are no Forest Plan designated Visual Emphasis management area categories in the Canyon Timber Sale analysis area. There are two management area categories that contain visual quality objectives however, Wild and Scenic Rivers (8D) and Special Interest Area (9L) (Figure 1-2).

Siouxon Creek (Eligible Wild and Scenic River)
This creek has been identified as eligible for Wild and Scenic River designation. The outstandingly remarkable values are its exceptional scenic and recreational values, and a lack of human intrusion into most of the river corridor providing solitude seldom found in an area this close to a large population center. Although the stream corridor is not noted for a variety of landscapes, its subtle beauty below the forest canopy and a wide variety of water features from pools and riffles to spectacular waterfalls make it one of the most scenic rivers in the State of Washington (see United States Department of Agriculture 1990, Land and Resource Management Plan, Appendix E, page 106). The Forest Plan recognizes the Potential for "Wild" classification for the segment inside the Forest boundary and has allocated the land within one-quarter mile of the creek as Wild and Scenic River (code 8D) to protect its scenic values. The suitability determination of Siouxon Creek in order to recommend designation has not been made. Additional study and environmental analysis would be required in a separate analysis.

Within the Wild and Scenic River allocation 8D vegetation varies from natural openings through stands of old-growth timber, and is predominately the product of natural succession. The Visual Quality Objective for this prescription is Preservation and the Recreation Opportunity Spectrum is Semi-primitive Non-motorized (LRMP, Amendment 11, page 5-32). Timber harvest is not scheduled, and ordinary timber salvage is not permitted.

Special Interest Area
Special Interest Areas designated 9L in the Forest Plan are unique because they contain features deserving special management, however they are not significant enough to qualify for classification under Code of Federal Regulations. The Visual Quality Objective is "Retention" and Recreation Opportunity Spectrum is "Roaded Natural".

Environmental Consequences

Alternative A

None of the proposed harvest units is near either of the special management areas. The closest units to each of the areas are Units 2 and 3, which are about 0.5 mile from the Wild and Scenic River corridor along Siouxon Creek and would not be visible from the corridor; and Unit 20, which is about 1.2 miles from the Special Interest Area.

The proposed thinning would remove trees from the intermediate and co-dominate crown classes, leaving a majority of the larger trees in the stand well-distributed. The resulting canopy closure would be 30 to 50 percent based on a vertical projection, and when viewed obliquely, the evidence of timber harvest would not be apparent. The harvest edge would be indistinct, and the color of the stands would be similar to the surrounding stands. The texture of the stands would differ from unthinned stands, but this difference lessens in proportion to viewing distance.

In the long-term, discernable scenic differences in the thinned stands would decrease. Individual crowns of leave trees would expand to occupy available space, and understory growth would contribute to stand color. The proposed thinning would meet visual quality objectives for those areas.

Cumulative Effects

The Crayon Timber Sale, which is within the Canyon Timber Sale analysis area, is using a similar thinning prescription. The resulting scenic impacts are similar to what would be expected with the Canyon Timber Sale. In combination, these sales would make timber harvest more discernable throughout the drainage, however, the lines, colors, and textures follow existing patterns, and would meet visual quality objectives.

Alternative B

No Action means that the Canyon timber sale would not go forward. Forest vegetation and scenery would be unchanged from the present in the short-term. In the long-term, growth of young trees in previously harvested stands would soften visually contrasting lines and colors that result from widely diverse stand ages.

There would be no cumulative effects.

Heritage Resources

Heritage resource surveys for the Canyon Timber Sale were completed in 2006, and a report was completed and approved on April 6, 2007. No sites potentially eligible to the National Register of Historic Places were recorded.

Economic Analysis

An economic analysis of the treatment alternative was done to compare the benefits with their costs. Because these benefits and costs are distributed through time, a meaningful comparison required that these figures be discounted to a common point in time (five years after harvest treatment). Hence, the present value of the benefits was compared to the present value of the costs. This comparison is displayed as the present net value (PNV). NEPA planning costs and surveys were not included in the analysis. The PNV and Benefit/Cost ratio Alternative A is displayed in Table 3-30. Alternative A shows a positive PNV.

Table 3-30. Economic comparison of the treatment alternative

Alternative	Present Net Value (PNV)	Benefit/Cost
Alternative A (Proposed Action)	$2,072,882	3.51:1

The following assumptions were used to determine the present net worth of the Canyon Proposed Action alternative:

- The alternative was projected thru the fifth year after stand manipulation.
- An inflation free discount of 4% was used.
- All costs and revenues are in base year constant dollars (no inflation or overhead).
- All volume was cut within the same year.
- The following costs were used:
  - Logging costs (stump to truck) - Tractor = $67/MBF.
  - Logging costs (stump to truck) – Skyline = $146/MBF
  - Truck hauling costs - $2.00/mile (90 miles from sale area to WKO mill)
  - Road Maintenance/Reconstruction costs Alternative A - $5,000/mile
  - Timber value (at mill) - $400/mbf
  - Prep (flagging, tagging, cruise) stands = $5/MBF.
  - Sale Administration = $3.00/MBF.
  - Temporary Road Construction = $7,000/mile
  - Temporary Road Decommission = $3000/mile
  - Reforestation = $500/acre.
  - Noxious weed abatement = $25/acre/treatment
  - Create Snags = $50/tree
  - Create CWD = $15/tree
  - Grapple Pile/Cover and Burn Piles = $350/acre

Table 3-31. Alternative activities

Activities	Alternative A (Proposed Action)	Alternative B (No Action)
CT Thin-uplands	438 acres	0
Thin - riparian	41 acres	0
Plant riparian	41 acres	0
Noxious Weed Abatement	438 acres	0
Temp. Rds	4,768 feet	0
Reconstruct Rds	5,556 feet	0
Skyline Log	259 acres	0
Tractor Log	217 acres	0
Grapple Pile Slash	9 acres	0
Volume	7,608 bf	0

Alternative A
Economic Analysis

Date	Year	Treatment	2007 Costs $$	2007 Benefit $$	Discounted Cost $$	Discounted Benefit $$
2007	0	Prep Stands (7,608 mbf)	$38,040		$38,040	
2008	1	Noxious Weeds (476 ac.)	$11,900		$11,442	
2008	1	Construct Temp. Rds (0.75 mi)	$4,410		$4,240	
2008	1	Decommission Temp. Rds (0.9 mi)	$6,321		$6,078	
2008	1	Reconstruct Rds (1.1 mi)	$5,500		$5,288	
2008	1	Skyline Logging Costs	$37,814		$36,360	
2008	1	Tractor Logging Costs	$14,539		$13,980	
2008	1	Log Haul Costs (4.2 mbf/load)	$652,114		$627,033	
2008	1	Harvest 7,608 mbf		$3,043,200		$2,926,154
2008	1	Sale Admin.	$22,824		$21,946	
2009	2	Grapple pile landings/cover/burn. (9 ac)	$3,150		$2,912	
2009	2	Noxious Weed Treatment – 1st	$11,900		$11,002	
2010	3	Reforestation (38 ac)	$19,000		$16,891	
2010	3	Noxious Weed Treatment – 2nd	$11,900		$10,579	
2012	5	Create Snags (2.6/acre)	$27,300		$22,439	
2012	5	Create CWD (1/acre)	$7,140		$5,869	
TOTALS			--	--	$834,099	$2,926,154

The total Present Value Benefit is $2,926,154
The total Present Value Cost is $834,099
The Present Net Value is $2,093,085
The Benefit/Cost Ratio is 3.51:1

Other Environmental Consequences

This section addresses those effects for which disclosure is required by National Environmental Policy Act regulations, Forest Service policy or regulation, various Executive Orders, or other laws and direction covering environmental analysis and documentation. In some cases, the information found here is also located elsewhere in the document.

Irreversible and Irretrievable Commitment of Resources

Irreversible Commitments

Irreversible impacts result from the use or modification of resources that are replaceable only over a long period of time.

Soil Productivity Soil productivity would be lost or reduced to some degree on temporary roads and landings due to soil displacement. Full recovery of productivity on these areas would not be anticipated despite efforts to reclaim these lands. The losses in productivity from the above would occur on a small part of the planning area (about 2.3 percent of the activity area). Also soil losses due to extensive erosion or mass failures resulting from timber harvest and road building activities would be an irreversible impact. However, this is not expected to occur considering the design features and mitigation measures included with the action alternative; principally, by not locating harvest units or other activities in unstable or potentially unstable areas.

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

Old-Growth No late-successional or old-growth stands or trees are proposed for harvest in the action alternative.

Irretrievable Commitments

Irretrievable commitments are opportunities for resource uses that are forgone because of decisions to use that land in another way. For example:

Timber Production – Generally, management activities, such as thinning, improve timber production. However, opportunities to increase net production of timber would be forgone in those areas not thinned at this time to protect other resources.

Relationship between Short-term Uses and Long-term Productivity

Long-term impacts to site productivity from soil being lost from the site are discussed above in the Irreversible Commitments of Resources.

Effects on Prime Farm Land, Range Land, and Forest Land

There are no prime farm lands or prime range lands within the Canyon Timber Sale planning area. Prime forest land is a term used only for non-public lands and does not apply to any land within the planning area.

Effects on Environmental Justice

Executive Order 12898 (February 11, 1994) directs federal agencies to focus attention on the human health and environmental condition in minority and low-income communities. The purpose of the Executive Order is to identify and address, as appropriate, disproportionately high and adverse human health or environmental effects on minority and low-income populations. The principle behind Environmental Justice is that people should not suffer disproportionately because of their ethnicity or income level.

While the sale of National Forest timber would create or sustain jobs and provide consumer goods, neither of the alternatives would have a disproportionately high or adverse human health or environmental effect on minority and low-income populations.

Effects on Wetlands and Floodplains

There would be no effects to wetlands or floodplains due to the implementation of project design criteria and mitigation measures included with the action alternative.

CHAPTER 4. CONSULTATION AND COORDINATION

Consultation with Other Agencies and Jurisdictions

The Washington State Department of Ecology (DOE) is responsible for enforcing the Clean Water Act of 1972. A Memorandum of Understanding prepared and agreed to by the Forest Service and DOE states that Best Management Practices, used by the Forest Service to control or prevent non-point sources of water pollution, would meet or exceed State water quality standards and other requirements, as outlined in the Washington State Forest Practices Rules. The project design criteria and mitigation measures in (Appendix A) would comply with the Memorandum of Understanding.

The Washington State DOE is also responsible for enforcing the Clean Air Act of 1977. The State Smoke Implementation Plan provides guidelines for compliance which are intended to meet the requirements of the Clean Air Act. All burning plans for activities associated with this project would comply with this Plan.

The United States Department of Interior, Fish and Wildlife Service (USFWS) is responsible for protection and recovery of threatened and endangered species. The effects determination for northern spotted owl is May Affect and and Not Likely to Adversely Affect. The effects of this project are covered under the Programmatic Biological Assessment for Forest Management for the Gifford Pinchot National Forest (August 2001), and additional consultation with USFWS is not required. Canyon Creek is not a bull trout watershed, so consultation on potential effects to this species is not required.

The United States Department of Commerce, National Marine Fisheries Service (NMFS) is responsible for the protection and recovery of Threatened and Endangered anadromous fish species. The effects determination for Lower Columbia River steelhead, Lower Columbia River Chinook, and designated critical habitat is No Effect, so consultation with NMFS is not required.

All steps in the cultural resource process are coordinated with the Washington State Historic Preservation Office. Cultural Resource Site Reports are filed with and approved by the Washington State Historic Preservation Officer. Based on the information documented in the Cultural Resource Report, there would be no adverse effects to cultural resources by implementation of either alternative, and consultation is not required.

List of Preparers

In April of 2006 Tom Mulder, Monument Manager drew together a team of Forest Service employees to develop the proposed action, develop alternatives, and complete the effects analysis for the Canyon Timber Sale Environmental Assessment. Member of the team were:

NAME	POSITION
Aldo Aguilar	Soil Scientist
Stephanie Caballero	Fisheries Biologist
Don Harm	Logging Systems
Cindy Henchell/Erin Black	NEPA Specialist, South Zone Planning Team Leader
Bruce Holmson	Silviculturist
Cheryl Mack	Archaeologist
Diana Perez	Fisheries Biologist
Andrea Ruchty	Botanist
Ben Scott	Transportation Planner
Ruth Tracy	Hydrologist
Mitch Wainwright	Wildlife Biologist, Canyon Timber Sale Planning Team Leader
Gary Walker	Fuels Specialist

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